

**DIETARY FACTORS ASSOCIATED WITH HYPERTENSION AMONG ADULTS IN
ASESEWA IN THE UPPER MANYA KROBO DISTRICT.**

BY

ESTHER APPIAH YEBOAH

(10396745)

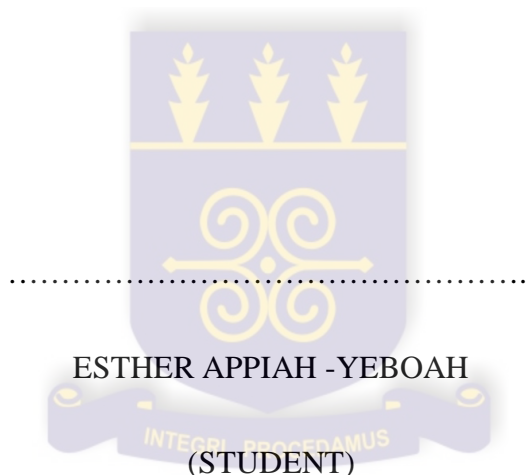
The crest of the University of Ghana is centered in the background. It features a shield with a yellow border, containing three yellow arrows pointing downwards. Below the shield is a yellow banner with the motto 'FOR THE PEOPLE'.

**THIS DISSERTATION IS SUBMITTED
TO THE UNIVERSITY OF GHANA, LEGON IN PARTIAL
FULFILLMENT OF THE REQUIREMENT
FOR THE AWARD OF MSC DIETETICS DEGREE**

JULY, 2015

DECLARATION / SIGNATURE

I, Esther Appiah -Yeboah hereby declare that this dissertation is the result of my own diligent research work under the supervision of Dr. George Asare (Maj. Rtd.) of the School of Biomedical and Allied Health Sciences, University of Ghana and Dr. Esi Colecraft of the School of Biological Sciences, University of Ghana. All references cited in this work have been fully acknowledged.



.....

DR. GEORGE ASARE (Maj. Rtd.)

(PRINCIPAL SUPERVISOR)

.....

DR, ESI COLECRAFT

(CO - SUPERVISOR)

ABSTRACT

Background: Hypertension is the leading risk factor for death worldwide and is beginning to be recognized as a significant public health problem in developing countries. Secondary data obtained from the Upper Manya District assembly's 2011 health report showed a 92 % sharp increase in the Out Patient Department attendance of hypertension cases between 2009 and 2010 only. A number of factors including diets high in fat and low in potassium, magnesium and calcium have been implicated in hypertension.

Aim: This study assessed the association between dietary intakes and hypertension among adults in Asesewa, a rural community in the Eastern Region of Ghana.

Methods: This was a cross-sectional study involving the diet pattern of 125 and 67 biochemical indices of adult participants in Asesewa. A structured questionnaire and a food frequency questionnaire was administered to obtain socio- demographic and dietary data. Anthropometric (height, weight, body and visceral fat) and blood pressure measurements were taken. Blood samples were taken from 67 participants for the analysis of serum blood glucose and lipid profile. Linear correlation, crosstab statistics and independent sample chi square-test were used to determine the association between blood pressure, background characteristics, anthropometric indicators and lifestyle variables.

Results: Results: The most common age group was 25 years - 35 years (44.8%). In total, 45% of the participants were females while 55% were males. Furthermore, 18.4% had high blood pressure. About 32% pre-hypertensive and 49.6% non-hypertensive. About 12% out of the 125 participants could confirm as having been diagnosed of hypertension by a qualified doctor. Meal frequency of participants was generally three times in a day as 57.0% of the participants and the majority ate thrice daily. No statistical relation was seen between total protein score (p

value 0.298), total vegetable score (p value, 0.294), total fruit score (p value 0.771), high fat diet (p value. 0.847). and blood pressure status. Average daily intake of carbohydrate and protein showed no significance with the various biochemical Indices of respondents. Saturated fat was seen to be significant at a p value of 0.041 and an r value of 0.267 with blood glucose. It was again significant (p = 0.002) with VLDL with an r value of 0.396. A statistical significance (p= 0.017) level was observed between saturated fat and TC: HDL. There was a significant relation between monounsaturated fat and Triglyceride (r value = 0.350, p-value = 0.007). Monounsaturated fat again correlated with VLDL (r value = 0.351, p value = 0.006). It again correlated with blood glucose (r value = -0.268, p value 0.04). There was also a significant relation between polyunsaturated fat intakes and triglyceride (r = 0.360, p-value = 0.005), VLDL (r value = 0.358, p-value =0.005) and blood glucose (r value = 0.558, p-value = 0.00). Fat correlated with only blood glucose with r value of -0.300 at a p-value of 0.021. There was no significant relation between the selected minerals (sodium, Potassium, magnesium and calcium) with blood pressure status.

Conclusion: Dietary factors associated with hypertension was the consumption of fatty acids (SFA, MUFA, and PUFA). Hypertension status of participants were relatively moderate. Notwithstanding, the high prevalence of pre-hypertension, puts the population at risk of hypertension in the near future.

DEDICATION

I dedicate this work to my lovely and caring husband Mr. Samuel Effah Frimpong, who motivated me to pursue this course to become a dietician. You relocated to Accra with me just to support and encourage me in my endeavour to become a dietician. I will forever remain thankful to you.



ACKNOWLEDGEMENTS

I thank the almighty God Jehovah for his guidance and protection throughout these years. Though the road has been rough and tough, for his loving kindness and mercy, I have been able to weather the storm.

My dear supervisors Dr. George Asare (Major Rtd) and Dr. Esi Colecraft. I owe you a gratitude for your insightful criticisms and comments, sacrifices and the love shown me especially towards my research work. May the ever merciful God grant you your heart desires. I am forever indebted to you. At the time that all hopes seem lost you assisted me. You wasted precious time reading my work. I am grateful.

Dear Dr. Matilda Asante I can't finish this without mentioning you. From the start through data collection till this project was a success, you gave me the needed assistance. The good God Jehovah will continue to bless you.

I give thanks to the people of Asesewa who wholeheartedly volunteered to participate in the research. The director, Asesewa health directorate and to the management and staff of the university of Ghana Nutrition Research Centre, Asesewa for assisting in the success of this research.

Mr. and Mrs. Appiah Yeboah, my dearest mum and dad, your prayers and support cannot go unmentioned.

My lovely kids Matilda, Nana Effah and Nana Asante I am appreciative of your sacrifices.

My siblings Fausti, Ken, Sam and Ceci you contributed your part.

TABLE OF CONTENT

Table of Contents

DECLARATION / SIGNATURE	ii
ABSTRACT.....	iii
DEDICATION	v
ACKNOWLEDGEMENTS.....	vi
TABLE OF CONTENT	vii
LIST OF FIGURES	xii
LIST OF TABLES	xiii
LIST OF ABBREVIATIONS	xiv
CHAPTER ONE.....	1
1.0. INTRODUCTION.....	1
1.1. Background.....	1
1.2. Problem Statement.....	3
1.3. Significance of Study	3
1.4 Hypotheses	4
1.5. Aim and Specific Objectives.....	4
1.5.1 Aim	4
1.5.2. Specific objectives.....	4
CHAPTER TWO.....	6
2.0 LITERATURE REVIEW	6
2.1. Hypertension	6
2.2 Prevalence of Hypertension	7

2.3 Classification and Causes of Hypertension.....	10
2.4 Consequences of Hypertension.....	11
2.5 Diet and Hypertension	12
2.6 Dietary Patterns and Hypertension	12
2.7 Alcohol.....	14
2.8 Dietary Fibre	15
2.9 Minerals and Their Association with Hypertension.....	17
2.10.0 Dietary Fat	24
2.10.1 Saturated Fatty Acids (SFA)	25
2.10.2 Monounsaturated Fatty Acids	26
2.10.3 Polyunsaturated fatty acids (PUFA)	26
2.10.4 Trans-fatty acids.....	27
2.11.0 Hypertension and Blood Lipids.....	28
2.12.0 Hypertension and Physical Activities	29
CHAPTER THREE.....	30
3.0 METHODOLOGY	30
3.1 Study Design	30
3.2 Study Site.....	30
3.3 Study Participants	30
3.4. Sample Size Determination	31
3.5. Data Collection Instruments.....	32
3.6. Pretesting of Questionnaire	32

3.7. Data Collection.....	32
3.7.1 Questionnaire Administration and Anthropometric Measures.....	33
3.7.2. Dietary Assessment	33
3.7.2.1 Food frequency questionnaire.....	33
3.7.2.2 Dietary Data	34
3.7.2.3. 24-Hour Recall.....	35
3.8. Anthropometric Assessment	35
3.9. Blood Pressure	36
3.10. Blood Sample Collection and Handling	36
3.11.0 Data Analyses.....	37
3.12 Diet Score	38
3.13.1 Biochemical Analysis	38
3.13.2. Lipid Profile	38
3.13.2.1 Cholesterol Test Principle.....	38
3.13.3.2 Triglyceride –Test principle.....	39
3.13.3.3 HDL- Cholesterol test principle	40
3.13.3.4. LDL- Cholesterol	41
3.13.4. Assay Procedure.....	41
3.14. Ethical Issues.....	41
CHAPTER FOUR.....	42
4.0 RESULTS.....	42
4.1. BACKGROUND CHARACTERISTICS.....	42

4.1.1.0. Socio-Demographic/ Household Characteristics of Participants	42
4.1.2. Monthly income of participants	43
4.1.2.0 Nutritional and Health Status of Participants.....	44
4.1.2.1 Hypertension status of participants.....	44
4.1.2.2 Nutritional Status of Participants.....	45
4.1.2.3 Lipid Profile and Glucose level.....	46
4.2. Examination of the Prevalence of Hypertension among Adults in Asesewa.....	48
4.2.1 Hypertension Status Awareness of Respondents	49
Table 4.5 show's Hypertension Awareness Status of Participants.....	49
4.2.2.0. Traditional Predisposal Factors to Hypertension.....	49
4.2.2.1. Disease history of respondents.....	49
Table 4.6: Disease History of Respondents.....	50
4.2.2.2 Family Disease History of Respondents.....	50
Table 4.7: Family Disease History of Respondents.....	51
4.2.3 Social Activities That Expose Individuals to Hypertension	52
4.3.0 Dietary Pattern Examination of Adults in Asesewa	52
4.3.1.0 Food frequency	52
4.3.1.1 Cereal and Grains.....	52
4.3.1.2 Starchy Root Tubers and Plantain.....	53
4.3.1.3 Legume, Nuts and Oil Seed.....	54
4.3.1.4 Fruit	55
4.3.1.5 Vegetables	56

4.3.1.6 Animal and Animal Products.....	57
4.3.1.7 Non Alcoholic and Alcoholic Beverages	58
4.3.1.9 Fats and Oil	59
4.3.1.10 High Fat Foods/ Snacks.....	60
4.3.2. Meal Pattern of Respondents	61
Table 4.8: Meal Patterns of Respondents	62
4.4. Relationship between Selected Food Groups and Blood Pressure.....	62
4.5. Relationship between macronutrients (Protein, Fat, Carbohydrate,) and the Measured Biochemical Indices (Lipid Profile and Serum Glucose)	64
4.5.1 Average Daily Intake of Respondents	64
4.5.3 A Correlation of macronutrients (Protein, Fat, Carbohydrate,) And the Measured Biochemical Indices (Lipid Profile and Serum Glucose)	64
4.6.0 Relationship between Selected micro nutrients (Sodium, Potassium, Magnesium, Calcium,) and hypertension.	66
CHAPTER 5.....	68
5.0 DISCUSSION AND CONCLUSION.....	68
REFERENCES	78
APPENDIXES	108

LIST OF FIGURES

Figure 2.0: Role of magnesium and calcium in the pathophysiology of hypertension, diabetes mellitus, and atherosclerosis	24
Fig 4.1: Monthly Income Distribution of Respondents	43
Figure 4.2: Frequency of Cereal and Grains Consumption among Participants	52
Figure 4.3: Frequency of Starchy Root Tuber and Plantain Consumption among Participants	53
Figure 4.4: Frequency of Legumes oil seed and nuts consumption among Participants	54
Figure 4.5: Frequency of Fruits consumption among Participants	55
Figure 4.6: Frequency of vegetables consumption among Participants	56
Figure 4.7: Frequency of animal and Animal Products consumption among Participants	57
Figure 4.8: Frequency of Alcoholic and Non Alcoholic Beverages consumption among Participants	58
Figure 4.9: Frequency of Fats and Oil consumption of Participants	59
Figure 4.10: Frequency of High Fat Diets/Snack Consumption among Participants	60

LIST OF TABLES

Table 4.1: Socio-Demographic Characteristics of Respondents at Asesewa	42
Table 4.2: Blood Pressure Status of Respondents	44
Table 4.3. Nutritional Status of Respondents	45
Table 4.4: Lipid Profile of Participants	47
Table 4.5: Hypertension Awareness Status of Participants	48
Table 4.6: Disease History of Respondents	49
Table 4.7: Family Disease History of Respondents	50
Table 4.8: Meal Patterns of Respondents	61
Table 4.9: Comparison of Food Groups and Blood Pressure Status	62
Table 4.10: Relationship Between Selected Food Nutrients (Protein, Fat, Carbohydrate,) And The Measured Biochemical Indices (Lipid Profile and Serum Glucose)	65
Table 4.11: A Comparison of Micronutrients of Respondents and Blood Pressure	66

LIST OF ABBREVIATIONS

ADA - American Dietetic Association

AU - African Union

BMI - Body Mass Index

BP - Blood Pressure

CVD - Cardiovascular Disease

DASH - Dietary Approach to Stop Hypertension

EFSA - European Food Safety Authority

GHS - Ghana Health Service

HDL - High- Density Lipoproteins-Cholesterol

HPT -	Hypertension
LDL -	Low – Density Lipoproteins –Cholesterol
MUFA -	Monounsaturated Fatty Acids
NCD -	Non Communicable Disease
OPD -	Out Patient Department
PUFA -	Polyunsaturated Fatty Acids
RDI -	Recommended Daily Intake
SFA -	Saturated fatty acids
TFA -	Trans fatty Acids
TG -	Triglycerides

VLDL - Very low-density lipoproteins cholesterol

WHO - World Health Organization

CHAPTER ONE

1.0. INTRODUCTION

1.1. Background

Hypertension is the leading risk factor for death among adults worldwide and it is beginning to be recognized as a significant public health problem in developing countries (WHO, 2009).

Poor management of hypertension is associated with heart attacks, ischemia, strokes and renal failure (Antman *et al.*, 2004). It is a known fact that hypertension left untreated can cause damage to the coronary arteries and to the heart. This according to the American Heart Association (2014) can give rise to heart attack, heart disease, congestive heart failure, aortic dissection and atherosclerosis. Other diseases associated with uncontrolled hypertension include, stroke, kidney damage, loss of vision, erectile dysfunction among others. Furthermore, when hypertension (HPT) is left untreated, it can lead to coronary heart disease, heart failure, stroke, kidney failure, and even memory loss (Hilsabeck, 2005). Constant HPT can damage the arterial walls and may cause aneurysm. These aneurysms can later burst and cause massive bleeding and death particularly when a large vessel such as the aorta is affected (Schlenker *et al.*, 2011). A 2014 fact sheet by the World Hypertension League and the International Society of Hypertension attributed 50% of heart disease (stroke and heart failure), 13% of all deaths and over 40% of deaths in people with diabetes and the risk for foetal and maternal death in pregnancy, dementia, and renal failure in 2010 to hypertension (Campbell *et al.*, 2014).

Hypertension, previously considered to be non-existent or extremely rare in most African societies, particularly in rural communities, is now emerging as a public health problem in sub-

Saharan Africa (Van der Sande *et al.*, 2004). In Ghana, hypertension is reportedly a leading cause of morbidity and mortality among adults (GHS, 2007). A previous study in the 1970's reported a hypertension prevalence of 4% in rural Ghana (Pobee *et al.*, 1977). In 2004, the prevalence of HPT among adults in the Greater Accra region was 32.9% in the urban areas and 24.1% in the rural areas (Cappuccio *et al.*, 2004).

These prevalent rates of hypertension in Ghana are of public health concern and needs to be addressed by all health professionals. Maletnlema (2004) reported that the rise in the prevalence of HPT may be as a result of rapid changes in diet and physical activity related to urbanization and modernization, which has affected both urban and rural dwellers. Lifestyle modifications including the Dietary Approach to Stop Hypertension (DASH) eating plan, weight reduction, dietary sodium reduction, moderate intake of alcohol and physical activity have been shown to be capable of lowering blood pressure, and can reduce cardiovascular risk factors at minimal cost and risk (Banasik, 2005).

The Dietary Approaches to Stop Hypertension (DASH) intervention study (Appel *et al.*, 1997) and the Oxford Fruit and Vegetable study (John *et al.*, 2002) have both shown that a diet rich in fruits, vegetables and low-fat dairy products can substantially lower both systolic and diastolic blood pressures. Asesewa is a rural community in the Upper Manya district in the Eastern Region. Secondary data obtained from the District assembly's 2011 health report showed a sharp increase in the OPD attendance of hypertension cases between 2009 and 2010 only. The total number of cases of patients in 2009 was 1763 and this increased to 3389: about 92% increase in 2010.

1.2. Problem Statement

Hypertension is increasingly becoming a public health problem in Ghana. Comparable results from a 2005 study in the Ashanti region, located in central Ghana, determined the prevalence of HPT among adults to be 33.4% in the urban area and 27.0% in rural areas (Agyemang, 2006). Secondary data obtained from the Upper Manya District assembly's 2011 health report showed a sharp increase in the OPD attendance of hypertension cases between 2009 and 2010 only. In tackling this increasing trend of hypertension, health promotion messages have focused on promoting healthy lifestyles including diet. These measures aim to reduce the risk of the disease. According to Maire *et al.* (2002) most diseases, including coronary heart diseases, stroke and diabetes, are related to diet and lifestyles. The AU Conference of Ministers of Health's Sixth Ordinary Session (2013) proposed a focus on policies to reduce risk factors of hypertension which include unhealthy diets as a way forward to reduce the burden of HPT.

Despite the increasing trend of hypertension in the rural areas, few studies in Ghana have investigated the relationship between diet and risk of hypertension in rural communities including Asesewa. This study seeks to fill this gap by examining the relationship between diet and risk of hypertension among adults in Asesewa.

1.3. Significance of Study

Diet plays a major role in the development of hypertension. Maintaining a healthy diet can prevent or manage hypertension.

Findings of this study will provide information that may be useful in planning evidence-based dietary intervention programmes for this population.

It is also evident that most people with hypertension are not aware of the condition until the condition becomes fatal. This study can also identify current and potential hypertensive adults in Asesewa and this will set the pace for future healthcare interventions and effective healthcare plan for the people of Asesewa. The study will also add to existing knowledge on risk factors associated with hypertension in the Asesewa township and in rural Ghana. The study will also serve as baseline for further studies in the Upper Manya District.

1.4 Hypotheses

Dietary intakes of adults living in Asesewa are associated with hypertension

1.5. Aim and Specific Objectives

1.5.1 Aim: the aim was to investigate the association between dietary factors and hypertension among adults in Asesewa

1.5.2. Specific objectives

The specific objectives were to:

To determine the prevalence of hypertension among adults in Asesewa.

To examine the dietary pattern of adults in Asesewa

To determine the relationship between some selected food groups (high fat foods, animal protein, fruits and vegetables) and hypertension

To measured biochemical indices (lipid profile and serum glucose) of participants

To determine the relationship between selected nutrients (protein, fat, carbohydrate,) and the measured biochemical indices (lipid profile and serum glucose)

To determine the relationship between selected minerals (sodium, potassium, magnesium, calcium) and hypertension

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1. Hypertension

Blood pressure is the pressure of the blood against the walls of the arteries. It results from forces created by the heart as it pumps blood into the arteries and through the circulatory system and the force of the arteries as they rest between heart beats (American Heart Association 2012). The higher the blood pressure, the harder the heart has to pump.

The normal level for blood pressure is 120/80mmHg where 120 represent the systolic measurement (peak pressure in the arteries) and 80 represents the diastolic measurement (minimum pressure in the arteries). Blood pressure between 120/80 and 139/89 is called pre-hypertension (to denote increased risk of hypertension), and a blood pressure of 140/90 or above is considered high blood pressure (WHO 2002). The condition of high or raised blood pressure also known as hypertension is defined by WHO (2013) as a systolic blood pressure equal to or above 140mmHg and/or diastolic blood pressure equal to or above 90mmHg.

According to Mullins *et al.* (2006), the homeostasis of blood pressure is multifactorial. As such, it is supposed to be compensated by feedback, complementary action, or change, in some other control mechanisms, in an effort to return blood pressure to normal in times of changes in blood pressure such as those due to mutation. Essential hypertension however results when the balance between the factor(s) that tend to increase the blood pressure and those that try to normalize it (homeostasis) is sufficiently disturbed and the compensatory mechanisms fail to counteract the perturbation (Mullins *et al.*, 2006).

Increased blood pressure (BP) is the leading risk factor for death and disability globally (Lim *et al.*, 2010). According to a Global status report on NCD (2010), hypertension has been identified as a major risk factor for CVD, which has emerged as an important medical and public health issue in sub-Saharan Africa despite the ravage being perpetuated by HIV, tuberculosis, and malaria (BeLue, 2009). Chobanian *et al.* (2003) describes the relationship between BP and risk of CVD events as continuous, consistent and independent of other risk factors. The higher the BP, the greater is the chance of heart attack, heart failure, stroke, and kidney disease. WHO (2013) identified hypertension to be responsible for at least 45% of deaths due to heart disease and 51% of deaths due to stroke. The irony however is that, hypertension happens to be one of the most important preventable causes of morbidity and mortality globally. Murray (1997) referred to Hypertension as a silent killer because it often has no early detectable symptoms but a major cause of serious health conditions.

2.2 Prevalence of Hypertension

Globally, hypertension accounts for 9.4million deaths every year (Lim *et al.*, 2012). In the year 2000, the estimated prevalence of hypertension in the adult population worldwide was 26.4% with 972 million of hypertensive individuals (Williams, 2006). Almost one billion individuals globally had hypertension in 2008, the majority of whom resided in developing countries. Sub-Saharan Africa had the highest rate at 46% (WHO, 2011). A Fact Sheet by the World Hypertension League and the International Society of Hypertension (2014) reports that, in 2013, World Health Organization recorded an increased blood pressure to be the cause of an estimated 9.4 million deaths and 162 million years of life lost in 2010. This is a confirmation of Lim *et al.* (2012)'s assertion. Kearney *et al.* (2005) has estimated that in 2025, 29% of adult of the world population will be hypertensive. This can be approximated to 1.56 billion

individuals. Hypertension is estimated to affect more than one in three adults aged 25 and over (or about one billion people) worldwide.

Africa sees the highest prevalence of hypertension (46% of adults aged 25 and over) while the Americas, the lowest (35%). Owing to appropriate public policies and better access to health care, high income countries have a lower prevalence of hypertension (35%) than low and medium-income countries (40%) (Global brief on hypertension, 2013).

In Ghana, hypertension was reported to be the second leading cause of outpatient morbidity in adults older than 45 years in 2005 (Ministry of Health of Ghana, 2005). There was more than a ten-fold increase in the number of reported new cases of hypertension in public health facilities in Ghana from 49,087 in 1988 to 505,180 in 2007 (Centre for Health Information Management, 2008). Hypertension has consistently ranked among the top ten causes of outpatient morbidity accounting for 3% to 5% of all new outpatient diseases. In the Greater Accra Region, hypertension ranked second as the commonest cause of outpatient morbidity in 2008. Generally, the proportion of new outpatient diseases due to hypertension is highest in the Greater Accra, Eastern and Volta Regions and lowest in the three northern regions (Ministry of Health, 2012). According to The Ministry of Health's strategic report (2012), estimated prevalence of hypertension in studies within the Greater Accra Region in 1998-2001 was about 25%-28%. By 2002-2006, the prevalence had increased somewhat to 30%-48%. Addo (2012), in eleven surveys conducted between 1973 and 2009 revealed that the prevalence of hypertension was higher in urban than rural areas in studies that covered both types of area and increased with increasing age (prevalence ranging from 19.3% in rural to 54.6% in urban areas). A study in the Greater Accra area in 2003 rounded an urban prevalence of hypertension to be 32.9% and a rural prevalence of hypertension to be 24.1% (Cappuccio *et al.*, 2004).

Comparable results from a 2005 study in the Ashanti region, of Ghana, reported the prevalence of hypertension as 33.4% in urban areas and 27.0% in rural areas (Agyemang, 2006). These studies suggest that hypertension can have detrimental effect on both rural and urban economies if it is left uncontrolled. In Accra alone, a total of 183,597 cases of hypertension were recorded in 2013, constituting approximately 6.0% of all cases seen at the Out Patient Department (Government of Ghana Official portal, 2014).

Despite the increasing trend of the disease, Studies in Africa have shown that many people with hypertension are unaware of their condition and even many of those who are aware are not on treatment, and many of those treated are not well controlled (Van de Vijver, 2012). Evidence suggests that many Ghanaians living with hypertension are not aware that they have the condition (Cappuccio, 2004). A research by Awuah *et al.* (2014) in three urban poor communities in Accra gave the overall prevalence of 28.3% (women 25.6% and men 31.0%), however among the respondents who had hypertension, only 7.4% were aware of their condition; 4% were on antihypertensive medication while only 3.5% of hypertensive individuals had adequate blood pressure (BP) control (BP <140/90mmHg). Chow *et al.* (2013), found the level of awareness of hypertension at south eastern part of Ghana to be 46% meaning whopping 54% of respondents were not aware of their condition. De-Graft Aikins *et al.* (2010), saw the low rates of awareness, treatment and control of hypertension in Africa as a major public health concern. Van de Vijver (2012) concludes that the low levels of hypertension awareness imply that there will be significantly large populations of hypertensive patients unaware of their increased risk of hypertension-related complications in the coming years.

2.3 Classification and Causes of Hypertension

Hypertension is grouped into two as primary and secondary hypertension. Primary hypertension also known as essential hypertension is currently understood as a polygenic and multifactorial disorder that results from genetic and/or environmental factors (Lifton *et al.*, 2001). Essential hypertension may result from a disturbance of the systems regulating blood pressure (BP) such as several circulating and local neurohumoral and vasoactive factors. Furthermore, genetic variations of factors such as the disturbance of the systems regulating blood pressure (BP) and circulating and local neurohumoral and vasoactive factors could also play a role in the genesis of Essential Hypertension (Mesrati, 2007). Additionally, essential hypertension rises with age, and it aggregates with other cardiovascular risk factors, such as dyslipidaemia, glucose intolerance, hyperinsulinaemia, abdominal obesity, hyperuricaemia and environmental factors such as high dietary intake of sodium, alcohol, and stress (Soualmia, 2012). It is argued that hypertension clusters in families and results from a complex interaction of genetic and environmental factors (Oparil *et al.*, 2003). The genetic contribution to essential hypertension is estimated to be between 30% and 40% of BP variation (Škarić-Jurić, 2003). More than 150 candidate genes have been implicated in the regulation of blood pressure (Singh, 2014). Among these hypertension-predisposition genes investigated are genes involved in the renin-angiotensin-aldosterone system, catecholaminergic/adrenergic function, and genes of signal transduction system as G protein β 3- subunit, sodium channel system, α adducin and atrial natriuretic peptides. Several other biomarkers have been reported to increase the ability to predict essential hypertension (EH) such as hormone receptors like glucagon receptor and insulin like growth factor 1 (Soualmia, 2012). In black individuals, the T594M mutation of the β subunit of this gene increases the risk of hypertension (Baker *et al.*, 1998, Dong *et al.*, 2002). T595m hypertension-related genes identified to date regulate renal salt and water handling. Major pathophysiologic mechanisms of hypertension include activation of the sympathetic

nervous system and renin–angiotensin–aldosterone system. Endothelial dysfunction, increased vascular reactivity, and vascular remodelling may be causes, rather than consequences, of blood pressure elevation. Increased vascular stiffness contributes to isolated systolic hypertension in the elderly.

Secondary, hypertension on the other hand is the high blood pressure occurring as a result of another disorder such as renal failure, diabetes or a side effect of drugs. This type of blood pressure is evident in about five to 10% of hypertension cases. (Cunha *et al.*, 2011). Taler (2008) defines secondary hypertension as the presence of a specific condition known to cause hypertension, which may be the primary cause or a contributing factor in a patient who already has primary hypertension.

2.4 Consequences of Hypertension

Hypertension hardens the arteries and prevents the flow of blood through them. It can lead to many complications such as atherosclerosis, heart attacks, ischaemic attacks, strokes and renal failure (Sharon *et al.*, 2009). Constant HPT can damage the walls of the arteries and may cause aneurysm. These aneurysms can later burst and cause massive bleeding and death particularly when a large vessel such as the aorta is affected (Schlenker *et al.*, 2011). Schlenker *et al.* (2011) again added that when the aneurysm occurs in the small arteries of the brain, it may lead to stroke and in the eye may lead to blindness. Kidneys also get damaged when the heart is unable to pump blood adequately through them and constant strain on the heart could lead to enlargement of the left ventricle which weakens it and finally result in heart failure.

2.5 Diet and Hypertension

The major behavioural risk factors of hypertension are overweight, obesity, lack of physical activity, excess alcohol intake and excess salt intake. These risk factors may lead to an increased risk of developing a heart attack, stroke, heart failure and other complications (WHO, 2011). While medications to treat hypertension such as amlodipine, statins among others are available, research has shown that lifestyle changes such as weight loss, physical exercise and dietary modification can cause smaller but important decrease in blood pressure. (Michael 2005). Nutritional interventions have an impact on prevention of hypertension. Dietary factors related to hypertension, include high intakes of animal protein (Altorf-van der Kuil, *et al.*, 2010). Low potassium, low magnesium, inadequate calcium, low fish fatty acid, high alcohol and high coffee consumption are also related to hypertension (Geleijnse *et al.*, 2005)

2.6 Dietary Patterns and Hypertension

Krebs-Smith (2014) defines dietary pattern as the quantities, proportions, variety or combination of different foods, drinks, and nutrients in diets, and the frequency with which they are habitually consumed. Dietary pattern analysis on the other hand is an epidemiological method designed to consider the complexity of food preferences and diet patterns of populations (Sofdar *et al.*, 2013).

According to Huijbregts *et al.* (1997), studying dietary patterns in relation to disease outcomes provides a practical way to evaluate the health effects of adherence to dietary guidelines by individuals. It can also enhance our conceptual understanding of human dietary practice, and provide guidance for nutrition intervention and education. (Kleinbaum, 1988). Nutritional epidemiology has traditionally conducted analysis of diseases in relation to a single or a few

nutrients or foods (National Research Council Committee on Diet and Health Diet and health, 1989). Since human beings do not eat isolated nutrients, rather meals consisting of a variety of foods with complex combinations of nutrients, single nutrient approach may be inadequate. It is argued that dietary pattern needs to be assessed because of the complexity of diet, correlation among dietary components, evidence for positive health outcomes with changes in total diet and, relevance for policy and guidance (Krebs-Smith, 2014).

Three main methods of assessing dietary patterns are: Investigator defined, Data driven outcome-independent and Data driven outcome-dependent (Krebs-Smith, 2014). Krebs-Smith, (2014) explains that the Investigator Defined Data is made up of selective diet and indexes/scores, Data Driven Outcome-independent consist of Cluster analysis and factor analysis whilst the Data Driven Outcome-dependent has reduced rank regression and CART. Kastorini *et al.* (2013) rather identifies two main methods of dietary pattern analysis in nutritional epidemiology as the a-priori and the a-posteriori analyses. Kastroni *et al.* (2013), identify the a-priori method as an approach based on the use of dietary indices that aim to capture pre-defined healthy patterns. Whilst the a-posteriori method is an approach that processes the collected dietary information through multivariate statistical methods, such as the principal components analysis (PCA). Notwithstanding the diversity of the methods, Newby (2006) contends that the factor Analysis under the Data driven Outcome-independent methods, is the most frequently used.

Factor analysis, as a generic term, includes both principal component analysis and common factor analysis. Principal component analysis is commonly used to define dietary patterns because the principal components are certain mathematical functions of the observed variables,

whereas common factors are not expressible by the combination of the observed variables (Hu, 2002). Factor analysis is a multivariate statistical technique, which uses information reported on food frequency questionnaires or in 24-hour recall (Kreb-Smith, 2014). This is used to identify common underlying patterns of food consumption. It combines specific food items or food groups on the basis of the degree to which food items in the dataset are correlated with one another. A summary score for each pattern is then derived and can be used in either correlation or regression analysis to examine relationships between various eating patterns and the outcome of interest, such as nutrient intake, cardiovascular risk factors, and other biochemical indicators of health (Hu, 2002).

2.7 Alcohol

Ridker *et al.* (1994) stated that, alcohol consumption in moderation may reduce the risk of coronary heart disease (CHD) by raising HDL cholesterol and preventing clot formation. Hanson *et al.* (2005) added that, wine contains resveratrol, which is an antifungal compound in grape skin has been associated with 11-16% increase in HDL cholesterol.

Beneficial effects of alcohol are most apparent in people over age 50, those with other risk factors and those with high LDL (Hein *et al.*, 1995). The effect of alcohol on triglyceride levels are close to dependent and are great in persons with triglyceride levels exceeding 150 mg/dl (Mahan *et al.*, 2012). However, these benefits may not be apparent for others. One recent study reported that abstainers and moderate drinkers share similar risks of dying from heart disease (Hart *et al.*, 1999). Nonetheless, it may not be advisable to encourage abstainers to start drinking in order to prevent CHD. Too much alcohol can raise blood pressure and serum triglyceride levels.

2.8 Dietary Fibre

Traditionally, dietary fibre was defined as the portions of plant foods that were resistant to digestion by human digestive enzyme. It included only polysaccharides and lignin but has currently been expanded to include oligosaccharides, such as inulin, and resistant starches (Levine *et al.*, 2004). The CODEX Alimentarius Commission (2009) identifies dietary fibre as carbohydrate polymers with 10 or more monomeric units, which are not hydrolysed by the endogenous enzymes in the small intestine of humans and belong to the following categories:

- Edible carbohydrate polymers naturally occurring in the food as consumed.
- carbohydrate polymers, which have been obtained from food raw material by physical, enzymatic or chemical means and which have been shown to have a physiological effect of benefit to health,
- Synthetic carbohydrate polymers, which have been shown to have a physiological effect or benefit to health. According to Meyer *et al.* (2006), although several classification systems have been used to classify dietary fibre, because most fibre types are at least partially fermented, it may be most appropriate to classify them as partially, poorly fermented and well fermented. Meyer *et al.* (2006) therefore identify the fibre types that are well fermented as those that include pectin, guar gum, acacia (gum arabic), inulin, polydextrose, and oligosaccharides, whereas the less well-fermented as the types that include cellulose, wheat bran, corn bran, oat hull fibre, and some resistant starches. Meyer *et al.* (2006) asserts that, well fermented fibres are generally soluble in water, while partially or poorly fermented fibres are insoluble in aqueous enzyme solution which is synonymous to the human alimentary enzymes.

Anderson *et al.* (2009), found that, dietary fibre intake provides many health benefits. They explained that Individuals with high intakes of dietary fibre appear to be at significantly lower risk for developing coronary heart disease, stroke, hypertension, diabetes, obesity, and certain

gastrointestinal diseases. They further suggested that, increasing fibre intake lowers blood pressure and serum cholesterol levels. Adding to this assertion, Wheltons (2005) following an outcome of 25 studies conducted on the effects of dietary fibre on blood pressure, related that, a high-fibre diet is associated with a significant reduction in blood pressure levels among people with high blood pressure or hypertension. In explaining the actual physiological effect of dietary fibre on blood pressure, Sánchez-Muniz (2011) admits that data concerning the effects of dietary fibres on blood pressure are scarcer than those available on their effects on cholesterol levels. Notwithstanding, studies including that of Adriene (2007) explained that, soluble fibre lowers blood cholesterol through its ability to reduce the amount of bile reabsorbed in the intestines. This happens when fiber interferes with absorption of bile in the intestines and as a result, bile excreted in the feces. She detailed that, in order to make up for this loss of bile, the liver makes more bile salts using cholesterol. That is in order to obtain the cholesterol necessary to make more bile salts; the liver increases its production of LDL receptors. These receptors pull cholesterol out of LDL molecules in the bloodstream. According to Sakurai *et al.*, (2011) there is an established positive correlation between LDL and risk of blood pressure. In effect the more dietary fiber is ingested, the more bile salts are made from the liver in an attempt to digest it, leading to excretion of bile in feces which intern pulls more LDL cholesterol from the blood resulting in reduced LDL in the bloodstream. Sánchez-Muniz (2011) Dealing with the effects of dietary fibre on blood pressure posits that fibre could influence cardiac input/output and total peripheral resistance by affecting the sympathetic and parasympathetic nervous systems or by modifying concentrations of several local or systemic regulators (e.g. K⁺, CO₂, H⁺, prostaglandins, thromboxane, NO). Sánchez-Muniz (2011) continues that dietary fibres could affect the angiotensin-converting enzyme (ACE) activity which contributes to the formation of angiotensin II, a powerful vasoconstrictor that induces formation of the hormones noradrenaline, aldosterone, and vasopressin (also

known as antidiuretic hormone, ADH). According to Sánchez-Muniz (2011) ACE is also involved in converting bradykinin (a vasodilator, natriuretic, and diuretic agent) into inactive degradation products. Sánchez-Muniz (2011) again talks about Dietary fibres usual association with antioxidant compounds (e.g. polyphenols) or mineral (major and trace) that may influence the production of regulators of vascular tone including thromboxane, prostacyclin, and serotonin. It is worth mentioning here that in recent times there has been a shift in Western societies from a diet based on whole grains, vegetables, fruits, and legumes to a diet based on meats, refined grains, and processed foods and this has resulted in a remarkable increase in the incidence of heart disease (WHO, 2003).

2.9 Minerals and Their Association with Hypertension

Minerals are naturally occurring elements found in the earth with a characteristic crystalline structure and chemical composition (Mineral Resources International, 2012). Dietary minerals are however identified by Soetan *et al.* (2010) as the inorganic nutrients, usually required in small amounts by humans from less than 1 to 2500 mg per day, depending on the mineral. Blake *et al.* (2013) adds that the dietary minerals are inorganic because they do not contain carbon. According to Blake *et al.* (2013) this inorganic nature of minerals and their molecules containing only atoms of the same element differentiates them from vitamins. Animals including humans, source their dietary minerals from plants, water supply and pure mineral deposits such as salt (Mineral Resources International, 2012).

Minerals are traditionally grouped into two as macro - (major) and micro - (trace) elements. However, there is a third grouping mentioned as ultra-trace elements by Nielsen (2008). Blake *et al.* (2013) identify macro minerals as minerals needed in amounts greater than 100 mg per

day and the micro or trace as minerals needed in amounts less than 20 mg daily. Nielsen (2008) on the other hand posits that Ultra-trace elements are those elements with an estimated dietary requirement usually less than 1 mg/g and often less than 50 ng/g diet for laboratory animals. He suggested arsenic, boron, bromine, cadmium, chromium, fluorine, lead, lithium, molybdenum, nickel, selenium, silicon, tin and vanadium as fitting into this category of minerals.

The importance of minerals in the health of humans cannot be over emphasised. Most minerals have been found to play major roles in the health needs of man. Blake *et al.* (2008) explain the role of minerals to include maintenance of fluid and electrolyte balance, the formation of blood, building of healthy bones, and maintenance of a healthy immune system. They again explain minerals role to include their function as cofactors and co-enzymes, their participation in energy production, and their invaluable role in the structural growth of man. Institute Medicine (IOM) (2011) on the importance of minerals revealed that there is a critical interrelationship between minerals and optimum human health. They assert that as many as seventeen known essential minerals and many other trace minerals are all needed for good health. Scaling the importance of minerals in relation to health down to hypertension, Sánchez-Benito *et al.* (2007) mention the appropriate intake of minerals such as sodium, calcium, magnesium and potassium in diets as having effect in reducing the risk of developing hypertension.

Sodium

Sodium, an essential nutrient is the principal cation in extracellular fluid in the body and is necessary for the maintenance of plasma volume, acid–base balance, transmission of nerve impulses and normal cell function (WHO, 2012). Soetan *et al.* (2010) adds that the mineral

sodium in the human system is involved in the maintenance of osmotic pressure of the body fluids, the preservation of normal irritability of muscles and cell permeability, activation of nerve and muscle function and involved in Na^+/K^+ -ATPase, maintenance of membrane potentials, transmission of nerve impulses and the absorptive processes of pyrimidine and bile salts.

Sodium and chloride are the chemical components of common table salt (Candeias *et al.*, 2009). According to Blake *et al.* (2013), table salt accounts for about 90% of the sodium humans consume. Gros *et al.* (2010) believe dietary salt intake is the most important factor contributing to hypertension, notwithstanding the fact that salts susceptibility of blood pressure (BP) is different in individual subjects. Gros *et al.* (2010) argues that the pathogenesis of salt-sensitive hypertension is mainly attributable to an impaired renal capacity to excrete sodium (Na^+). Wardener *et al.* (2004) has a similar assertion that dietary salt is the major cause of the rise in the blood pressure with age and the development of high blood pressure in populations.

WHO (2012) reports that, sodium can be found naturally in foods such as milk, cream, eggs, meat and shellfish and in processed foods, such as breads, crackers, processed meats like bacon and snack foods such as pretzels, cheese, puffs and popcorn, as well as in condiments such as soy sauce, fish source, and bouillon or stock cubes. Though most of these foods are now available on the Ghanaian market, according to a Department for International Development (DFID) (2011) report, it is rather the use of salt in cooking and at table and the regular consumption of salted fish and meat which are the common sources of dietary salt in Ghana. Kaplan (2006) noted that primary hypertension and age-related increases in blood pressure were virtually absent in populations of which individual consumption of sodium was less than 50 mmol per day. But conditions were relatively different in populations in which

people consumed more than 100 mmol of sodium per day. Sacks *et al.* (2001) have therefore concluded that the reduction of sodium intake to levels below the current recommendation of 100 mmol per day lowers blood pressure substantially. The WHO (2012) estimates 2,000 mg (51.28mmol) of sodium in a day for an adult.

Potassium

Potassium is yet another essential mineral and a major electrolyte found in the human body (Bellows *et al.*, 2013). Blake *et al.* (2013) outline potassium's role in the human body to include the following: its help to maintain fluid balance, acting as a blood buffer, helping with muscle contraction and nerve impulse conduction, helping to lower high blood pressure and its role in bone health and reducing kidney stones. Palmer (2014), detailing on the role of potassium of aiding in the maintenance of fluid balance and acting as a blood buffer. Almost all cells possess a $\text{Na}^+\text{-K}^+\text{-ATPase}$, which pumps Na^+ out of the cell and K^+ into the cell. This leads to a K^+ gradient across the cell membrane, thereby maintaining the potential difference across the membrane. He mentions the kidney as primarily responsible for this maintenance of total body K^+ content by matching K^+ intake with K^+ excretion. Bellows *et al.* (2013) states categorically that potassium works with sodium to maintain the body's normal blood pressure. Androque *et al.* (2007) observed that the Human kidneys are poised to conserve sodium but excrete potassium. In effect, potassium which is supposed to help maintain the balance is readily excreted from the blood stream as quick as possible leaving sodium which has adverse effect on blood volume and pressure. They suggest prehistoric human's consumption of sodium-poor and potassium-rich diet as reason for this bodily system. Androque *et al.* (2007) therefore conclude that primary hypertension results from the interplay of internal derangements (primarily in the kidney) and the external environment. Aburto (2013) supports this relationship of potassium intake and blood pressure. Androque *et al.* (2007) believe most western diets have

more sodium as compared to potassium. They contend that, when such foods are ingested, due to the kidneys adaptation and its other defects in sodium excretion, including the Renal Angiotensin Aldosterone System (RAAS), there is an effective retention of sodium but excessive renal and faecal potassium loss which can result in excess sodium in the body at the expense of potassium. Androque *et al.* (2007) continues that this can lead to an expansion of extracellular fluid volume and the release of digitalis-like factor Na^+/K^+ -ATPase which can cause vascular smooth-muscle cell contraction which in turn might result in increased peripheral vascular resistance and hypertension. Webster *et al.* (2010) has observed that, food processing reduces the amount of potassium in many food products also diets high in processed foods and low in fresh fruits and vegetables often lack potassium. In view of the above analysis and changes in the eating pattern of the world, WHO (2012) has recommended an increase in potassium intake from food for reduction of blood pressure. They suggest a potassium intake of at least 90 mmol/day (3510 mg/day).

The WHO (2012), recounts that potassium is commonly found in a variety of unrefined foods, especially fruits and vegetables. It gives foods like cowpeas, pigeon peas, lima beans, African yam beans with potassium content of 1300 mg/100g fresh weight, Hazelnuts, walnuts, cashew nuts, brazil nuts with potassium content of 600 mg/100g fresh weight; spinach, cabbage, parsley with potassium content of 550 mg/100g fresh weight; carrots, onions, beetroot with potassium content of 200 mg/100g fresh weight; tomatoes, cucumbers, pumpkins with potassium content of 300 mg/100g fresh weight and bananas, papayas, dates with potassium content of 300 mg/100g fresh weight as some common dietary sources of potassium.

Calcium

Calcium is yet another nutrient of significance to the pathophysiology of hypertension. According to Ross *et al.* (2011), Over 99% of total body calcium is found as calcium hydroxyapatite ($\text{Ca}_{10} [\text{PO}_4]_6 [\text{OH}]_2$) in bones and teeth of humans. IOM (2011) cite calcium as essential for the formation of blood clots, the transmission of nerve impulses, as a metabolic cofactor to release energy from macronutrients, for maintaining a rhythmic heart rate and controlling concentrations of substances on different sides of cell membranes throughout the body. Explaining the pathophysiology of calcium, Zemel (2001) contends that the dysregulation of calcium homeostasis appears to be a fundamental factor linking the conditions of hypertension and obesity. He believes that, the regulation of intracellular calcium in key disease-related target tissues by calcitropic hormones provides the opportunity to modulate disease risk with dietary calcium. Explaining further, Zemel (2001) asserts that sub-optimal calcium intakes contribute to the aetiology of salt-sensitivity and hypertension. In that, the high salt diets exert a calciuretic effect, which then serves to exacerbate the physiological consequences of sub-optimal calcium diets. He cites the increase in 1, 25-dihydroxyvitamin D, which will cause an increased vascular smooth muscles intracellular calcium as an example. According to Zemel (2011) the resultant effect of this increase in vascular smooth muscles intracellular calcium is increased peripheral vascular resistance and blood pressure. Zemel (2001) relates that the reverse is observed when dietary calcium is high in the body. 1, 25 dihydroxyvitamin D is suppressed in the presence of calcium, thereby normalizing intracellular calcium. Ross *et al.* (2011) mentions dairy products (milk, yogurt, and cheese), vegetables, grains, legumes, fruit, meat, poultry, and fish and eggs as rich dietary sources of calcium. The NIH Medline Plus (2011) gives the dietary recommended allowance of calcium as 1000mg/day for ages between 19 and 70 years.

Magnesium

Magnesium is the second most abundant intracellular cation and is involved in several important biochemical reactions (Deepti, 2014). Cunha (2012) observed that the mineral magnesium has antiarrhythmic effect (used to suppress abnormal rhythms of the heart) and as such can influence blood pressure levels by modulating vascular tone. Cunha (2012) observed magnesium content is able to modify the production and release of nitric oxide (NO) which can result in the alteration of arterial smooth muscle tone by affecting calcium concentrations. Touyz (2007) also recounts that magnesium acts as a calcium channel antagonist, stimulates production of vasodilators prostacyclins and nitric oxide and alters vascular responses to vasoactive agonists. Galioto *et al.* (2003) observed that smaller concentrations of magnesium seem to be associated with reduced serum HDL-cholesterol but increased LDL-cholesterol and triglycerides levels which have adverse effect on the blood pressure of an individual. Nathan *et al.* (2010) contends that Magnesium is found in most foods, but in varying concentrations. He mentions Leafy vegetables, nuts, whole grains, fruits, and legumes as food sources with high-magnesium concentrations. Eisenberg *et al.* (2001) also found varied amounts of magnesium in tap, mineral and bottled water. The dietary recommendation (Recommended Dietary Allowances/RDA) for magnesium is 400mg to 420 mg daily for adult men and 310mg to 320 mg daily for adult women (Cunha, 2012)

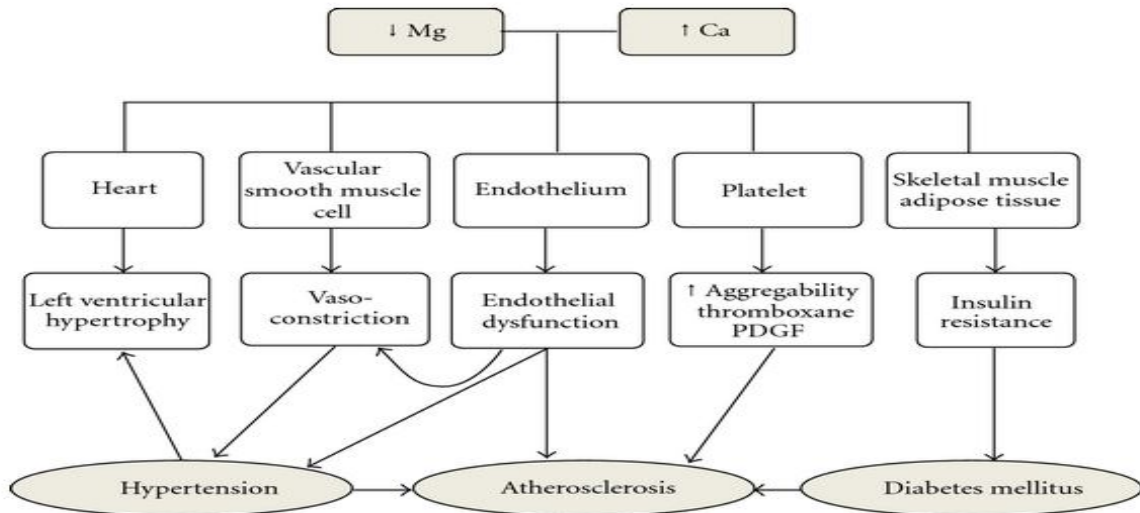


Figure 2.0: Role of magnesium and calcium in the pathophysiology of hypertension, diabetes mellitus, and atherosclerosis

Source: Cunha, 2011.

2.10.0 Dietary Fat

Dietary fat includes all lipids in plant and animal tissues that are eaten as food (FAO, 2010).

Dashty (2014) states that fats consist of a wide group of compounds with the same chemical structure that are derivatives of Fatty Acids and glycerol bounded together via “ester” bonds.

Dashty (2014) further continues that the properties of fats depend on their structure and on the composition of their Fats.

Generally, animal fats are solid at room temperature due to its high content saturated fatty acids, giving it a higher melting point. Plant fats (oils) however are liquid at room temperature, have high contents of unsaturated fatty acids and as such a lower melting point. Exceptions are however observed in the seed oils (e.g., coconut oil and palm kernel oil), which are plants but are high in saturated fat and solid at room temperature (Institute of Medicine of National Academies, 2005).

Fats role in the human body system cannot be overemphasised, according to Wilken *et al.* (2006), fat is a nutritionally concentrated source of energy (9 Cal/gram), provides essential fatty acids which are the building blocks for the hormones needed to regulate bodily systems, serves as carrier for the oil soluble vitamins A, D, E, and K and enhance the texture, the mouth feel, the flavour, and the feeling of satiety of foods.

FAO (2010) has divided Fatty Acids into Saturated Fatty Acids (SFA), Monounsaturated Fatty Acids (MUFA) and Polyunsaturated Fatty Acids (PUFA). EFSA (2010) identifies the SFA as the fatty acids without double bonds, the MUFA as the fatty acids having one double bond while the PUFA are the fatty acids with two or more double bonds. It asserts that, the double bonds in the PUFA can have either the *cis* or *trans* configuration. They were however quick to add that most unsaturated fatty acids in diets have the *cis* configuration. EFSA (2010) continues that the *trans* fatty acids (TFA) also exist but as either *trans*-MUFA or *trans*-PUFA.

2.10.1 Saturated Fatty Acids (SFA)

Misner *et al.* (2006) identified SFA as the fatty acids that have all the hydrogen they can hold. EFSA (2010) give lauric acid, myristic acid, palmitic acid, and stearic acid as most prevailing SFAs. Misner *et al.* (2006) mentioned pork, poultry skin butterfat and egg yolk, oils such as palm and coconut oil as some dietary sources of the fat. EFSA (2010) contends that, SFA are synthesised by the body and as such not required in the diet. Misner *et al.* (2006) observed that SFA can raise blood cholesterol levels, increasing the risk of heart disease.

2.10.2 Monounsaturated Fatty Acids

Misner *et al.* (2006) identifies MUFA as the fatty acids missing one hydrogen pair on their chemical chain. EFSA (2010) adds that the *Cis*-monounsaturated fatty acids are synthesised by the body, have no known specific role in preventing or promoting diet-related diseases, and are therefore not essential constituents of the diet. Misner *et al.* (2006) however observed that MUFAs can help lower total blood cholesterol, but have no effect on HDL-cholesterol. MUFA originate from both plant and animal-derived foods such as olive, high oleic acid sunflower, rapeseed oils and fish (EFSA, 2010)

2.10.3 Polyunsaturated fatty acids (PUFA)

Katan *et al.* (2004) identifies PUFAs, as derivatives of linoleic acid (n-6 PUFAs) and α -linolenic acid (n-3 PUFAs). Misner *et al.* (2006) on the other hand identifies it as fatty acids missing two or more hydrogen pairs on their chemical chains. PUFA's unlike the SFA are not synthesised in the body but can only be obtained from an external source and are therefore said to be essential (Moore, 2012). The most important families of PUFA, in terms of extent of occurrence and human health and nutrition, are the n-6 and n-3 families (FAO, 2010).

Omega-6 fatty acids: The important n-6 PUFAs are arachidonic acid (AA) and dihomogamma linolenic acid (DHGLA), arachidonic acid (AA) is the most important n-6 PUFA of all the n-6 fatty acids because it is the primary precursor for the n-6 derived eicosanoids. AA is present at low levels in meat, eggs, fish, algae and other aquatic plants (Wood *et al.*, 2008; Ackman, 2008a). EFSA (2010) mentions Foods rich in n-6 PUFA include vegetable oils such as corn oil, soybean oil, and sunflower seed oil. Medium-high levels are found in rapeseed oil. Also dressings and fat spreads containing these oils have moderate levels of n-6 PUFA. Linoleic

acid is the predominating PUFA in many vegetable oils. Oils derived from bacteria and microalgae and to a lesser extent, egg yolk and lean meat contain AA.

Omega-3 fatty acids: Eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) are the most important n-3 fatty acids in human nutrition. EPA and DHA are components of marine lipids. Marine fish such as mackerel, salmon, sardine, herring and smelt are excellent sources of EPA and DHA (Ackman, 2008a). Fatty acids that are highly polyunsaturated. These are found in seeds, nuts and corn oil. Alpha-Linolenic acid (18:3, n-3), a plant-derived n-3 PUFA, is found in some vegetable foods, e.g. linseeds, rapeseed oil and walnuts. Fish is a unique rich source of n-3 LCPUFA (EPA and DHA). Other natural sources are human milk and cultivated marine algae (single cell oils). EPA and DHA may also be provided by foods and supplements enriched with the LCPUFA.

2.10.4 Trans-fatty acids

In addition to the fatty acids mentioned earlier, there is yet another group of fatty acids in human diet referred to as *trans* fatty acids. Misner *et al.* (2006) identifies these trans-fatty acids as a type of saturated fat, in which hydrogen has been added to the carbon chains. They opine that, Foods high in these particular saturated fats are often high in cholesterol as well. Craig-Schmidt and Teodorescu (2008) observed Trans-fatty acids are common with partially hydrogenated vegetable oils, (margarine and shortening). Huth, (2007) saw it to be originated from ruminant deposits and milk fats. It has been found that these types of fat can actually raise LDL or “bad” cholesterol and lower HDL or “good” cholesterol Misner *et al.* (2006). According to EFSA, (2010), a large number of TFA isomers of MUFA and PUFA, including positional isomers of individual fatty acids, occurs in foods. EFSA (2010) identifies other

sources of trans fatty acids as bacterial transformation of unsaturated fatty acids in the rumen of ruminant animals, Industrial hydrogenation (used to produce semi-liquid and solid fats that can be used for the production of foods such as margarine, shortenings and biscuits) Deodorisation (a necessary step in refining) of unsaturated vegetable oils (or occasionally fish oils) high in polyunsaturated fatty acids and Heating and frying of oils at too high temperatures.

2.11.0 Hypertension and Blood Lipids

The lipid profile is a group of tests comprising triglycerides, total cholesterol, HDL and LDL cholesterol. Hypertension is known to be associated with alterations in lipid metabolism which gives rise to abnormalities in serum lipid and lipoprotein levels. It has also been documented that the presence of hyperlipidemia substantially worsens the prognosis in hypertensive patients (Third Report of the National Cholesterol Education Program (NCEP), (2002). A complete fasting lipoprotein profile is known to show the following: Total blood (or serum) cholesterol-Cholesterol is a fat-like substance (lipid) that is present in cell membranes and is a precursor of bile acids and steroid hormones. Cholesterol travels in the blood in distinct particles containing both lipid and proteins (lipoproteins).

The British Dietetic Association (BDA), (2013) asserts that Cholesterol is found naturally within the body in the structure of cell walls. They included cholesterol's involvement in the production of steroid hormones, vitamin D, the manufacturing of bile acids which aids in the digestion and absorption of dietary fat in the gut as some of its important roles in the human body. According to the BDA (2013) lipoproteins can be either high (High Density Lipoprotein-HDL) or low (Low Density Lipoprotein-LDL) lipoproteins, or 'good' and 'bad' cholesterol respectively.

According to the BDA,(2013) the European Union accepts an Optimal total cholesterol of less than 5.0 mmol/l., LDL cholesterol of 3.0 mmol/l or less but HDL cholesterol level of 1.2 mmol/l or more in women and 1.0 mmol/l in men. Triglycerides is 1.7 mmol/l or less.

2.12.0 Hypertension and Physical Activities

Physical activity is defined as any bodily movement produced by skeletal muscles that require energy expenditure. Lack of physical activity has been identified as the fourth leading risk factor for global mortality (6% of deaths globally) (WHO, 2014).

Regular physical activity is known to reduce blood pressure in 75% of individuals with hypertension and is a key component of lifestyle therapy for the prevention and management of hypertension (Headley *et al.*, 2009). Headley *et al.* (2009) is however of the view that the frequency, intensity, duration, and mode of activity play a role in the magnitude and duration of blood pressure reduction. Aerobic activity is the preferred type of activity to lower blood pressure. Acute, moderate-intensity aerobic activity (40%-60% VO_{2max}) can decrease blood pressure by 5 to 7 mm Hg for up to 22 hours post exercise, so participation in aerobic activity is recommended on most, if not all, days of the week. The recommended duration for aerobic activity is 30 to 60 minutes of continuous or intermittent activity. Resistance activity results in a 3-mm Hg decrease in blood pressure and should supplement the aerobic activity. The volume of resistance training for blood pressure reduction is 1 to 3 sets of 10 to 15 repetitions for 8 to 10 exercises that target large muscle groups (thighs, hips, back, chest, arms, and abdominals). (Headley *et al.*, 2009).

CHAPTER THREE

3.0 METHODOLOGY

3.1 Study Design

This study employed a cross-sectional design that included both qualitative and quantitative data collection.

3.2 Study Site

The study was conducted in Asesewa, the administrative capital of Upper Manya Krobo district in the Eastern region of Ghana. The district has a total population of 72,092 with a male population of 36,500 and a female total population of 35,592 (MLG, 2014). The site was chosen because of the presence of the University of Ghana Nutrition Research and Training Centre (NTRC) which is a research site for the University of Ghana's school of health sciences and their international collaborators at Asesewa. The University of Ghana Nutrition Research and Training Centre (NTRC) served as an important infrastructure to support the research activities.

3.3 Study Participants

Inclusion criteria:

The study population included adults between the ages of 25 years to 65 years who had resided in Asesewa township for more than two years.

Exclusion criteria:

Individuals who fell outside the age range of 25-65 years were not recruited into the study. In addition, people on any dietary regime, any disability that will interfere with anthropometric measurements or any known major organ pathology were excluded.

3.4. Sample Size Determination

A sample size of 308 was determined for the study based on a formula:

Sample Size (N) = ((Confidence Interval (T)² × Prevalence (P) [1- P])) / Margin of Error (M)²
² adopted from a suggestion by Charan *et al* (2013)

The estimated district prevalence of hypertension (30%), Composite Budget of the Upper Manya Krobo District Assembly (2012), an absolute precision of 5% and a confidence interval of 95% were employed.

With Sample Size (N) = Confidence Interval (T)² × Prevalence (P) [1- P]/Margin of Error (M)²

$$\begin{aligned}
 N &= \frac{T^2 \times P (1- P)}{M^2} \\
 &= \frac{(1.96)^2 \times 0.3(1-0.33)}{0.05^2} \\
 &= 3.8416 \times 0.3-0.099 / 0.0025 \\
 &= 3.8416 \times 0,201 / 0.0025 \\
 &= 308
 \end{aligned}$$

Confident Interval (T): 1.96

Prevalence (P): 0.3

Margin of error (M):0.05

3.5. Data Collection Instruments

The research methods that were employed in this study included interviews using structured questionnaire. The questionnaire was divided into four sections namely demographics, medical history, physical function and dietary intakes (Food Frequency and dietary recall). Anthropometric measurements and biochemical measurements were also used. The anthropometric measurements included height, weight, BMI, total body fat and visceral fat. The biochemical measurement included fasting blood glucose, lipid profile and blood pressure measurement.

3.6. Pretesting of Questionnaire

In order to ensure that the questionnaire was accurate and able to give the needed data for the set objectives to be met, the questionnaire was pre-tested in 10 participants (5 males and 5 females) before the main study was carried out. Some food items on the questionnaire that were not known in the study area were removed from the food frequency questionnaire following the pretesting.

3.7. Data Collection

Convenience sampling method was employed for this study. The study was carried out between August and September, 2014 and was in two phases; phase one covered collection of dietary data and measurement of anthropometry and the second phase involved the collection of blood samples for biochemical analyses. A van from the Asewewa Information Centre moved through the town and announced to the people of the town about an on-going health screening exercise at the nutrition centre. The principal investigator and research assistants also visited some churches in the town to provide more details about the study. This was done on Sunday, a day

prior to the commencement of the data collection. Subjects who were interested were asked to report at the University of Ghana Nutrition Research and Training Centre for the first phase of the study which covered anthropometric measurements and dietary interviews. Consent forms were given to participants to sign or thumbprint after the explanation of the study and the individual's willing to participate before the administration of the questionnaire to such individuals. The second phase of the study involved the collection of blood samples, for the analysis of serum glucose and lipid profile. The second phase of the study was done two weeks after all the required number of participants had been recruited and interviewed. The minimum sample size was 308 but 125 people volunteered to participate in the study at phase one. Sixty-seven participants turned up for the second phase but the lab analysis gave results of HDL, total cholesterol and triglyceride on 66 people.

3.7.1 Questionnaire Administration and Anthropometric Measures

After a thorough explanation of procedures involved in the study to consenting participants, a structured questionnaire was administered to participants to obtain information on social status, medical histories and other lifestyle activities.

3.7.2. Dietary Assessment

3.7.2.1 Food frequency questionnaire

A modified food frequency questionnaire adapted from a similar study on hypertension (Archana, 2012) was used to assess usual dietary intakes. The food frequency questionnaire included food items or specific food groups that were consumed over a reference period. The participants' food consumption patterns were assessed by multiple responses in which respondents were asked to estimate how often particular foods or beverages were consumed.

Categories ranging from never, weekly, monthly were included in the questionnaire and participants chose one of these options.

3.7.2.2 Dietary Data

Dietary intake information was collected using a non-quantitative food-frequency questionnaire (FFQ). The FFQ list consisted of 82 food items. Each participant in the study was asked to provide for each item of the FFQ. Participants were asked how frequently (5-7x/week, 1-4x/week, 1-2x/month and never/ seldom) they consumed the food. Frequencies of respondents' intake were coded 1= 5-7x/week, 2= 1-4x/week, 3= 1-2x/month and 4= never/ seldom. Data were recorded manually on a paper form at the end of the health interview by the study interviewer. The answers were open, thus allowing this variable to be treated as continuous. The foods on the questionnaire were then classified into the following food groups:

1. Cereals and grains (butter bread, polished rice, tea bread, spaghetti and maize);
2. Starchy root tubers and plantain (yam, cocoyam, gari, cassava, plantain and potato)
3. Legumes, oil seeds and nuts (beans groundnut, agushie, palmnut)
4. Fruits (citrus banana water melon, pineapple, pear)
5. Vegetables (okro, garden eggs, onion, turkey berries, tomatoes, kontomire, cabbage)
6. Animal and Animal Products (cheese, yogurt, mutton, chicken, fish, whole milk, low fat milk, beef, pork, poultry and fish goat meat, game, crab, snail, shrimp)
7. Non-alcoholic and alcoholic beverages (carbonated cold drinks, coffee, tea, milo, fruit juice, beer, Guinness, and local gin)

8. Fat and oil (butter/margarine, palm oil, coconut oil, frytol, palm kernel oil)
9. High fat diets/snacks (snacks, kelewele, fried yam, fried cocoyam, koose,) these groupings were based on the similarity of nutrient content.

3.7.2.3. 24-Hour Recall

A three day 24-hour dietary intake of participants was taken. These included one weekend and two week days. Participants were asked to give account of all foods and beverages consumed over a period of 24 hours for their nutrients analysis. Items like match box, soup ladle, stewing spoon, empty sardine can and other food models like toy orange, sliced yam and fish were employed as handy measures. These aided participants to give a near accurate measure of their food sizes.

3.8. Anthropometric Assessment

Body weight and height were measured to the nearest 0.1 kg and 0.5 cm, respectively, with participants standing in upright positions and without any foot wear. Height was measured with a Model, SEC-213 Seca Stadiometer (Kyoto, Japan). Body weight, BMI, visceral fat and percentage body fat of the participants were measured with an HBF-514C Omron Bioimpedance analyzer (Kyoto, Japan). Waist and hip circumferences of respondents were measured by a flexible tape measure to achieve central obesity which is an important risk factor for hypertension.

3.9. Blood Pressure

Blood pressure was checked using an Omron 785 Blood Pressure Monitor after 5 minutes rest by each participant. In a relaxed position, the cuff of the blood pressure monitor was placed around the upper arm 1-2 cm above the elbow. Two resting BP measurements were taken (spaced 3 minutes apart) for each participant and the mean of these two measurements was taken as the final reading. Blood pressure was checked using an Omron 785 Blood Pressure Monitor after 5 minutes rest by each participant. In a relaxed position, the cuff of the blood pressure monitor was placed around the upper arm 1-2 cm above the elbow. Two resting BP measurements were taken (spaced 3 minutes apart) for each participant and the mean of these two measurements was taken as the final reading. Blood pressure readings of participants were classified by the Seventh Report of the Joint National Committee report on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (2004) as low, ideal blood pressure, pre- high pressure and high blood pressure. Low pressure ranged from 70/40 to 90/60 while ideal was between 90/60 and 120/80. readings between 120/80 and 140/90 were considered pre high pressure whereas reading more than 140/90 were classified as high blood pressure.

3.10. Blood Sample Collection and Handling

After 8 -12 hours fast, participants reported at the Nutrition Research Centre for the blood sample collection. Out of the 125 participants interviewed and assessed nutritionally the previous week, only 67 were available for the blood sample collection. Three millimetres of blood (3ml) samples were taken by a trained phlebotomist from the antecubital vein with minimal pressure into vacutainers and aliquotted into appropriate tubes. Blood samples for plasma glucose analysis were collected into vacutainers containing fluoride oxalate. These

Samples were centrifuged at 3,000 rpm for 10 minutes at 4°C. Blood samples for analysis of triacylglycerol (TAG), total cholesterol, high density lipoproteins (HDL) and low density lipoproteins (LDL) cholesterol were collected into vacutainers containing no anticoagulant. These samples were centrifuged at 3,000 rpm for 15 minutes at 4°C and serum aliquots collected into eppendorf tubes. All the samples were transported on ice packs to the Chemical Pathology Laboratory of the School of Biomedical and Allied Health Sciences and frozen at -20°C until final analysis.

3.11.0 Data Analyses

Data collected were checked to ensure regularity and accuracy; this was useful in ensuring that the objectives of the study were being addressed. Analyses were done according to the objectives of the study. Data generated by questionnaires were cleaned, edited and coded before analyses were done. The Statistical Product and Service Solution Version 16 (SPSS. 16) programme and the Esha food processor software (Esha Fpro) were used to analyse data collected. The data were presented in the form of frequencies, percentages, and mode using the Statistical Product and Service Solution Version 16 (SPSS. 16). Qualitative data were organised according to themes identified from research questions and analysed using the descriptive design. The descriptive design concerns itself with describing situations as they were and hence, aimed at providing a description that is as factual and as accurate as possible. Mean standard deviation and ranges were calculated for continuous variables while proportions were presented for categorical variables. Linear correlation, crosstab statistics and independent sample t-test were used to determine the association between blood pressure, background characteristics, anthropometric indicators and lifestyle variables and also to compare mean levels of lipids among male and female populations of the study participants. All tests were

computed as two-tailed and p-values less than 0.05 were considered as significant. Summary of results were displayed in graphs, tables and narrative forms.

3.12 Diet Score

Diet scores were created by summing up frequency scores of participants, an expansion of a concept originally presented by Steffen, *et al.* (2005). A Respondent scored 1 in a group if he/she chose never/seldom and once/ twice a month, 2 if he/she chose 1-4 times a week and 3 if he/she chose 5-7 times a week. Scores of individuals were summed up to ascertain the total score in each food group. A simple rule of thumb was used to group scores into intervals (Low, Moderate and High). Grouped food scores were used to ascertain the relationship between food groups and blood pressure of participants. Food groups of interest included fruits, vegetables, animal and animal products and high fat diets.

3.13.1 Biochemical Analysis

All blood samples were analysed at the Chemical Pathology Unit of the School of Biomedical and Allied Health Sciences, Korle-Bu, Accra. All samples were analysed using the A-25 biosystems auto analyzer (Spain, Madrid). Controls from Elitech (electro1, 2) were run alongside samples for accuracy of result.

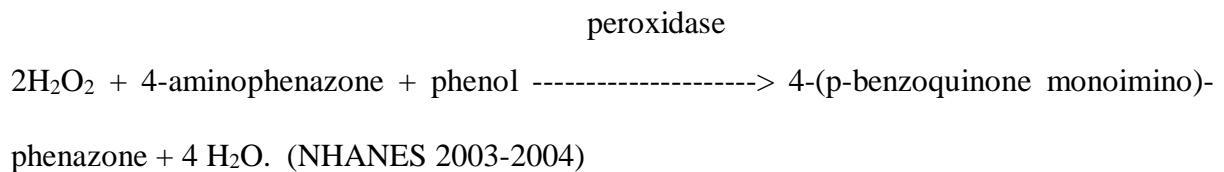
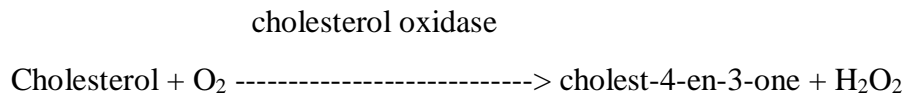
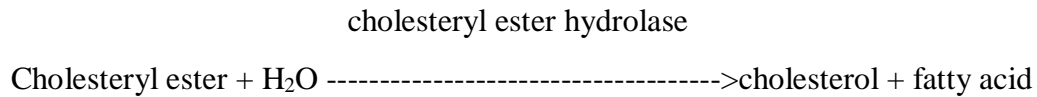
3.13.2. Lipid Profile

3.13.2.1 Cholesterol Test Principle

Cholesterol was measured enzymatically in serum in a series of coupled reactions that hydrolyze cholesteryl esters and oxidize the 3-OH group of cholesterol. One of the reactions

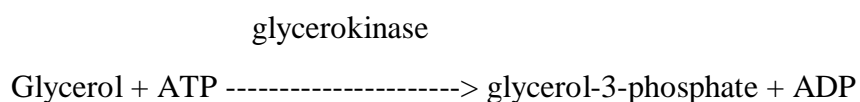
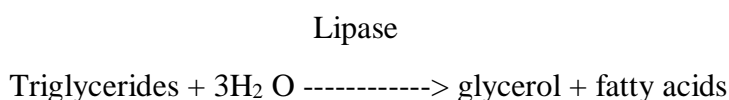
by-products, H_2O_2 was measured quantitatively in a peroxidase catalyzed reaction that produces a colour. Absorbance was measured at 500 nm. The colour intensity is proportional to cholesterol concentration.

The reaction sequence is as follows:

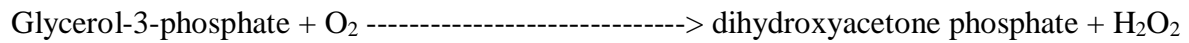


3.13.3.2 Triglyceride –Test principle

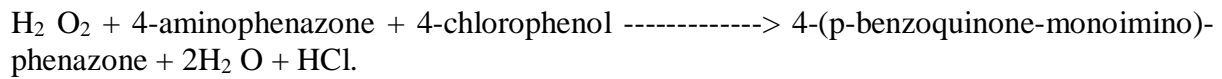
Triglycerides were measured enzymatically in serum using a series of coupled reactions in which triglycerides were hydrolyzed to produce glycerol. Glycerol was then oxidized using glycerol oxidase. H_2O_2 , one of the reaction products, was measured as described above for cholesterol. Absorbance was measured at 500 nm. The reaction sequence is as follows:



glycerophosphate oxidase



peroxidase



(NHANES 2003-2004)

3.13.3.3 HDL- Cholesterol test principle

HDL was measured directly in serum. The basic principle of the method is as follows. The apoB containing lipoproteins in the specimen were reacted with a blocking reagent that renders them non-reactive with the enzymatic cholesterol reagent under conditions of the assay. The apoB containing lipoproteins were thus effectively excluded from the assay and only HDL-cholesterol was detected under the assay conditions. The method used sulfated alpha-cyclodextrin in the presence of Mg^{+2} , which formed complexes with apoB containing lipoproteins, and polyethylene glycol-coupled cholesteryl esterase and cholesterol oxidase for the HDL-cholesterol measurement. The reactions are as follows:

(1) ApoB containing lipoproteins + α -cyclodextrin + Mg^{+2} + dextran SO_4 ---> soluble non-reactive complexes with apoB-containing lipoproteins

(2) HDL-cholesteryl esters $\xrightarrow{\text{PEG-cholesteryl esterase}}$ HDL-unesterified cholesterol + fatty acid

(3) Unesterified chol + O_2 $\xrightarrow{\text{PEG-cholesterol oxidase}}$ cholestenone + H_2O_2

(4) H_2O_2 + 5-aminophenazone + N-ethyl-N-(3-methylphenyl)-N'-succinyl ethylene diamine

—————>

+ H_2O + H^+ peroxidase quinoneimine dye + H_2O

Absorbance was measured at 600 nm.

3.13.3.4. LDL- Cholesterol

LDL –Cholesterol was estimated based on the Friedewald equation;

LDL-Cholesterol= Total Cholesterol – [(Triglycerides/2.2)-HDL] (Friedewald *et al.*, 1972)

3.13.4. Assay Procedure

All samples were allowed to thaw at 25°C. Samples were run on an A-25 Biosystems analyser (Spain, Madrid).

3.14. Ethical Issues

Approval for the study was given by the Ethics and Protocol Review Committee of the School of Allied Health Sciences (SAHS-ET./10396745/AA/11A/2013-2014). Participants had the right to withdraw from the study at any time. The purpose, risk and benefits of the study were explained to participants before they were recruited into the study. An informed written consent form was signed (or thumb printed) by each participant before his/her participation in the study. Permission was sought from the Upper Manya District Health Directorate before the commencement of the study. Participating subjects' confidentiality was ensured at all times.

CHAPTER FOUR

4.0 RESULTS

4.1. BACKGROUND CHARACTERISTICS

4.1.1.0. Socio-Demographic/ Household Characteristics of Participants

Table 4.1 shows the socio-demographic characteristics of respondents at Asesewa.

The most common (44.8%) age group among the 125 participants was between the ages of 25 years and 35 years. The least 12% were between the ages of 56-65 years.

Females took about 45% of the population with males making the remaining 55%.

It was realised that, 72% of the total participants were married with only 28% still single.

The majority of the participants, (99.2 %) belonged to the Christian faith. Only 1 person (0.8%) was identified as a Moslem.

Majority (92%) had basic education as their highest level of education whereas a few, 8% had tertiary education as their highest level.

Labour type of the study area was basically the unskilled. About 83.2% found themselves in this type of employment with the remaining 16.8% in the skilled type of employment.

Half of the participants (50.4%) had stayed in Asesewa for between 1 year and 20 years while the remaining half (49.6%) had stayed there for between 21 year and 40 years.

Table 4.1: Socio-Demographic Characteristics of Respondents at Asesewa

Characteristics	Frequency (n=125)	Percentage (%)
Gender		
Female	56	44.8
Male	69	55.2
Age group		
25-35	55	44
36-45	29	23.2
46-55	26	20.8
56-65	15	12
Marital Status		
Single/Never Married	35	28
Married	90	72
Religion		
Moslem	1	0.8
Christian	124	99.2
Level Of Education		
Tertiary	10	8
Basic School	115	92
Labour Type		
Skilled	21	16.8
Unskilled	104	83.2
Years of stay		
1-20	63	50.4
21-40	62	49.6

4.1.2. Monthly income of participants

Majority of the participants (70%) earn between GH¢ 100-500 monthly, 17% earn less than GH¢ 100 per month, 10% had GH¢ 501-1000 whereas very few of them, 2% and 1% earned between GH¢ 1501-2000 and GH¢ 1001-1500 respectively (Figure, 4.1.)

Monthly Income of Respondents

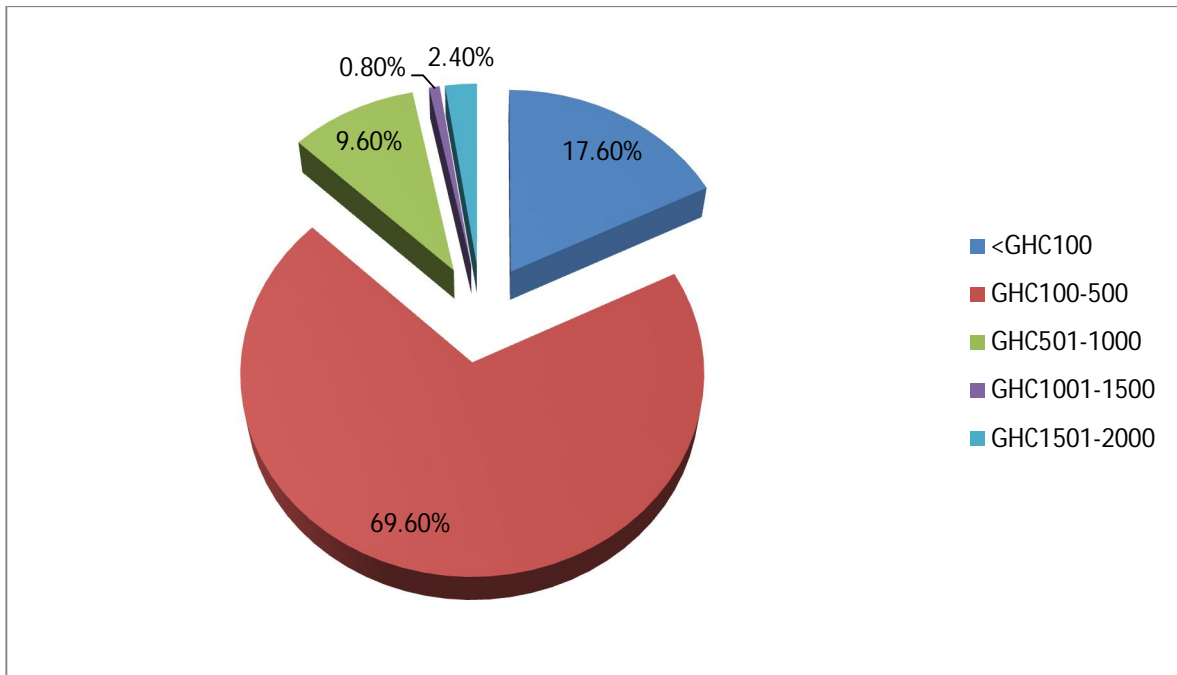


Figure 4.1: Monthly Income Distribution of participants.

4.1.2.0 Nutritional and Health Status of Participants

4.1.2.1 Hypertension status of participants

Table 4.2 shows the blood pressure status of respondents.

Out of the 125 participants interviewed, 18.4% were identified as having high blood pressure.

About 32% were found to be pre-hypertensive with 49.6% non-hypertensive.

Table 4.2: Blood Pressure Status of Respondents

BP Status	Frequency n=125	Percent (%)
Non Hypertensive (70/40-120/80mmHg)	62	49.6
Pre- High BP (>120/80-140/90 mmHg)	40	32
High BP (>140/90 mmHg)	23	18.4

4.1.2.2 Nutritional Status of Participants

Table 4.3 shows the nutritional status of respondents.

Out of the 125 participants, the body mass index (BMI) of 84(67.2%) showed normal weight. The remaining 23(18.4%) and 11(8.3%) were detected as overweight and obese respectively.

Normal visceral fat dominated with 83.2%, whereas high and very high had 14.4% and 2.4% respectively.

Participants with normal total body fat had a frequency of 63 (50.4%). About 12.8% of the participants were seen with a high total body fat while 20.8% had very high total body fat. Also 16% had low total body fat.

Table 4.3. Nutritional Status of Respondents

	Frequency (n=125)	Percentage (%)
Visceral Fat Status Of Participants		
Normal	104	83.2
High	18	14.4
Very High	3	2.4
Body Mass Index Of Participants		
Underweight	7	5.6
Normal Weight	84	67.2
Overweight	23	18.4
Obese	11	8.8
Total Body Fat Of Participants		
Low	20	16
Normal	63	50.4
High	16	12.8
Very High	26	20.8

4.1.2.3 Lipid Profile and Glucose level

Table 4.4 shows the lipid profile of participants.

About 69.7% of 66 participants belonged to the low category HDL levels. About 18.2% were considered as having acceptable levels whereas 12% had desirable HDL levels.

LDL also had 52.2% out of 67 of the participants being classified as ideal. Participants making 34.3% were found under the near optimal category while 3% and 10.4% were classified under the high and borderline categories respectively of LDL levels.

VLDL, another index was classified as desirable and high. Out of the 67 participants, 88.1% had desirable VLDL the remaining 11.9% however had high VLDL.

Desirable total cholesterol was common among participants as 78.87% of them belonged to this category whereas the remaining 16.7% and 4.5% were found under borderline high and high respectively.

Triglyceride levels identified 86.4% of participants as normal as opposed to 12.1% and 1.5% who were classified as borderline high and high respectively.

Blood glucose, also had 83.6% being classified as having normal glucose level. Notwithstanding, 13.4% impaired levels while 3% were identified as diabetics. TC: HDL ratio, the last indicator all 65(100%) participants as optimal.

Table 4.4: Lipid Profile of Participants

Lipid Profile	Frequency	Percent
HDL	(n=66)	(%)
Low	46	69.7
Acceptable	12	18.2
Desirable	8	12.1
LDL	(n= 67)	(%)
High	2	3
Borderline High	7	10.4
Near Optimal	23	34.3
Ideal	35	52.2
VLDL	(n=67)	(%)
Desirable	59	88.1
High	8	11.9
Blood Cholesterol	(n=66)	(%)
Desirable	52	78.8
Borderline High	11	16.7
High	3	4.54
Triglyceride	(n=66)	(%)
Normal	57	86.4
Borderline High	8	12.1
High	1	1.5
Blood Glucose	(n=67)	(%)
Normal	56	83.6
Impaired	9	13.4
Diabetes	2	3
TC:HDL Ratio	(n=65)	(%)
Optimal	65	100
High	0	0

4.2. Examination of the Prevalence of Hypertension among Adults in Asesewa.

4.2.1 Hypertension Status Awareness of Respondents

Table 4.5 show's Hypertension Awareness Status of Participants.

Out of the 125 respondents interviewed only 15 could confirmed as having been diagnosed of hypertension by a qualified doctor. About 60% of the participants who knew their status were Females whiles the remaining 40% were males. About 88% of the participants knew their blood pressure status.

Table 4.5: Hypertension Awareness Status Of Participants

	Female	Male	Total
	n (%)	n (%)	n (%)
Awareness/Gender	56 (44.8)	69 (55.2)	125 (100)
YES	9(60)	6(40)	15(100)
NO	47(42.73)	63(57.27)	110(88)

4.2.2.0. Traditional Predisposal Factors to Hypertension

4.2.2.1. Disease history of respondents

Table 4.6 shows the disease history of respondents. Some disease conditions that may give rise to secondary hypertension were looked at during the study and that included diabetes, heart disease, high cholesterol, arthritis and cancer. Out of the 125 participants, only 4 (3.2%) had been diagnosed of diabetes by a qualified doctor. Other diagnosed conditions were heart disease 2 (1.6%), high cholesterol 1 (0.8%) and arthritis 2 (21.6%). None had stroke nor cancer.

Table 4.6: Disease History of Respondents

Disease Type	Frequency (n=125)	Percentage (%)
Hypertension		
Yes	15	12
No	110	88
Stroke		
No	125	100
Yes	0	0
Diabetes		
Yes	4	3.2
No	121	96.8
Heart Disease		
Yes	2	1.6
No	123	98.4
High Cholesterol		
Yes	1	0.8
No	124	99.2
Cancer		
No	125	100
Yes	0	0
Arthritis		
Yes	2	1.6
No	123	98.4

4.2.2.2 Family Disease History of Respondents

Table 4.7 shows family disease history of respondents.

Family disease history of participants was also traced as part of researcher's quest to ascertain the risk of prevalence of hypertension among participants. Out of the 125 participants interviewed, 28.8% had witnessed hypertension in their family, 8.8 % had relatives diagnosed

of stroke, 10.4 % had at least a family member diagnosed of diabetes, 3.2% had a relative diagnosed of heart disease, 0.8% for cancer and 0.8% for arthritis but none had a family member with high cholesterol.

Table 4.7: Family Disease History of Respondents

	Frequency (n=125)	Percentage (%)
Hypertension		
Yes	36	28.8
No	89	71.2
Stroke		
Yes	11	8.8
No	114	91.2
Diabetes		
Yes	13	10.4
No	112	89.6
Heart Disease		
Yes	4	3.2
No	121	96.8
High Cholesterol		
Yes	0	0
No	125	100
Cancer		
Yes	1	0.8
No	124	99.2
Arthritis		
Yes	1	0.8
No	124	99.2

4.2.3 Social Activities That Expose Individuals to Hypertension

Smoking status which is one of the known social activities contributing to the development of hypertension was investigated. Out of the 125 respondents questioned, 119 (95.2%) never smoked, however, 4.8% confirmed to have smoked along the line but have since come off it.

4.3.0 Dietary Pattern Examination of Adults in Asesewa

4.3.1.0 Food frequency

4.3.1.1 Cereal and Grains

Figure 4.2 shows frequency of cereal and grains consumption among participants.

The cereal group had maize and its products as the most popular food item. It had about 72% of the participants confirming to eating its product 5 to 7 times in a week. Polished rice had 9.6% intake 5-7 times a week. It was next to butter bread and tea bread which had 15.2% and 12.8% respectively. Notwithstanding, only 22.4% answered to have never or seldom eaten rice as opposed to 52.8% and 47.2% of butter bread and tea bread respectively. Other food items in the group including: brown rice, wheat, brown bread, indomie, oats, millet were ill patronised by respondents. About 80% had never or seldom eaten brown rice, 91.2% had never or seldom eaten wheat while 86.4% had never or seldom eaten brown bread. Again, 58.4% had never or seldom eaten indomie, 66.4% oats and 53.6% millet.

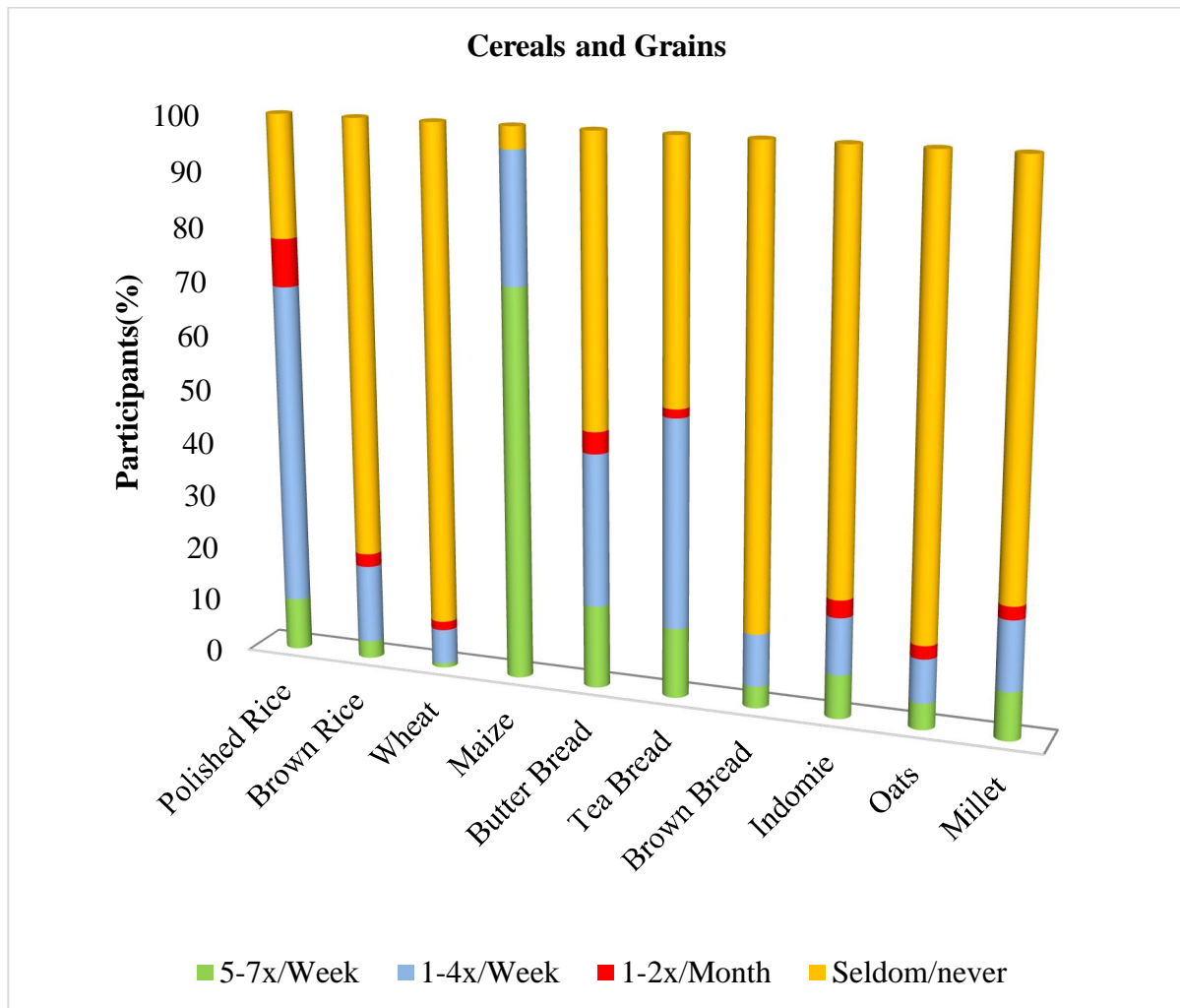


Figure 4.2: Frequency of cereal and grains consumption among participants

4.3.1.2 Starchy Root Tubers and Plantain

Figure 4.3 shows the frequency of starchy root tuber and plantain consumption among participants.

For the Starchy root tubers and plantain food group, cassava was the most popularly consumed food item. Out of the 125 participants, 48% consumed cassava or its product 5-7 times per week. Plantain followed closely in terms of frequency intake. It had 39.2% consumption 5-7 times per week. Other food items in this group including yam, cocoyam, gari and potato had a section of the participants affirming to be eaten them. Their patronages were quite lower as

compared to that of cassava and plantain. Out of the 125 participants, about 30% ate yam 5-7 times a week whereas about 23%, 13% and 12% ate cocoyam, gari and potato 5-7 times per week respectively. Notwithstanding, quite a substantial number of the respondents asserted that they had never eaten some of the food items 64% had never eaten potatoes while 44.8% and 49% had never eaten cocoyam and gari, respectively.

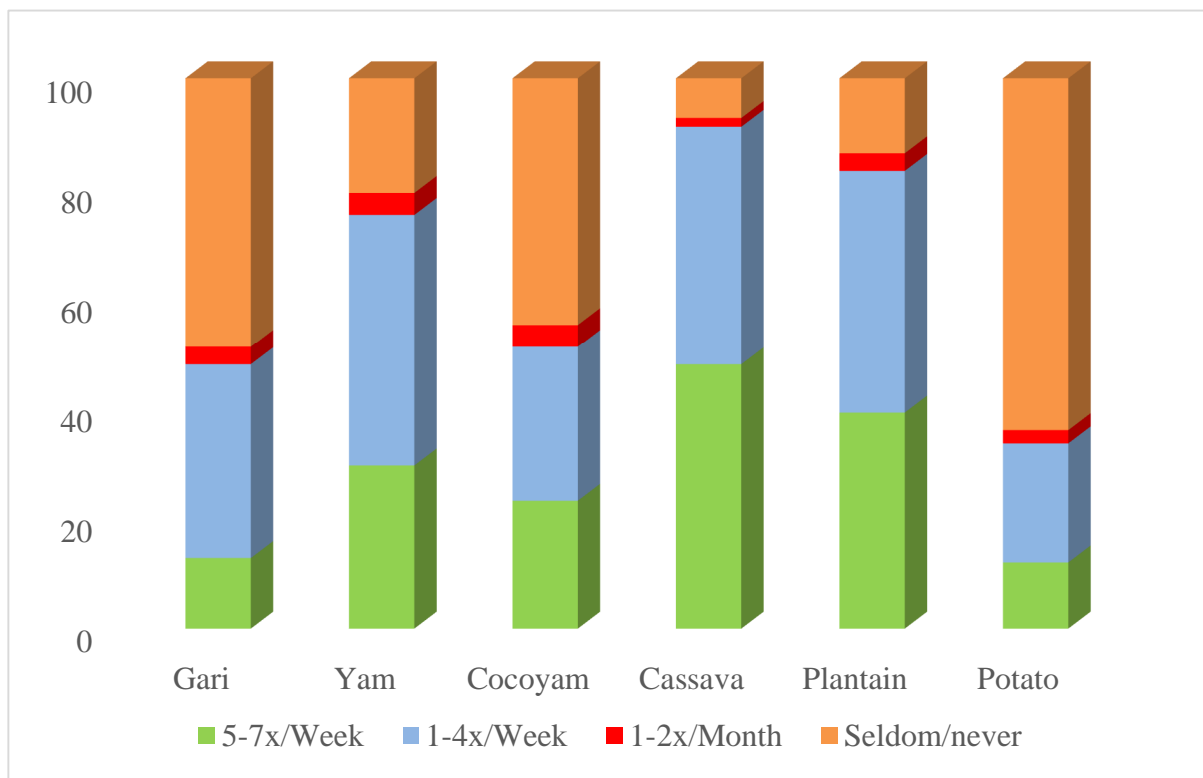


Figure 4.3: Frequency of starchy root tuber and plantain consumption among participants

4.3.1.3 Legume, Nuts and Oil Seed

Figure 4.4 shows the frequency of legumes oil seed and nuts consumption among participants. The legume, nuts and oil seed food group had palm nut dominating. It had 46.4% of the participants affirming to be eaten its product 5-7 times in a week. Following closely were beans and groundnuts which had 20% and 24% consumption 5-7 times a week respectively. Among

all the food items in the group, agushie was the most ill patronized. It was the only food item that had as high as 70.4% of participants to have never or seldom eaten it.

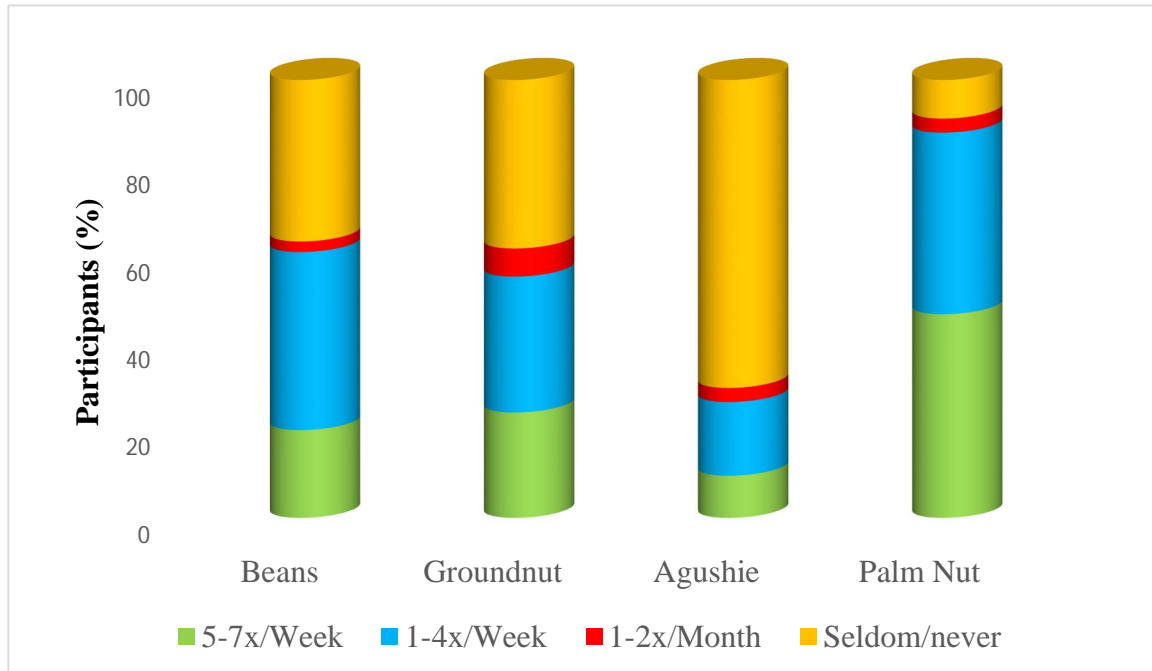


Figure 4.4: Frequency of Legumes oil seed and nuts consumption among Participants

4.3.1.4 Fruit

Figure 4.5 shows the frequency of Fruits consumption among Participants.

Fruits were generally ill patronized by majority of participants. Out of the 125 participants, less than 30% consumed fruits daily. The most frequently consumed food item was Mango. It had only 29.6% of the participants consuming it daily. Banana also had 24.8% intake of 5-7 times a week. It was identified that majority do not or rarely eat food items from this group.

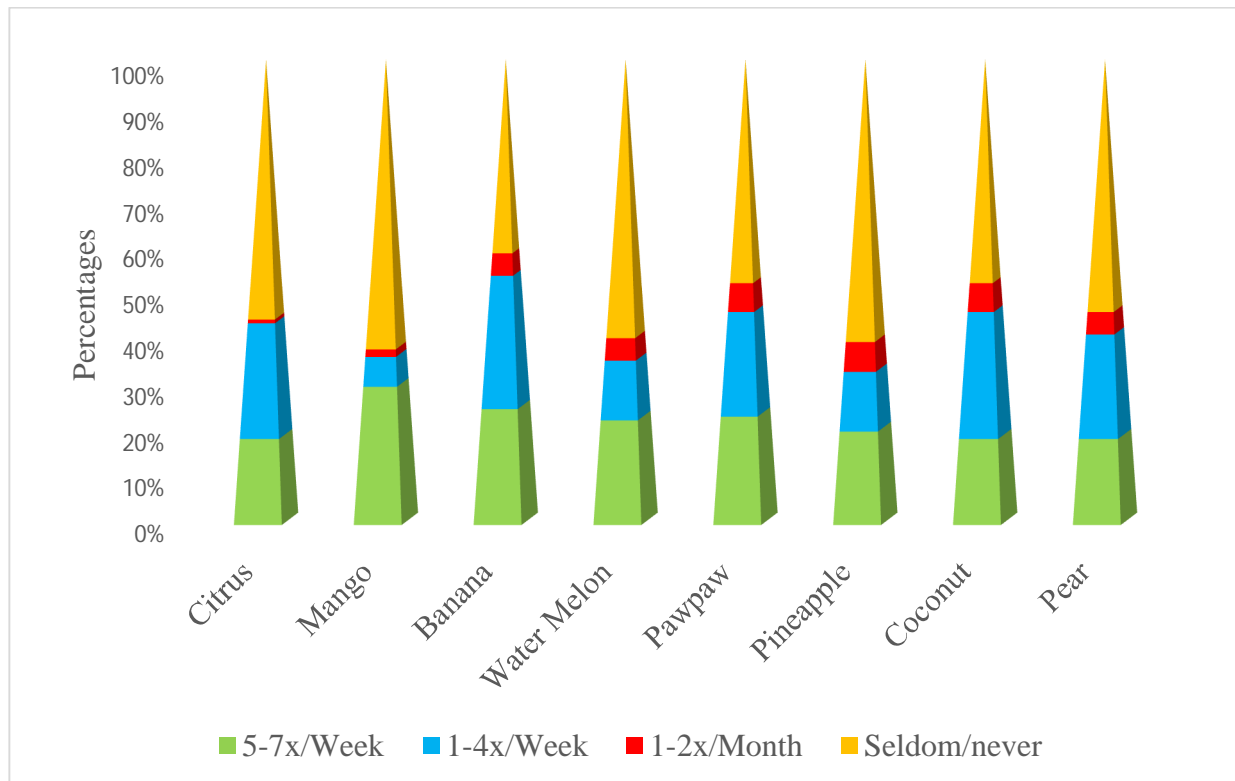


Figure 4.5: Frequency of fruits consumption among participants

4.3.1.5 Vegetables

Figure 4.6 shows the frequency of vegetables consumption among participants.

All the known and most common vegetables in the Ghanaian diet showing high frequencies of patronage. Onion, tomato, garden eggs and turkey berries were consumed by 50% of participants consuming 5-7 times a week. Onion and tomato recorded the highest percentage of patronage. Over 99% used onion 5-7 times whilst 98.4% used tomato 5-7 times a week. The other vegetables including okro, garden eggs, kontomire and turkey berries (referred to locally as *aleshega*) in the area also had frequencies of 44%, 72.8%, 46.4% and 60.0% respectively. Some exotic but common food items such as cabbage, lettuce, carrot, green pepper and dandelion were ill patronized in the community. Comparatively high percentages of the respondents said they had never eaten them. Out of the 125 respondents 64%, 84%, 80%, 75.2%

and 94.4% chose never/seldom for cabbage, lettuce, carrot, green pepper and dandelion respectively. The same could be said about food items such as bokoboko, bitter leaf, ayoyo, beans leaf and cassava leaf which were alien to majority of the participants.

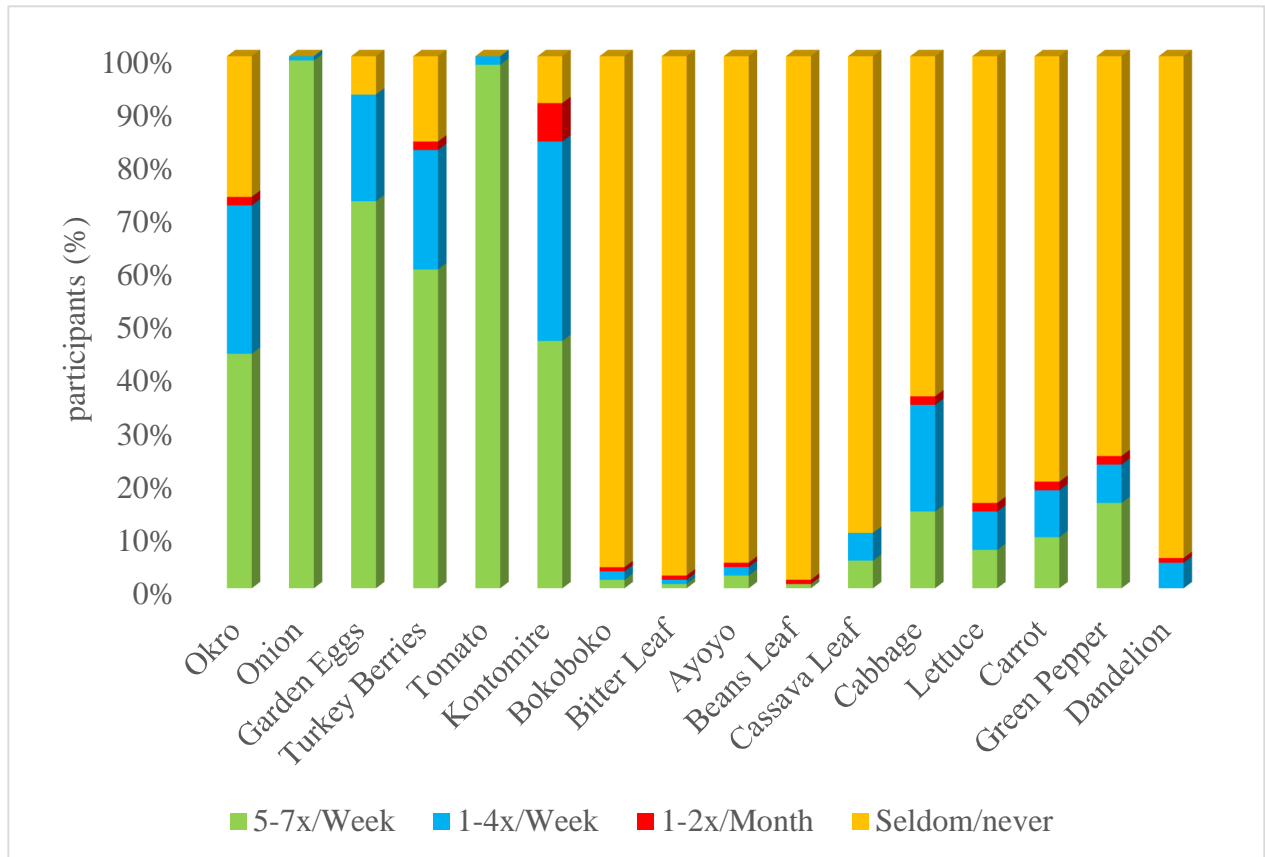


Figure 4.6: Frequency of vegetables consumption among participants.

4.3.1.6 Animal and Animal Products

Figure 4.7 shows the frequency of animal and animal products consumption among participants.

Fish stood out in the group as the most popularly consumed food item on the list. Fish recorded the highest frequency among the lot with 86.4% consumption of 5-7 times in a week. The food item in this category which could compete slightly with fish was chicken

which rather had a frequency of not more than 13.6% for 5-7 times in a week. About 32.8% participants consumed Chicken 1-4 times a week whereas 25.6% ate it only once or twice in a month. About 27.2% of participants rarely or had never eaten it. Other food items in this group had majority selecting never or seldom. Snail, pork, burkina, cheese, lobster, oyster and shrimps were poorly patronized by participants. Almost 90% of participants hardly patronize these foods.

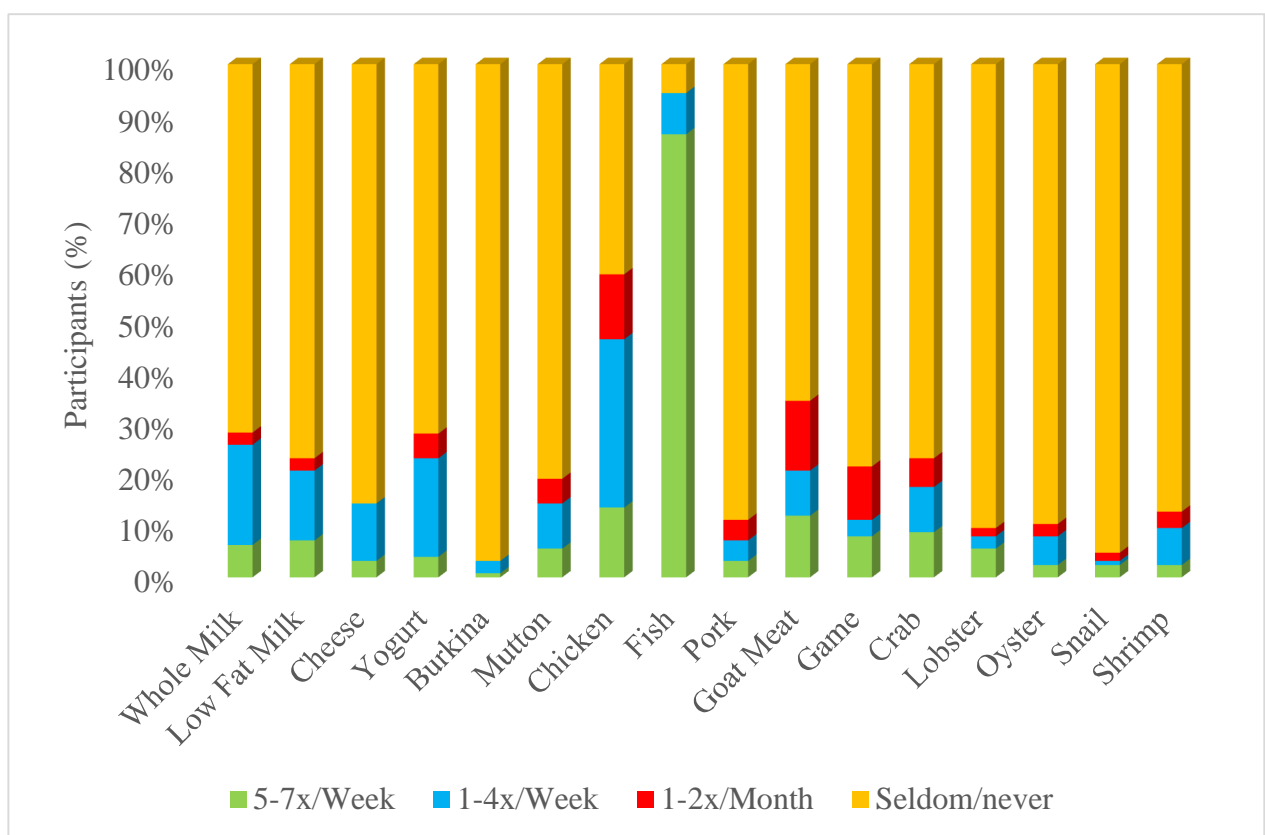


Figure 4.7: Frequency of animal and animal products consumption among participants

4.3.1.7 Non Alcoholic and Alcoholic Beverages

Figure 4.8 shows the frequency of alcoholic and non-alcoholic beverages consumption among Participants.

Non-alcoholic and alcoholic beverages were seen to be poorly patronized by the participants.

Among the 5 non-alcoholic and 4 alcoholic beverages, only carbonated drink and milo had

18.4% and 19.2% consumption of 5-7 times in a week. In all 88% answered never or seldom for Beer, 95.2% for wine, 94.4% for Guinness. Local gin which is locally referred to as *akpeteshie* and mostly popular in the rural and peri urban communities also had 86.4% consumption for never or seldom.

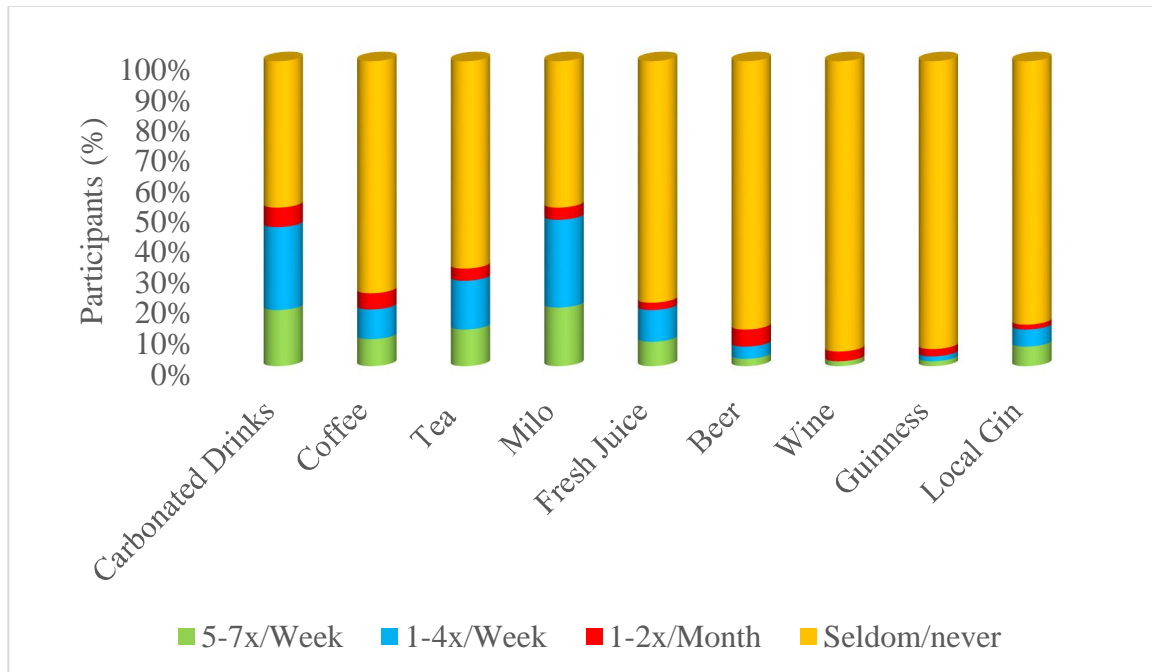


Figure 4.8: Frequency of alcoholic and non-alcoholic beverages consumption among participants

4.3.1.9 Fats and Oil

Figure 4.9 shows the frequency of fats and oil consumption among participants.

Among the fats and oils, palm oil was the most popular. Close to 62% of the participants patronize usage of palm oil 5-7 times a week. Following closely to palm oil was frytol which had 30.4% of respondents eating it 5-7 times in a week. Palm kernel oil and coconut oil were also identified as not so popular in the area since 18.4% and 16.8% of participants respectively ate them 5-7 times in a week.

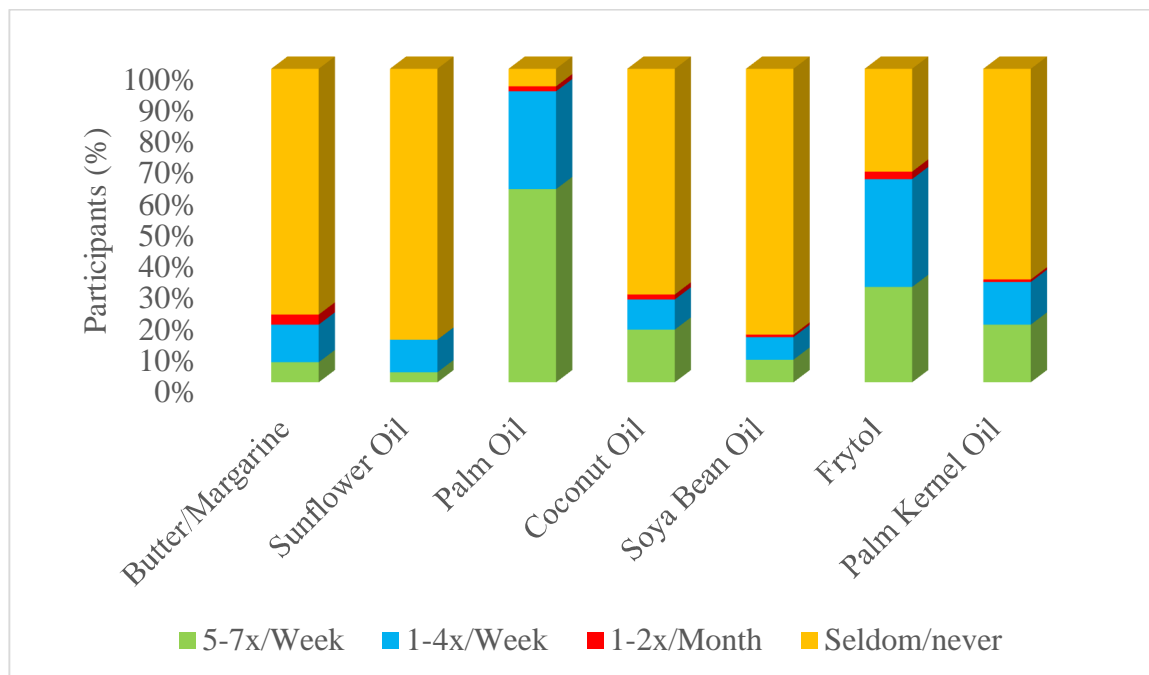


Figure 4.9: Frequency of fats and oil consumption among participants

4.3.1.10 High Fat Foods/ Snacks

Figure 4.10 shows the frequency of high fat foods and snacks consumption among participants.

Fried yam the most popular food item in the group had 18.4% of participants consuming it be 5 and 7 times in a week. Fried cocoyam on the other hand had 16.8% also eating it 5-7 times in a week. Out of the 125 respondents, 88% had never eaten kelewele. The same was seen with maasa which also recorded 95.2 % as never/seldom.

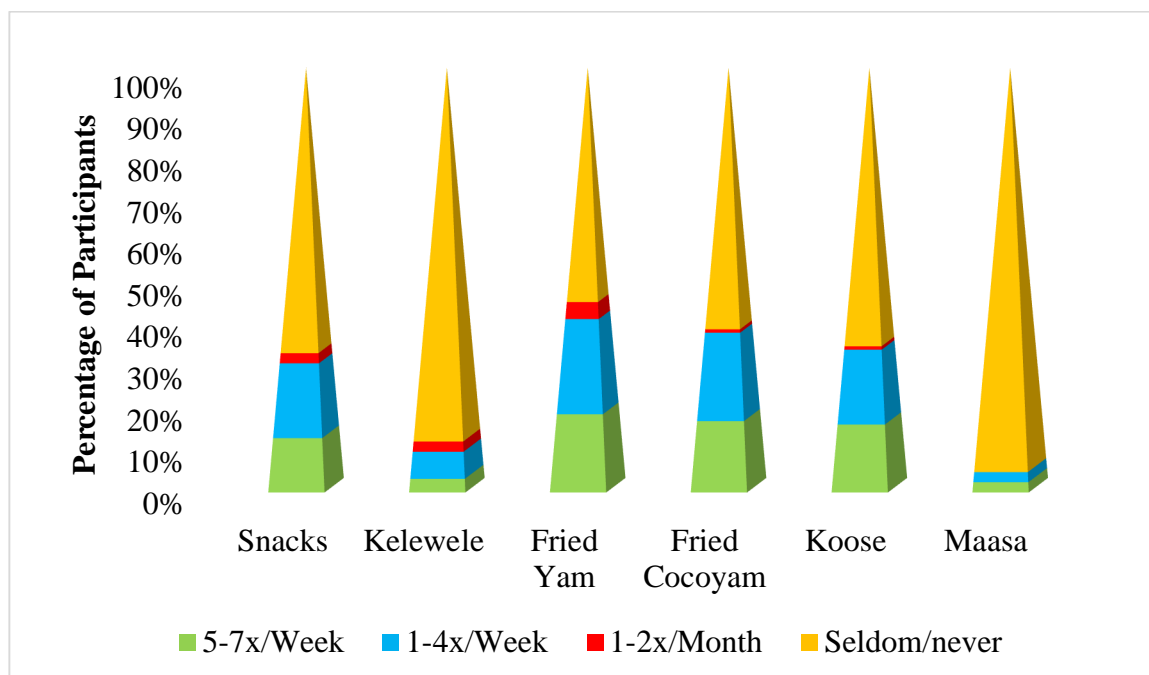


Figure 4.10: Frequency of high fat foods and snacks consumption among participants.

4.3.2. Meal Pattern of Respondents

Table 4.8 shows the meal patterns of respondents. About 57.0% of the participants ate thrice daily, 36.8 % ate twice with the remaining 5.6% eating 4 times in a day. About 84.4% of the participants had not taken any special food such as dandelion, moringa, etc. as immune busters. None of the participants was identified as a vegetarian.

Table 4.8: Meal Patterns of Respondents

	Frequency (n=125)	Percentage (%)
Meal Frequency/day		
Twice	46	36.8
Trice	72	57.6
Four	7	5.6
Special Food		
Yes	17	13.6
No	108	86.4
Vegetarian Status		
No	125	100
Yes	0	0

4.4. Relationship between Selected Food Groups and Blood Pressure

Table 4.9 shows the comparison of food groups and blood pressure status.

Out of the total 125 participants, 31.2% scored low, 40.8% scored moderate and 28% scored high. In relation to blood pressure, 52.1% being the highest hypertensive participants scored moderate protein intake. There was no statistical significance between total protein score and blood pressure readings (p value 0.298).

Participants' total fruit score had 38.4% scoring low, 33.6% moderate and 28% scoring high. Relating total fruit scores to participants' blood pressure scores it was realised that 43.47% of participants with high blood pressure belonged to the low fruit score group only 17.39% had high score for fruit. There was no significance relationship between fruit score and blood pressure (p value 0.771).

Total vegetable score was also determined and compared with the blood pressure reading. In total, low total vegetable score was 37.6%, moderate was 24.8% and 37.6% high. There was no statistical significance between total vegetable score and blood pressure (p value, 0.294).

The last but not the least group is the high fat food group. About 27.2% scored low and 44% for high. There was no relationship between high fat food group and blood pressure (p value. 0.847).

Table 4.9: Comparison Of Food Groups And Blood Pressure Status

	Non Hypertensive n (%)	Pre-Hypertension n (%)	Hypertension n (%)	P- Value
Total Protein Score				0.298
Low	16(25.8)	15(37.5)	8(34.9)	
Moderate	26(38.7)	13(32.5)	12(52.2)	
High	20(32.3)	12(30.0)	3(13.0)	
Total Fruit Score				0.771
Low	24(38.7)	14(35.0)	10(43.5)	
Moderate	19(30.6)	14(35.0)	9(39.1)	
High	19(30.6)	12(30.0)	4(17.4)	
Total Vegetable Score				0.294
Low	24(38.7)	18(45.0)	5(21.7)	
Moderate	15(24.2)	7(17.5)	99(39.1)	
High	23(37.1)	15(37.5)	99(39.1)	
Total High Fat Diet Score				0.847
Low	15(24.2)	11(37.5)	8(34.9)	
Moderate	20(32.3)	11(37.5)	5(21.7)	
High	27(43.5)	18(45.0)	10(43.5)	

4.5. Relationship between macronutrients (Protein, Fat, Carbohydrate,) and the Measured Biochemical Indices (Lipid Profile and Serum Glucose)

4.5.1 Average Daily Intake of Respondents

About 72.6% of participants exceeded the adequate level of protein intake. Only 7.3 % of the respondents showed an adequate daily average protein intake with the remaining 20.2% showing a low average daily protein intake. The average daily carbohydrate intake of respondents was generally high. Out of the 125 participants assessed, 123 making 98.4% scored high as opposed 1.6% who scored low for carbohydrates.

4.5.3 A Correlation of macronutrients (Protein, Fat, Carbohydrate,) And the Measured Biochemical Indices (Lipid Profile and Serum Glucose)

Table 4.10 shows the relationship between selected food nutrients (protein, fat, carbohydrate,) and the measured biochemical indices (lipid profile and serum glucose).

Average daily intake of protein intake of respondents compared with the various biochemical indices of participants. Inclusive of which were HDL, total Cholesterol, Triglyceride, LDL, VLDL, TC: HDL and blood glucose. None of the indices showed a statistical significance relationship with average protein intake of respondents.

Relationship between carbohydrates and the same biochemical indices were also not statistically significant.

Saturated fat of respondents correlated with most biochemical indexes with p value of 0.002 and an r value of 0.396. A statistical significance at a 0.017 significance level was observed between saturated fat and TC: HDL. Saturated fat again showed a significant relationship with blood glucose at a p value of 0.041 and an r value of -2.67. Mono unsaturated fat showed a significant association with triglyceride (p value of 0.007, r value of 0.35). It again correlated with VLDL with a positive r value of 0.351 and at a p value of 0.006. Polyunsaturated fat intakes also were observed to have correlated with triglyceride, VLDL and blood glucose. It had an r value of .360 and a p value of 0.005. It correlated with Blood Glucose (r value of .558, p value of 0.00).

Table 4.10: Relationship Between Selected Food Nutrients (Protein, Fat, Carbohydrate,) And The Measured Biochemical Indices (Lipid Profile And Serum Glucose)

	HDL	Blood Cholesterol	TG	LDL	VLDL	Blood Glucose	TC:HDL
Protein							
R	-0.086	-0.065	-0.005	-0.046	-0.009	-0.04	0.025
p-Value	0.516	0.624	0.969	0.732	0.948	0.761	0.854
Carbohydrates							
R	-0.189	-0.213	-0.005	-0.199	-0.008	-0.073	0.193
p-Value	0.153	0.104	0.967	0.13	0.95	0.585	0.144
Saturated Fat							
R	-0.051	0.141	.396*	0.155	.396*	-.267*	.311*
p-Value	0.701	0.285	0.002	0.24	0.002	0.041	0.017
MUFA							
R	0.132	0.245	.350*	0.215	.351*	-.268*	0.123
p-Value	0.319	0.061	0.007	0.102	0.006	0.04	0.354
PUFA							
R	0.227	0.104	.360*	-0.027	.358*	.558*	-0.006
P-Value	0.083	0.432	0.005	0.84	0.005	0	0.967
Fat							
R	-0.038	0.018	0.121	0.024	0.12	-.300*	0.138
p-Value	0.776	0.892	0.36	0.857	0.365	0.021	0.298

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

4.6.0 Relationship between Selected micro nutrients (Sodium, Potassium, Magnesium, Calcium,) and hypertension.

Table 4.11 shows a comparison of micronutrients of respondents and blood pressure.

None of the relations were statistically significant when tested with chi- square. It was the same for sodium.

Table 4.11: A Comparison Of Micronutrients Of Respondents And Blood Pressure

	Non Hypertensive	Pre-Hypertensive	Hypertensive	P-Value
Magnesium				0.115
Low	62	38	23	
High	0	2	0	
Calcium				0.549
Low	42	31	17	
High	20	9	6	
Sodium				0.115
Low	62	38	23	
High	0	2	0	
Potassium				
Low	62	40	23	
High	0	0	0	

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

CHAPTER 5

5.0 DISCUSSION AND CONCLUSION

WHO (2013) mentions globalization, urbanization, ageing, physical inactivity, income, education, housing as social determinants or `drivers of hypertension. Most participants falling within the ages 25 years of 30 years is a proof that the residents are very youthful and all things being equal are supposed to have ideal blood pressure. The 2010 national census of Ghana categorized populations within this age group as the working class. This therefore confirms why a majority 91.2% of participants were gainfully employed.

Employment type of the area was mainly the unskilled type which involves a lot of activity rather than the skilled type. This again is a proof that respondents were active and that may put them less at risk to hypertension.

Urbanization has had its own toll on the health of the nations. Majority of respondents testifying that they have stayed in Asesewa for over 30 years may be a proof that they hardly move out of the peri urban enclave.

Hypertension has been related to the rich in society by the WHO (2013) report, in effect, 69.6% of participants making a monthly income of not more than GHS 500 per month may indicate the low cost of living of the citizens.

Males dominated with a population of 55.2% to a female population of 44.8% was just a confirmation of the 2010 general census in Ghana of which males dominated in the upper Manya Krobo district.

About 72% of the respondents were married as opposed to only 28% who were single. This could mean a lot of the respondents might have responsibilities in terms of looking after their families.

Mutsikiwal *et al.*, (2012) contends that food choices are influenced by religion hence with about 99% of respondents belonging to only one religion, food choices and patterns were not biased since respondents belonged to a relatively same religion.

The highest education level of majority of respondents was basic school. This could have affected the reliability of some of the responses given particularly with the estimation of portion sizes and recalling of the usual dietary intakes for the past six months. This was surmounted since handy measures were employed and reliable research assistants who could probe well for reliable information assisted in the data collection. Data collected was therefore not biased.

Respondents numbering 23 out of the total 125 sampled were found to be having high blood pressure whereas 40 out of the 125 were diagnosed as pre-hypertensive. Prevalence of hypertension was therefore estimated to be 18.4% while prevalence of prehypertension was estimated to be 32%. This was the reverse of Gebreselassie (2014)'s conclusion that prevalence of prehypertension and hypertension in Ghana are 30.7% and 42.4%, respectively. It was however consistent with the findings of Bosu (2010) who gave the prevalence of hypertension (BP \geq 140/90 mmHg) with or without antihypertensive treatment) to be in the range of 19% to 48% between studies. This is an indication that people who have the risk of developing the disease far outweighs those who have developed it.

According to the Status Report on Hypertension in Africa (2013), hypertension is usually more pronounced in males than in females. This was not the case at Asesewa as most were rather females. About 57% of the participants with hypertension were females as opposed to 43% who were males. Out of the 23 respondents identified with high blood pressure reading, 15 (65.2%) were aware of their pressure readings. This was consistent with Bosu's (2010) claim that comparatively most Ghanaians are aware of their pressure reading than most citizens of other African countries.

Blood pressure readings of respondents correlated favourably with their age since majority with high blood pressure readings were aged between 56 years and 65 years.

Prehypertension is not a disease category rather, it is a designation chosen to identify individuals at high risk of developing hypertension, so that both patients and clinicians are alerted to this risk and encouraged to intervene and prevent or delay the disease from developing (Chobanian, *et al.*, 2004). Hence with 32% of the respondents recording pre-high blood pressure indicates that most respondents are at high risk of developing hypertension. The study identified most of these pre-hypertensive to be between the ages of 25 years and 35 years who the 2010 national census of Ghana described to belong to the labour force. In effect, the study has revealed that majority of the labour force of the study area are at risk of developing hypertension.

As part of the prevalence examination of the study area, the study probed the family disease history of respondents, social activities that expose individuals to hypertension, BMI, visceral fat and total body fat. This was done to confirm how the participants are exposed to the disease. Thus in conformity to the WHO (2013)'s factors that contribute to the development of hypertension. It was realized that only 3.2% respondents had ever been diagnosed of diabetes by a qualified doctor while, 1.6%, 0.8% and 1.6% had been diagnosed with heart disease, high cholesterol and arthritis, respectively, by a qualified doctor, none had stroke nor cancer. This could be an indication that hypertension of the area is mostly of the primary type.

The disease background of the participants' family was also looked at and inclusive were stroke, diabetes, heart disease, high cholesterol, cancer and arthritis. Only 28.8 % accepting to have witnessed hypertension in their family, 8.8 % stroke, 10.4 % diabetes, 3.2% heart disease, 0.8% cancer, 0.8% arthritis but none for high cholesterol. This could mean that, hypertension is hardly traced to the families of the participants or genetically linked.

Social lifestyles such as smoking were not prevalent in the community likewise excessive intake of alcoholic beverages. These may be an indication that these social behaviours are not part of causes of hypertension among the participants (WHO, 2013).

Anthropometric measures of participants including BMI and visceral fat were generally within acceptable ranges except the total body fat which ironically was very high among respondents. Over 67.2% of the participants were categorized as having normal BMI. This is an indication that most participants had normal BMI. The risk of hypertension is higher among population groups with overweight and obesity (Tesfaye *et al.*, 2007). An observation of only 18.4% of participants was therefore a confirmation. Visceral fat has been identified to have a positive correlation with high blood pressure (Chandra *et al.*, 2014). It was therefore not surprising to have witnessed only 18.4% among the participants as having high blood pressure since majority of the respondents (104 making 83.2%) were categorized as having normal visceral fat.

Food items on the food frequency table were first categorized into different food groups which comprised of cereals and grains, starchy root and plantain, legumes, oil seeds and nuts, fruits and vegetables, animals and animal products, fats and oil and high fat foods. The most popular food item that was identified in the cereal and grains group was maize and its products. Maize and its products had over 70% consuming it daily. This confirms Nti (2008)'s findings from the same area. Maize was consumed primarily in the form of *kenkey* (cooked balls of fermented maize dough), *banku* (cooked meal of fermented maize and cassava dough) and porridge. Polished rice which also belonged to this group, was the next commonly consumed cereal by quite a number of respondents. Nti (2008) again confirms this in her study conducted in the same district. Rice was consumed, mainly boiled, and served with stew. Cassava and Plantain were identified as the most consumed food items belonging to the starchy root and plantain group. Cassava was identified to be consumed by 48% of participants almost daily whereas

39.2% consumed plantain daily. This again is in line with Nti (2008). Most food items in this group including cassava and plantain were eaten mainly in the form of *fufu* (a pounded mash of cooked cassava with plantain or cocoyam) and *ampesi* (boiled root, tuber or plantain). Cassava was also eaten in the form of *kokonte* (cooked meal of dried cassava flour), *gari* (roasted fermented cassava meal) or *agbelima* (a fermented cassava dough) mixed with fermented maize meal and cooked into a soft meal, *banku*. Palmtree and its products were identified as the most popular in the legumes oil seed and nuts group. About 46.4% of the respondents affirming to be eaten palm nut or its product 5-7 times in a week, it was mainly consumed in a form soup. Respondents proved that fruits were generally not well patronised in the area. Banana popped up as the most popular food item 24.8% of participants ate it almost daily. All vegetables which are common in a typical Ghanaian diet were identified with comparatively higher mean frequencies than the known exotic vegetables such as lettuce, cabbage and carrots. Common vegetables found included okro, onion, garden eggs, tomato and kontomire. The only revelation was turkey berries which is relatively not popular in most Ghanaian diet but was seen to be very popular in this community. About 44% of respondents ate it daily. Participants put turkey berries in their palm nut soups and tomato stews. Fish was the most popular Animal protein source. It had 86.4% of participants patronizing it 5-7 times in a week. It was consumed mainly in soups and stews, as well as in hot pepper sauce as an accompaniment to the major staples such as *banku* and *kenkey*. As revealed under the legumes, oil seed and nuts, palm nut was popular here too. Palm oil, a product of palm fruit popped up as the most popular in the Fats and Oil group. Palm oil recorded close to 62% of the participants affirming to consuming it almost daily mainly in stews. Palm oil being a very good source of Vitamin A could mean the respondents would most likely meet their requirements for vitamin A.

Mattson *et al.* (2014) conceded that relatively little is known about a more fundamental aspect of frequency and circadian timing of meals and potential benefits of intermittent periods with no or very low energy intakes. However, the most common eating pattern in modern societies is the three meals (breakfast, lunch and supper) and sometimes plus snacks every day. Asewewa had no different meal frequency. Out of the 125 respondents interviewed, 58% followed the traditional pattern of eating thrice in a day. However, 36% of the respondents answered twice daily while 6% chose four times daily.

Reddy (2004) evidenced the availability of several studies conducted within and across populations which links several nutrients, minerals, food groups and dietary patterns with an increased or decreased risk of cardiovascular diseases including hypertension. This study compared some selected food groups and blood pressure among the study population. Fruits and vegetables intake has been proven to have a reducing effect on the blood pressure of humans. According to Reddy (2004) regular frequent intake of fruits and vegetables is protective against hypertension. Martı́nez-González *et al.* (2004) also found an inverse relationship between fruit and vegetable consumption and the prevalence of non-previously diagnosed hypertension in a Mediterranean population with a very high intake of both fat and plant-derived foods. Results from Asewewa confirms this assertion, in that, most respondents with high blood pressure readings were found among the respondents with lower score of fruits and vegetables.

Total protein score when compared with the blood pressure was not significant. This meant protein diet intake had no effect on the hypertension status of respondents. Notwithstanding, Crosstabulation showed only 13% of hypertensive participants belonging to the high scored group. This is a confirmation of Hu (2005) 's allusion that emerging evidence from clinical trials indicate that higher-protein diets improve blood lipids and by extension blood pressure.

Hu (2005) again relates that, findings from epidemiologic studies show a significant relationship between increased protein intake and lower risk of hypertension. He was however quick to add that; different sources of protein appear to have different effects on cardiovascular diseases inclusive of which is hypertension.

According to Gupta *et al* (2014), most epidemiologic studies have shown no clear relation between total dietary fats and blood pressure but have found an association between the intake of saturated fats and mean blood pressure and a negative relation to the intake of polyunsaturated fats. This finding seems to have confirmed this study since there was no relationship established between blood pressure readings and fat and oils. Rojo-Martinez (2003) found positive and independent association with the intake of cooking oil and the risk of hypertension. Gupta (2014) observed a long-term effect of recycled deep-frying oil on blood pressure. It caused vascular reactivity on blood pressure and aortic structure change in rats. It was therefore not surprising to have observed no relationship between deep fried foods and blood pressure as well in this study since majority of participants were youthful and that the implication of their saturated fat intakes might be seen in later years. On the other hand, there was relatively generally low patronage of deep fried foods in the study area which can also be a reason.

Relationship of protein and carbohydrates with lipoproteins was generally not significant. This means respondent's protein and carbohydrates intake had no effect on the various biochemical indices. Fat however showed some statistical significance with blood glucose. Daoud (2014) observed that diets low in fat content generally reduce total LDL and HDL cholesterol meaning there is positive relationship between fat, LDL and HDL levels. This was not confirmed directly by this analysis as no direct relation was observed between the HDL and the LDL.

However, saturated fat of respondents was observed to have positively correlated with triglyceride. McConnell (2007) in explaining lipoproteins makes a clearer distinction between HDL, LDL and VLDL. McConnell (2007) explains that, though all the three are lipoproteins, each is classified according to its chemical composition (i.e. cholesterol or triglyceride). He continues that the lipid portions of HDL and LDL is mainly cholesterol whereas that of VLDL is 80% triglyceride and 20% cholesterol. In effect triglyceride dominates with VLDL. Participants' saturated fat correlating positively with triglyceride and VLDL could be an indication that diets of participants mainly form triglyceride in their body systems. It was therefore not surprising to have seen 32% of respondents at risk of developing hypertension and 18.4% actually having the disease. As observed through the 24-hour recall tool employed, respondents' main staples were *banku* or *fufu* with palm nut soup or stew prepared with palm oil which are high in calories and excess can easily be converted into triglycerides. Moreover, majority (98.4%) of the participants exceeded their RDI for carbohydrate. Kraus *et al* (2010) clarifies that replacement of saturated fat by carbohydrates increases levels of triglyceride. The study revealed that, PUFA showed a positive relation with TG and VLDL ($p=0.005$). MUFA also showed a positive relation with TG and VLDL ($p=0.007$) and ($p=0.006$) respectively. This might be an indication that PUFA and MUFA moves in tandem with TG and VLDL. Merkel *et al.*, (2001) in a similar study observed that MUFA diets increased very low density lipoprotein-cholesterol (VLDL-C). The observation again can be a confirmation that participants' diet adds up to their triglyceride levels which is a component of the VLDL. Ooi *et al* (2015) contends that High n-6 PUFA intake decreases very low-density lipoprotein (VLDL) cholesterol and triglyceride concentrations by up-regulating VLDL lipolysis and uptake. Though this is contrary to the outcome of this research it can be argued on the basis of the assertion that the proportion of SFA, MUFA, and PUFA in diet determines their effect on serum lipids profile (Wolanska *et al*, 2012). A negative correlation was observed between all

fat components with blood glucose except PUFA. SFA showed a correlation of -0.267 while MUFA showed -0.268 and PUFA (0.558). This means SFA and MUFA increases as blood glucose levels decreases and decreases as blood glucose increases. However, Scheiner (2010) explains that fat begins to digest few hours after it has been ingested resulting in a raised triglyceride. Scheiner (2010) continues that high triglycerides in the bloodstream cause the liver to become resistant to insulin. The absence of insulin, results in more secretion of glucose than usual in the blood. In summary, Scheiner (2010) rather observed a positive relation between fat and blood glucose. Scheiner (2010)'s study contradicts the inverse relationship observed in this study. Still borrowing from (Wolanska *et al*, 2012) the observation could be attributed to the type and the quantity of fat used for the analysis.

No statistical relation was observed between all the micronutrients and hypertension. This is an indication that participants' micronutrients intake hardly influences their blood pressure status.

Limitations of the study included the use of the Esha F Pro software for nutrient analysis. The Esha F Pro software did not have nutritional information on some of local foods such as salted fish and as such they were substituted with similar foods. This might have introduced biasness in the dietary intake data.

Not all participants turned up for their blood samples to be taken for the biochemical analysis and that may have affected the accuracy of the data. Out of the 125 participants, 67 turned up for the blood sample collection.

Another limitation was participants recalling their usual dietary intake for the past 6 months as the food frequency questionnaire demanded. This could also introduce some bias since it relied on participants' memory.

To Conclude, dietary factors associated with hypertension were identified to be the various types of fat which had influence on lipid profile and blood glucose. The prevalence of hypertension (18.45%) was comparatively on the high side which puts the study population at a high risk. There were no significant association between selected minerals (sodium, potassium, calcium and magnesium) and blood pressure.

It was recommended that: Respondents should be educated on the need to vary their diets.

There should be health education on the need to consume a DASH diet considering the higher prevalence of risk of hypertension observed in the study area.

Authorities of the town should liaise with health professionals to introduce a routine free hypertension screening programs to the area to alert their citizens.

The main animal source of protein of respondents was seen to be fish which is supposed to have had good impact on the blood pressure readings of respondents, the reverse was however seen. The study attributed this to the means of processing. It is therefore recommended that the method of preparing the fish must be varied and preferably be adjusted to boiling and grilling instead frying most of the time.

REFERENCES

Aburto, N. J., Hanson, S., Gutierrez, H., Hooper, L., Elliott, P. and Cappuccio, F. P. (2013) Effect of increased potassium intake on cardiovascular risk factors and disease: systematic review and meta-analyses, *British Medical Journal* 346 (2): 1-19.

Ackman, R.G. (2008a) Fatty acids in fish and shellfish. In Chow C.K. (ed): Fatty Acids in Foods and Their Health Implications. London: CRC Press.

Addo, J. Agyemang, C. Smeeth, L., De-Graft, A., Edusei, A. K. and Ogedegbe, O. (2012) Review of hypertension in Ghana a Review of Population-Based Studies on Hypertension in Ghana. *Ghana Medical Journal*, 46(2):4-11.

Adrienne, F. (2007) Foods that lower cholesterol. Available from www.health.howstuffwork.com/diseases-condition/cardiovascular/cholesterol. (Accessed On 15th October 2014)

Adroge, H. J. and Nicolaos E. M. (2006) Mechanisms of disease: Sodium and Potassium in the Pathogenesis of Hypertension. *The New England Journal of Medicine*, 356:1966-78.

Agyemang, C. (2006) Rural and urban differences in blood pressure and hypertension in Ghana. *West Africa Journal of the Royal Institute of Public Health*, 120: 525-533.

Agyemang, C., Bruijnzeel, M. A. and Owusu-Dabo, E. (2005) Factors associated with hypertension awareness, treatment, and control in Ghana, West Africa. *Journal of Human Hypertension*, 20(1):67-71

Altorf-van der Kuil, W. (2010) Dietary protein and risk of hypertension in a Dutch older population. *The Rotterdam Study Journal of Hypertension*, 28(12):2394-400

American heart Association (2012). What is High Blood Pressure? Available from: <http://www.heart.org/highbloodpressure> Accessed on 15th Of October 2014

American Heart Association (2014) Understanding and Managing High Blood Pressure. Available from: <http://www.heart.org/highbloodpressure> Accessed on 15th Of October 2014

American Heart Association/American Stroke Association's High Blood Pressure Toolkit. Available from: <http://www.heart.org/highbloodpressure> Accessed on 15th Of October 2014

Anderson, J.W., Baird P., Davis, R. H., Ferreri, S., Knudtson M., Koraym A., Valerie Waters W. and Williams, C. L. (2009). Health benefits of dietary fibre. *Nutritional Review*, 67 (4): 188-205

Antman, E. M., D. T. Anbe, *et al.* (2004). ACC/AHA guidelines for the management of patients with ST-elevation myocardial infarction: executive summary: a report of the ACC/AHA task force on practice guidelines (committee to revise the 1999 guidelines on the management of patients with acute myocardial infarction). *Journal of American College of Nutrition*, 44(3):671-719.

Appel, L.J, Moore, T.J., Obarzanek, E, Vollmer, W. M., Svetkey, L.P., Sacks, F. M., Bray, G. A., Vogt, T. M., Cutler, J. A., Windhauser, M. M., Lin, P. H. And Karanja, N. (1997) Clinical trial of the effects of dietary patterns on blood pressure. *New England Journal of Medicine*, 336: 1117-1124.

Appel LJ, Brands MW, Daniels SR, Karanja N, Elmer PJ, Sacks FM, American Heart Association (2006). Dietary approaches to prevent and treat hypertension: a scientific statement from the American Heart Association. *Hypertension* 47(2):296-308

Archana, S. (2012) Dietary factors associated with Hypertension in Nepal. A thesis submitted in partial fulfilment of the Requirement for the degree of Master of Public Health: University of Washington.

Awuah, R.B., Anarfi, J.K., Agyemang C, Ogedegbe, G., Aikins, A.d. (2014) Prevalence, awareness, treatment and control of hypertension in urban poor communities in Accra, Ghana. *Journal of Hypertension* 32(6):1203-10.

Baker, E.H., Dong, Y.B. & Sagnella, G. A. (1998). Association of hypertension with T594M mutation in beta subunit of epithelial sodium channels in black people resident in London. *Lancet*, 351:1388-1392

Banasik, J. L. (2005) heart failures and dysrhythmias: common sequelae of cardiac disease. in Copstead, L. C., Banasik J.L. editors: pathophysiology 3ed. st Louis, Elsevier Saunders 21:486

Bellows, L. and Moore, R. (2013) Dietary Fat and Cholesterol. Available from <http://www.bloodpressureuk.org>, (Accessed on 14th October 2014)

BeLue R., Okoror, T. A., Iwelunmor, J., Taylor K. D., Degboe, A. N., Agyemang, C. and Ogedegbe, G. (2009) An overview of cardiovascular risk factor burden in sub-Saharan African countries: a socio-cultural perspective. *Globalization and Health*, 2: 5-1

Blake, J.S., Munoz, K.D. and Volpe, S. (2013). Nutrition: from science to you. 2nd ed. San Francisco: Pearson Benjamin Cummings

Bosu W.K. (2010) Epidemic of hypertension in Ghana: a systematic review. *Journal of the BMC Public Health series*, 10:418.

Bredbenner, C., Gaile, M., Beshgetoor, D., Berning, J., (2009). Wardlaw's Perspectives in Nutrition. 8th Edition. New York: The Mcgraw Hill Companies.

British Dietetic Association (BDA), (2013) Food Factsheet available from www.freelancedietitians.org (Accessed 15th January /2015)

Campbell, N.R., Appel, L.J., Cappuccio, F.P., *et al*, (2014) A call for quality research on salt intake and health: from the World Hypertension League and supporting organizations. *The Journal of Clinical Hypertension* (Greenwich), 16:469-71.

Candeias, V., Brown, I.J., Tzoulaki, I, *et al*. (2009), Salt intakes around the world: implications for public health. *International Journal of Epidemiology*, 38(3):791–813.

Cappuccio, F.P., Micah, F.B, Emmett, L., Kerry, S.M, Antwi, S., Martin-Peprah, R. (2004) Prevalence, detection, management and control of hypertension in Ashanti, West Africa, *Hypertension* 43(5):1017-1022.

Centre for Health Information Management (2008) Outpatient morbidity in health facilities, Ghana. Accra: Ghana Health Service

Chandra, A., Neeland, I. J. Berry, J. D., Ayers C R., Rohatgi, A., Sandeep R., Khera, A., McGuire, D K. de Lemos, J A. Turer, A. T. (2014) The Relationship of Body Mass and Fat Distribution with Incident Hypertension Observations from the Dallas Heart Study. *Journal of American College of Nutrition*, 64(10):997-1002.

Charan, J., Biswas, T. (2013) How to calculate sample size for different study designs in medical research? *Indian Journal of Psychological Medicine*. 35(2):121–126

Chobanian, A.V., Bakris, G.L., Black, H.R., Cushman, W.C., Green, L.A., Izzo, J.L. Jr, *et al.* (2003) The seventh report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure: the JNC 7 Report. *The Journal of the American Medical Association*, 289: 2560–2572.

Chobanian, A.V., Bakris, G.L., Black, H.R., Cushman, W.C., Green, L.A., Izzo, J.L. Jr, *et al.* (2004) The seventh report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure: the JNC 7 Report. *The National Heart, Lung, and Blood Institute; National High Blood*, 43(5):31

Chow, C. K., Teo, K. K., Rangarajan, S., *et al.*, (2013), Prevalence, awareness, treatment, and control of hypertension in rural and urban communities in high-, middle-, and low-income countries. *Journal of the American Medical Association*, 310: 959–968.

CODEX Alimentarius Commission (2009) Joint FAO/WHO report of the 30th session of the codex committee on nutrition and foods for special dietary uses Cape Town, South Africa.

Craig-Schmidt, M. C., Teodorescu, C. A. (2008) Trans -fatty acids in foods; in Chow CK (ed) *Fatty Acids in Foods and Their Health Implications*. London: CRC Press pp 377–437

Cunha J. P & Marks J, W. (2011). High blood pressure (hypertension). Available: http://www.medicinenet.com/high_blood_pressure/article.htm. (Accessed 20th October 2014)

Cunha, A. R., Umbelino, B., Correia, M. L. and Neves, M. F. (2012) Magnesium and Vascular Changes in Hypertension. *International Journal of Hypertension*, 2012:754250

Dashty, M. (2014) A Quick Look at Biochemistry: Lipid Metabolism. *Journal of Diabetes and Metabolism*, 2: 324.

Daoud, E., Scheede-Bergdah, C. and Bergdahl, A. (2014) Effects of Dietary Macronutrients on Plasma Lipid Levels and the Consequence for Cardiovascular Disease. *Journal of Cardiovascular Development*, 1: 201-213

Deepti, R., Nalini, G. (2014). Magnesium plays a Salient Role in the Cells. *Journal of Clinical and Biomedical Sciences*, 4(4):341-45

De-Graft Aikins, A. Boynton, P. and Atanga, L. L. (2010). Developing effective chronic disease interventions in Africa: insights from Ghana and Cameroon. *Globalization and Health*, 6(6):1 15.

Department for International Development (2011) Helpdesk Report: Salt intake

DE Wardner, H.E., Feng J. H. and Macgregor, A. G. (2004) Plasma Sodium and Hypertension. *Kidney International*, **66**: 2454–2466

Dong, Y. B., Plange-Rhule, J., Owusu, I., Micah, F., Eastwood, J. B., Carter, N.D., Saggarmalik, A. K., Cappuccio, F.P. & Jeffery, S. (2002) T594M mutation of the beta-subunit of the epithelial sodium channel in Ghanaian populations from Kumasi and London and a possible association with hypertension, *Genet Test* 6:63-5.

European Food Safety Authority Panel on Dietetic Products, Nutrition, and Allergies (2010) Scientific Opinion on Dietary Reference Values for fats, including saturated fatty acids, polyunsaturated fatty acids, monounsaturated fatty acids, trans fatty acids, and cholesterol. *European Food Safety Authority Journal*, 8(3):1461. pp. 107.

ETHIOPIA. The AU Conference of Ministers of Health's Sixth Ordinary Session (2013) The Impact of Non-Communicable Diseases and Neglected Tropical Diseases on Development in Africa. Addis Ababa. Carmma

Eisenberg, M. J. & Azoulay, A., Garzon, P., (2001). Comparison of the mineral content of tap water and bottled waters. *Journal of General Internal Medicine*, 16(3): 168–175.

ROME: Food and Agriculture Organization of the United Nations (2010) Fats and fatty acids in human nutrition Report of an expert consultation FAO Food and Nutrition Paper.

Friedewald, W.T., Levy, R.I., Fredrickson, D.S. (1972) Estimation of the concentration of low-density lipoprotein cholesterol in plasma, without use of the preparative ultracentrifuge. *Clinical Chemistry*, 18 (6): 499-502.

Galioto A, Barbagallo M., Dominguez, L.J., Ferlisi, A., Cani, C., Malfa, L., Pineo, A., Busardo, A., Paolisso, G. (2003) Role of magnesium in insulin action, diabetes and cardio-metabolic syndrome X. *Molecular Aspects of Medicine*, (1-3):39-52.

Geleijnse, J. M., Grobbee, D. E., and Kok, F. J. (2005) Impact of dietary and lifestyle factors on the prevalence of hypertension in Western populations. *Journal of Human and Hypertension*, 19 (3):1-4.

Gebreselassie, K. Z. and Padyab, M. (2014) Epidemiology of Hypertension Stages in Two Countries in Sub-Sahara Africa: Factors Associated with Hypertension Stages. *International Journal of Hypertension*, 959256 (11): 2.

GHANA: The Ghana Health Sector Program of Work (2005) Bridging the Inequality Gap: Addressing Emerging Challenges with Child Survival. Ministry of health.

GHANA: Ministry of Health. (2007). Creating wealth through health, national health policy report. Available from www.moh-ghana.org (Accessed on 30th January 2015)

GHANA: Ghana Health Service (GHS) (2012). Strategic Objectives and New Paradigm of the Ministry of Health. Ashanti Regional Health Directorate.

GHANA. Upper Manya District assembly 2011 health report (2012). The composite budget of the Upper Manya Krobo district assembly for the 2012 fiscal year. Available www.mofep.gov.gh or www.ghanadistricts.com.

Global Status Report on Noncommunicable Diseases (2010); World Health Organization: Geneva, Switzerland, 2011.

Gros, M., Drenjančević-Perić, I., Jelaković, B., Lombard J.H., Kunert M.P., Kibel, A. (2010). A High-Salt Diet and Hypertension: Focus On the Renin-Angiotensin System. *Kidney and Blood Pressure Research Journal*, 34(1):1-11.

Gupta, R., Vind, S. K., Singh, S. P., Kumar S., Kumar M. (2014), The Effect of Different Deep Fried Vegetable Oil On Cardiovascular System in Rats Model. *World Journal of Pharmaceutical Research*, 3: 1130-1139.

Hilsabeck, R., Mercado, J. M. (2005) Untreated hypertension can lead to memory loss by cutting down on blood flow to the brain. *American Journal of Neurology*, 64: 28-29.

John, J.H., Ziebland, S., Yudkin, P., Roe, L.S. and Neil, H. A. (2002) Oxford Fruit and Vegetable Study Group. Effects of fruit and vegetable consumption on plasma antioxidant concentrations and blood pressure: a randomised controlled trial. *Lancet*, 359: 1969-75.

Hansen, A. S. (2005). Effect of red wine and red grape extract on blood lipids, haemostatic factors, and other risk factors for cardiovascular disease. *European Journal of Clinical Nutrition*, 59:449.

Harsha, D., Sacks, F. M., Obarzanek, E., Svetkey, L. R., Lin, P. H., Bray, G. A., *et al.* (2004) Effect of dietary sodium intake on blood lipids: results from the DASH-sodium trial. *Hypertension*, 43:393-8.

Hart, C. L., Smith, G. D., Hole, D. J., Hawthorne, V. M., (1999) Alcohol consumption and mortality from all causes, coronary heart disease, and stroke: results from a prospective cohort study of Scottish men with 21 years of follow up. *British Medical Journal*, 318: 1725–1729

Headley, S. A. E., Goodwin, K. A., Pescatello, L. S. (2009) Exercise Prescription for the Prevention and Management of Hypertension. *American Journal of Lifestyle Medicine*, 3 (6): 446-449.

Hein, L., Barsh, G. S., Pratt, R. E., Dzau, V.J., Kobilka, B.K. (1995) Behavioural and cardiovascular effects of disrupting the angiotensin II type-2 receptor in mice. *Nature*, 377:744-7.

Hu, F.B. (2002) Dietary pattern analysis: A new direction in nutritional epidemiology. *Current opinion in lipidology*, 13: 3–9.

Huijbregts, P., Feskens, E., Rasanen, L., et al. (1997) Dietary pattern and 20-year mortality in elderly men in Finland, Italy, and The Netherlands: longitudinal cohort study. *British Medical Journal*, 315:13-7.

Institute of Medicine of National Academies, (2005). Dietary Reference Intakes for Energy, Carbohydrate, Fiber, Fat, Fatty Acids, Cholesterol, Protein, and Amino Acids available from www.iom.edu. (Accessed March 1st 2015)

Huth, P. J. (2007). Ruminant trans fatty acids: composition and nutritional characteristics. In List, G.R., Kristchevsky, D. and Ratnayake, W.M.N. eds. *trans fats in foods*. Urbana: AOCS Press pp. 97-126.

Institute of Medicine (IOM) (2011) *Dietary Reference Intakes for Calcium and Vitamin D*. Washington, DC: The National Academies Press

Kaplan, N.M. (2006) Primary hypertension: pathogenesis. In: Kaplan NM, ed. *Kaplan's clinical hypertension*. 9th ed

Kastorini, C. M., Papadakis, G., Milionis, H. J., Kalantzi, K., Puddu, P. E., Nikolaou, V., Vemmos, K.N., Goudevenos, J.A., Panagiotakos, D.B. (2013) Comparative analysis of a-priori and a-posteriori dietary patterns using state-of-the-art classification algorithms: a case/case-control study. *Artificial Intelligence in Medicine*, 3:175-83.

Katan, M.B., Geelen, A., Brouwer, I.A., Zock, P.L. (2004). Antiarrhythmic effects of n-3 fatty acids: evidence from human studies. *Current opinion in lipidology*, 15: 25–30.

Kearney P. M., Whelton M., Reynolds K., *et al.* (2005). Global burden of hypertension analysis of world data. *Lancet*, 365: 217-223

Kleinbaum, D.G., Kupper, L.L., Muller, K.E. (1988) Variable reduction and factor analysis. Applied regression analysis and other multivariable methods. Boston: PWS-KENT Publishing Company, 595–640.

Krebs-Smith (2014) Approaches to Dietary Pattern Analyses: Potential to Inform Guidance

Krauss, R. M., Siri-Tarino, P. W., Sun, Q. Hu, and F. B. (2010) Saturated Fatty Acids and Risk of Coronary Heart Disease: Modulation by Replacement Nutrients. *Current Atherosclerosis Reports*, 12(6): 384–390.

Layman, D. K., Clifton P. G., Krauss, R. M. and Nuttall, F. Q. (2008) Protein in optimal health: heart disease and type 2 diabetes^{1–4}. *American Journal Clinical Nutrition*, 87:1571–5.

Levine, M.J., Jones, J.R., Lineback, D.M., (2004). Dietary reference intakes: implications for fibre labelling and consumption: a summary of the International Life Sciences Institute North American Fibre Workshop. Washington, DC. *Nutrition Review*, 64:31–38.

Lifton, R.P., Gharavi, A.G., and Geller, D.S. (2001). Molecular mechanisms of human hypertension. *Cell*, 104: 545-556.

Lim, S.S., Vos, T., Flaxman, A.D., *et al.* (2010). A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990–

2010: a systematic analysis for the Global Burden of Disease Study 2010. *Lancet*, 380:2224–2260.

Lim, S.S., Vos, T., Flaxman, A.D., Danaei, G., (2012) A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990–2010: a systematic analysis for the Global Burden of Disease Study 2010. *Lancet*, 380: 2224–60.

Mahan, L.K, Escott-Stump, S. and Raymond, J. (2012). Krause Food and Nutrition Therapy Care Process. 13th ed. Philadelphia: Saunder Elsevier.

Maire, B, Lioret, S, Gartner, A, Delpeuch, F. (2002) Nutritional transition and non-communicable diet-related chronic diseases in developing countries. *Sante*, 12(1):45-55

Maletnlema, T.N. (2004), A Tanzanian perspective on the nutrition transition and its implications for health. *Public Health Nutrition*, 5:163–168.

Martínez-González, M.A., Fernández-Jarne, E., Serrano-Martínez, M., Wright, M., Gómez-Gracia, E. (2004). Development of a short dietary questionnaire for the quantitative estimation of adherence to a cardioprotective Mediterranean diet. *European Journal Clinical Nutrition* 58:1550–1552

Mattson, M. P., Allison, D. B., Fontana, L. (2014) Meal frequency and timing in health and disease. University of Texas Southwestern Medical Center, Dallas.

McConnell, J.P., Garza, C.A., Montori, V.M., Somers, V.K., Kullo, I.J., Lopez-Jimenez, F. (2007) Association between lipoprotein-associated phospholipase A2 and cardiovascular disease: a systematic review. *Mayo clinic proceedings* 82(7):888

Merkel, M., Velez-Carrasco, W., Hudgins, L.C., Breslow, J.L. (2001) compared with saturated fatty acids, dietary monounsaturated fatty acids and carbohydrates increase atherosclerosis and VLDL cholesterol levels in LDL receptor-deficient, but not apolipoprotein E-deficient, mice. *Proceedings of the National Academy of Science of U S A*, 98 (23):13294-9.

Mesrati, F. H. (2007). Essential hypertension. *Lancet* 370:591-603

Meyer, W.J., Schreiber, S., Guo, Y., Volkmann, T., Welte, M.A., Muller, H.A. (2006). Overlapping functions of argonaute proteins in patterning and morphogenesis of *Drosophila* embryos. *PLoS Genet*, 2(8): 134.

Mineral Resources International. (2012). Guide to Minerals and Trace Minerals. Created for Ionique a Division of Mineral Resources International, Inc.

Misner, S., Curtis, C., Whitmer, E. (2006) Fat and Cholesterol Update. The University of Arizona College of Agriculture and Life Sciences Tucson, Arizona.

Moore, M.R., and King, R.A. (2012). Effects of omega-3 fatty acids on progesterin stimulation of invasive properties in breast cancer. *Hormones and Cancer*, 3: 205-17.

Mullins, L. J. Bailey, M. A. and Mullins, J. J. (2006) Hypertension, kidney, and transgenics: a fresh perspective. *Physiological Reviews*, 86: 709–746.

Murray C. J, Lopez A.D. (1997) Mortality by cause for eight regions of the world: Global Burden of Disease Study. *Lancet*, 349:1269–76.

Mutsikiwal, M. & Clay, H. B. (2012) The Influence of Socio-cultural Variables on Consumers' Perception of Halal Food Products: A Case of Masvingo Urban, Zimbabwe. *International Journal of Business and Management*, 7: 1833-8119.

Nathan, L., Chacko, S. A., Song, Y., *et al.* (2010) Relations of dietary magnesium intake to biomarkers of inflammation and endothelial dysfunction in an ethnically diverse cohort of postmenopausal women, *Diabetes Care*, 33:304–310.

National Institutes of Health, (2011) Dietary Supplement Fact Sheet: New Recommended Daily Amounts of Calcium and Vitamin D. *The NIH MedlinePlus* 5:12

Newsby, P. K., Christoph, W., Agneta, A., Katherine, L.T. and Wolk, A. (2006) Long-Term Stability of Food Patterns Identified by Use of Factor Analysis among Swedish Women. *American Society for Nutrition*

NHANES (2003-2004) Laboratory Procedure Manual: Total Cholesterol, HDL-Cholesterol, Triglycerides, and LDL-Cholesterol

http://www.cdc.gov/nchs/data/nhanes/nhanes_03_04/113_c_met_lipids. Accessed 14/10/2014

Nielsen, F.H. (2008) Ultratrace elements of possible importance for human health: an update. *Progress in Clinical and Biological Research*, 380:355-76.

Nti, C. A. (2008) Household dietary practices and family nutritional status in rural Ghana. *Nutrition Research and Practice* 2(1): 35-40.

Ooi, M.M., Watts, G. F., Theodore, W.K., *et al.* (2015) Review Effect of Dietary Fatty Acids on Human Lipoprotein Metabolism: A Comprehensive Update. *Nutrients* 7(6): 4416-4425

Oparil, S., Zaman, M. A and Calhoun, D A. M. (2003) Pathogenesis of Hypertension Physiology in Medicine: A Series of Articles Linking Medicine with Science. *Annals of Internal Medicine*, 139:761-776

Palmer, B.F. (2014) Regulation of Potassium Homeostasis. Renal physiology. *Journal of the American Society of Nephrology*, 10:.2215

Pobee, J.O., Larbi, E.B., Belcher, D.W., Wurap,a F.K., Dodu, S.R. (1977) Blood pressure distribution in a rural Ghanaian population. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, 71:66-72

Reddy K S and Katan M B (2004) Diet, nutrition and the prevention of hypertension and cardiovascular diseases. *Public Health Nutrition*, 7(2):167-86

Ridker, P.M, Vaughan, D.E, Stampfer M.J., *et al.* (1994) Association of moderate alcohol consumption and plasma concentration of endogenous tissue-type plasminogen activator. *The Journal of the American Medical Association*; 272:929–33

Ross, A.C., Manson, J.E., Abrams, S.A., Aloia, J.F., Brannon, P.M., Clinton, S.K, *et al* (2011) Clarification of DRIs for calcium and vitamin D across age groups. *Journal of American Dietetic Association*, 111(10):1467

Sabliov, C., Chen, H., Yada, R. (2015) *Nanotechnology and Functional Foods: Effective Delivery of Bioactive Ingredients*. Wiley-Blackwell

Sachs, F. N., Svetkey, L.P., and Vollmer, W.M. (2001): Effect on blood pressure of reduced dietary sodium and the Dietary Approaches to Stop Hypertension (DASH) diet. *New England Journal of Medicine*, 344: 3-10.

Sánchez-Muniz F. J. (2011) Dietary fibre and cardiovascular health. *Nutrición Hospitalaria*. 27:1

Sánchez-Benito, J. L., Sánchez-Soriano, E. and Ginart, S. J. (2007) Unbalanced intake of fats and minerals associated with risk hypertension by young cyclists. *Nutrición Hospitalaria* 22(5):552-9

Schlenker, E. D., Long, S. (2011) *William’s essentials of nutrition and diet therapy*, 10th edition, 21:472-488.

Sharon M. W., Sonya S. L and Kerry S. C. (2009). Physical Activity as a Supportive Care Intervention in Palliative Cancer Patients: A Systematic Review Manuscript. *The journal of supportive oncology*, 7(1):27-34

Škarić-Jurić T. (2003) Path analysis of familial resemblance in blood pressure in Middle Dalmatia, Croatia. *Collegium Antropologicum*, 27(1):229–237.

Singh, K. D., Jajodia, A., Harpreet, K, Ritushree, K. and Muthusamy, K. (2014). Gender Specific Association of RAS Gene Polymorphism with Essential Hypertension: A Case-Control Study. *BioMed Research International*, 2014:10

Safdar, N. F., Bertone-Johnson, E, Cordeiro, L., Jafar, T. H.and Cohen, N. L., (2013) Dietary patterns of Pakistani adults and their associations with sociodemographic, anthropometric and life-style factors. *Journal of Nutritional Science*, 2: 42.

Soetan, K. O., Olaiya, C. O. and Oyewole, O. E. (2010). The importance of mineral elements for humans, domestic animals and plants: A review. *African Journal of Food Science*, 4(5): 200-222

Soualmia, H., (2012). Candidate Genes in Hypertension, Genetics and Pathophysiology of Essential Hypertension, Prof. Madhu Khullar (Ed.), Rijeka, Croatia: Intec Europe Available from:<http://www.intechopen.com/books/genetics-and-pathophysiology-of-essential-hypertension/genetic-variants-inessential-hypertension>

Steffen, L.M., Kroenke, C. H., Yu, S. and *et al.* (2005) Associations of plant food, dairy product, and meat intake with 15-y incidence of elevated blood pressure in young black and white adults: The Coronary Artery Risk Development in Young Adults (CARDIA) study.

American Journal of Clinical Nutrition, no. 82: 1169-77

Taler, S.J. (2008) Secondary causes of hypertension. *Primary Care*, 6 (3) 489-500.

Tesfaye, F., Nawi, N.G., Van, M. H., Byass, P., Berhane1 Y., Bonita R. and Wall, S. (2007). Association between body mass index and blood pressure across three populations in Africa and Asia. *Journal of Human Hypertension*, 21: 28–37

The 7th report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC-7) (2004) complete report. National Institutes of Health

Third Report of the National Cholesterol Education Program (NCEP) (2002). Expert Panel on Detection, Evaluation and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III). NIH Publication No. 02-5215.

Touyz, R.M., Sontia, B., (2007) Role of magnesium in hypertension. *Archives of Biochemistry and Biophysics*, 458(1):33–39.

Van der Sande, M.A., Milligan, P.J., Nyan, O.A. (2004). Blood pressure patterns and cardiovascular risk factors in rural and urban Gambian communities. *Journal of Human Hypertension*, 14:489–496

Van de Vijver S, Oti S, Addo J, de Graft-Aikins A, Agyemang C. (2012) Review of community-based interventions for prevention of cardiovascular diseases in low- and middle-income countries. *Ethnicity and Health*, 17(6):651–76.

Whelton S.P., Hyre A.D., Pedersen B., Yi Y., Whelton P.K., He J., (2005). Effect of dietary fibre intake on blood pressure: a meta-analysis of randomized, controlled clinical trials. *Journal of Hypertension*, 23:475-481

Williams B. (2006). The year in hypertension. *Journal of the American College of Cardiology*, 48:1698–1711.

Wilken, J., Tiffany T., Wainwright B., *et al.* (2006) Food Fats and Oils Ninth (Ed) Available from <http://www.iseo.org/foodfats.htm>.

World health organization, world health report (2002) reducing risks, promoting healthy life. Geneva WHO.2002

World Health Organization: (2009). Cardiovascular Diseases Fact Sheet N°317. [Available from <http://www.who.int/mediacentre/factsheets/fs317/en/index.html>]

WHO, (2012). Guideline: Potassium intake for adults and children. Geneva, World Health Organization (WHO), 2012.

WHO (2012) WHO. Guideline: Sodium intake for adults and children. Geneva, World Health Organization (WHO), 2012.

World health organization. (2013) A global brief on Hypertension Silent killer, global public health. Available from www.who.int accessed 03/11/2013

World Health Organization. (2008) Causes of Death 2008 [online database]. www.who.int/healthinfo/global_burden_disease/cod_2008_sources_methods.pdf.)

World Health Organization: (2011) Noncommunicable diseases Country profiles Geneva (Switzerland): WHO available from www.who.int assessed 20 October 2014

World health organization. (2013) A global brief on hypertension silent killer, global public health .available from www.who.int

Wood JD, Enser M, Richardson RI, Whittington FM (2008) Fatty acids in meat and meat products; in Chow CK (ed): *Fatty Acids in Foods and Their Health Implications*. London, CRC Press, 2008, pp 87–107.

Wolanska, D. (2012) Fatty Acids Intake and Serum Lipids Profile in Overweight and Obese Adults. *Rocz Panstw Zakl Hig journals*. 63 (2):155-62.

Zemel, M.B. (2001) Calcium modulation of hypertension and obesity: Mechanisms and implications. *Journal of American college of nutrition*. 20:428–435.

APPENDIX 1

CONSENT FORM

Consent to Participate in Research

I _____, confirm that I have been briefed on the nature of the research and my role as a participant. I understand that the researcher is a student of the Department of Dietetics, of the School of Allied Health Sciences, University of Ghana and this research is the student's dissertation.

Hence, I _____, freely and voluntarily give my consent for the use of my data in this research, with the knowledge that I have the right to withdraw from this research at any point in time without explanations and prejudice. I permit the Department of Dietetics, University of Ghana to use the findings from this research as they deem fit on the condition that my name will be disassociated from the results.

Name of Participant

Date

Signature/ Thumbprint

Name of Witness

Date

Signature /Thumbprint

APPENDIX 2

RESEARCH PARTICIPANT INFORMATION SHEET

Dear Sir/Madam,

I am a graduate student of the Department of Dietetics, School of Allied Health Sciences, University of Ghana. In fulfilment of the requirements to obtain a Master of Science degree in Dietetics, I am undertaking a research on the “Dietary factors associated with hypertension in Asesewa”. The study aims at determining the relationship between diet and hypertension. Your involvement, cooperation and commitment as a participant in this research is very important to the researcher. This participant information sheet seeks to provide information on the nature of the research, procedures, benefits, risks, discomforts, precautions, the expectations of the researcher and ethical considerations, providing grounds for you to make a voluntary, informed decision before participating in the research.

Explanation of Procedure

You will be required to provide information about yourself and your usual food intake. We will also do a physical exam and conduct other procedures including body and blood pressure measurements.

Risks and Discomforts

By agreeing to participate in this research, you are likely to experience some minor inconveniences (delay) during the interview.

Benefits

You will receive some dietary advice on healthy eating after the meeting. Findings of this research will also be used in planning dietary intervention programmes for the Asesewa community, ultimately improving health.

Confidentiality

Your real name or any other data that can be used to trace you will not be used at any point in time during the data collection or in the written report. Your identity as a participant will not be disclosed to unauthorized people. All participants in this research will be given codes as identification.

Withdrawal from project

Your participation in this research is voluntary. You have the right to withdraw from this research at any point in time, for any reason and without prejudice.

Costs for participation

You will incur no costs for participating in this research. You will also not be paid for participation in this research. In the light of the above, I would be grateful if you would complete the informed consent form as a testimony to your voluntary participation in this research.

Rights and Complaints

To clarify any questions concerning the research project, participants can call Esther Appiah on Tel: 0208000972. Questions regarding any rights issues as a person in this research project and in the case of injury due to the project should be directed to the chairman of the Ethics and Protocol Review Committee of the School of Allied Health Sciences, College of Health Sciences, University of Ghana, Tel: 0302687975.

APPENDIX 3

INDIVIDUAL INTERVIEW

CODE

0000/ /2014

Thank you for agreeing to participate in this study. Please be assured

that all answers you provide here will be kept strictly confidential. We ask that you be as honest as possible with your responses.

DEMOGRAPHICS

1. Gender: (1) Female (2) Male

2. What is your age?

3. What is your marital status? (1) single/never married (2) married (3) separated/divorced

(4) Widowed (7) other, specify: _____

4. What is your religion? (1) Traditionalist (2) Moslem (3) Christian

(7) Other, specify: _____

5. What is the highest level of education you have completed?

(1) Post grad/Masters (2) University or college graduate (3) HND

(4) SHS/SSSS (5) Middle School/JHS (6) Primary school or less

6. Are you currently employed? (1) Employed (2) unemployed (3) retired

7. What is/was your main occupation?

8. How many years/months have you lived in this Aseewa? ____ ____ |__

9. What is your approximate household (gross) income/month? _____

GHS

MEDICAL HISTORY

10. Have you been told by a doctor or other health care worker that you have (had) any of the following:

(a) High Blood Pressure (1/0/8) age at diagnosis: _____ take meds? (1/0/8) |__| ____ ____
|__|

(b) Diabetes (1/0/9) age at diagnosis: _____ take insulin? (1/0/8) |__| ____ ____ |__|

(c) Heart disease (1/0/8) age at diagnosis _____ |__| ____ ____

(d) Stroke (1/0/8) age at diagnosis: _____ |__| ____ ____

(e) High cholesterol (1/0/8) age at diagnosis: _____ take meds? (1/0/8) |__| ____ ____ |__|

(f) Cancer (1/0/8) age at diagnosis _____ |__| ____ ____

Type: _____

(g) Arthritis (1/0/8) age at diagnosis: _____ |__| ____ ____

11. Are your parents still alive? a) Mother (1/0/8) |__|

If alive: Did she ever have a) Heart problems b) Lung problems c) Cancer |__| |__| |__|

If dead: Cause _____ age at death ____ ____ ____

b) Father (1/0/8)

If alive: Did she ever have a) Heart problems b) Lung problems c) Cancer

If dead: Cause _____ age at death _____

SMOKING AND DRINKING

12. a. Which best describes your history of tobacco use? (If never, skip to Q 21)

(1) Formerly used (2) Currently use (3) Never used

b. At what age did you start? _____ years _____

c. If former, at what age did you quit? _____ years _____

13. Have you ever regularly used any of the following tobacco products?

a. Cigarettes (yes/no/) If yes, how many per day? _____ _____

b. Pipes/cigars

c. Chewing tobacco (yes/no/) How many times per day? _____

14. Does anyone living with you smoke cigarettes/tobacco regularly? _____

If yes, how many cigarettes per day? _____

15. a. Do you ever drink beer? (1) Yes (0) No

If yes, how often? (0) Rarely (< 1x per month) (1) < 1 day per week

(2) 1-2 days per week (3) 3-6 days per week (4) Every day

About how many drinks per occasion? _____

b. Do you ever drink wine or local wine? (1) Yes (0) No

If yes, how often? (0) Rarely (< 1x per month) (1) < 1 day per week

(2) 1-2 days per week (3) 3-6 days per week (4) Every day

About how many drinks per occasion? _____

c. Do you ever drink hard liquor? (1) Yes (0) No

If yes, how often? (0) Rarely (< 1x per month) (1) < 1 day per week

(2) 1-2 days per week (3) 3-6 days per week (4) Every day

About how many drinks per occasion? _____

d. Have you changed your habit of alcohol consumption in the past five years? (yes/no/)

If yes, how? 1) increased intake 2) decreased intake

e. Overall, how many days per week do you drink any alcohol (0-7)?

f. If you do not drink alcohol now, did you ever drink alcohol regularly?

(1) Yes (0) No (9) Refused

g. IF YES to the above, how long ago did you stop drinking alcohol regularly? _____ years

____|____|

PHYSICAL FUNCTION

16. Do you have difficulty walking 1 kilometer? (0) No (1) Yes

17. Do you have difficulty walking around your home? (0) No (1) Yes

18. Do you have difficulty getting out of a bed or chair? (0) No (1) Yes

19. Do you have difficulty walking up 10 steps? (0) No (1) Yes

20. Because of health or physical problems, do you have any difficulty or are you unable to.....

a. ...do heavy housework like scrubbing and washing, (0) No (1) Yes

b....do light housework?..... (0) No (1) Yes

c... shop for personal items?..... (0) No (1) Yes

FOR WOMEN ONLY

21. Are you still having monthly periods?

(0) No (1) Yes, but irregularly (2) Yes, as usual

22. At what age did you begin having your period? _____ years _____

23. Have you ever been pregnant? (0) No (1) Yes

If yes: a. Number of pregnancies: _____

b. Number of live births: _____

c. If live births: At what age did you have your first child? _____ years _____

d. How many children have you had surviving five years and beyond? _____

24. If pre-menopausal, are you currently using oral contraceptives (OCP) or Depo? (yes/no/)

If yes, for how many years have you been taking it (total) _____

25. If post-menopausal: How old were you when your periods stopped completely? __

years_____

DIETARY QUESTIONNAIRE

26. How many times do you eat in one day? _____

27. Do you take any special foods for your health? (1) Yes (0) No

If Yes: a) Garlic.....

b) Moringa.....

c) Dandelion.....

d) Other:_____

28. Do you take any nutritional supplements?

(1) Yes (0) No

29. How many times in a week do you usually eat away from home? _____

30. a. Are you currently a vegetarian (no meat, poultry or fish)?

(1) Yes (0) No (8) Unknown/Ref

b. If yes, since what age? (0) Birth or _____ years of age _____

APPENDIX 4

FOOD FREQUENCY QUESTIONNAIRE

Food Item	5-7x/ Week	1-4x/ Week	2-3x/ Week	1-2x/ Month	Seldom/Never
Cereals and Grains					
Polished Rice					
Wheat					
Maize					
Millet					
Guinea corn					
sorghum					
Others					
Starchy Root And					
Plantain					
Gari					
Yam					
Cocoyam					
Cassava					
Plantain					
Potato					

Food Item	5-7x/ Week	1-4x/ Week	2-3x/ Week	1-2x/ Month	Seldom/Never
Legumes/oilseeds/nuts					
Beans					
Groundnut					
Nerri					
Agushie					
Palm nut					
Other					
Fruits					
Citrus					
Mangoes					
Water melon					
Pawpaw					
Pineapple					
Coconut					
Pear					
others					
Vegetables					
Okro					
Onion					

Food Item	5-7x/ Week	1-4x/ Week	2-3x/ Week	1-2x/ Month	Seldom/Never
Garden eggs					
Turkey berries (bedru)					
Tomato					
Kontomire					
Bokoboko					
Bitter leaf					
Beans leaf/cassava leaves					
Cabbage					
Lettuce					
Carrot					
Green pepper					
Dandelion					
Animal and animal Products					
Milk - whole					
Milk - low fat					
Cheese					
Yogurt					

Food Item	5-7x/ Week	1-4x/ Week	2-3x/ Week	1-2x/ Month	Seldom/Never
Burkina					
Mutton					
Chicken					
Fish					
Pork					
Goat meat					
Game					
Crab					
Lobster					
Oyster					
Snail					
shrimp					
Beverages					
Carbonated cold drinks					
Coffee					
Tea					

Food Item	5-7x/ Week	1-4x/ Week	2-3x/ Week	1-2x/ Month	Seldom/Never
Hard liquor					
Other					
Processed food items					
Readymade snacks					
Canned Foods					
Nuts, Dried fruits					
Fats /Oil					
Butter/Margarine					
Sunflower oil					
Palm oil					
Coconut oil					
Palm kernel oil					
Deep Fried Foods					
kalawele					
Fried yam					
Fried cocoyam					
Koose					
Maasa					

APPENDIX 5

ETHICAL CLEARANCE FORM

**SCHOOL OF ALLIED HEALTH SCIENCES
COLLEGE OF HEALTH SCIENCES
UNIVERSITY OF GHANA
ACADEMIC AFFAIRS**

Phone: +233-0302-687974/5
Fax: +233-0302-688291

My Ref. No. SAHS/ 10396745
Your Ref. No.



P. O .Box KB 143
Korle Bu
Accra
Ghana

11th July, 2014.

Ms. Esther Appiah-Yeboah,
Dept. of Dietetics,
SAHS,
Korle Bu.

Dear Ms. Appiah-Yeboah,

ETHICS CLEARANCE

Ethics Identification Number: SAHS – ET. /10396745/AA/11A/2013-2014.

Following a meeting of the Ethics and Protocol Review Committee of the School of Allied Health Sciences held on Monday 24th March, 2014, I write on behalf of the Committee to approve your research proposal as follows:

TITLE OF RESEARCH PROPOSAL: “Dietary Factors Associated with Hypertension among Adults in Aseewa”

This approval requires that you submit six-monthly review reports of the protocol to the Committee and a final full review to the Committee on completion of the research. The Committee may observe the procedures and records of the research during and after implementation.

Please note that any significant modification of the research must be submitted to the Committee for review and approval before its implementation.

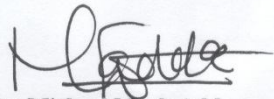
You are required to report all serious adverse events related to this research to the Committee within seven (7) days verbally and fourteen (14) days in writing.

As part of the review process, it is the Committee’s duty to review the ethical aspects of any manuscript that may be produced from this research. You will therefore, be required to furnish the Committee with any manuscript for publication.

Please always quote the ethical identification number in all future correspondence in relation to this protocol.

Thank you.

Yours sincerely,



Dr. Michael Mark Addae
(Chairman, Ethics and Protocol Review Committee)

cc Dean
Co-ordinator/HoD, Dept. of Dietetics
Senior Assistant Registrar