Master of Global Health Program 2018-2019

Prevalence of Hypertension, Obesity, and Diabetes in Rural Ghana: a cross-sectional study in the Birim central district of Ghana.

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Executive Summary

Background: Non-communicable diseases are gradually on the rise in sub-Saharan Africa. The situation is even more worrying as the burden of communicable diseases being the major cause of death still exist in this region. Ghana has not been an exception to the increasing prevalence of non-communicable diseases. Despite the alarming public health burden, data on the prevalence and determinants of these diseases are scanty, especially for rural communities.

Aims/Objectives: The aim of this study is to assess the prevalence of hypertension, type 2 diabetes, and obesity in the Birim Central District of Ghana and to assess the possible relationship between socio-economic factors and these non-communicable diseases.

Methods: This a cross-sectional survey that was conducted on 844 adults aged ≥ 18 residing in the Birim Central District of Ghana in August 2018. Information on socio-demographic characteristics, health behavior and medical history were collected using structured questionnaires. Physical measurements including blood pressure, fasting blood glucose, and anthropometric measurements were collected using standardized procedures.

Results: The median systolic blood pressure was 124 mmHg and 77 mmHg for diastolic blood pressure. Median blood glucose was 4.9mmol/L and the median body mass index was 23.1 kg/m2. The prevalence of hypertension in men and women was 13.5 % and 17.0%, respectively. 59.9% of men and 56.4% of women were pre-hypertensive. Type 2 diabetes was 7.2% prevalent among men and 6.8% among women. 13.4% of men and 11.3% of women recorded impaired fasting glucose values. Obesity was 6.9% prevalent among men and 6.1% among women. Older age, alcohol, non-manual work, smoking and overweight or obesity were associated with type 2 diabetes and hypertension. Our findings showed that manual work was a protective factor for hypertension.

Conclusion: Context-specific and community-based intervention programmes in a multisectoral approach are crucially needed to increase the awareness, prevention, and control of non-communicable diseases.

Keywords: Non-communicable diseases, cardiovascular diseases, hypertension, diabetes, obesity, rural Ghana, socio-economic factors, education, occupation.

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LIST OF ABBREVIATIONS

AHA	American Heart Association
BGL	Blood glucose level
BMI	Body mass index
BP	Blood pressure
BMI	Body mass index
BGL	Blood glucose level
CVA	Cerebrovascular accident
CVD	Cardiovascular diseases
DALYs	Disability-adjusted life years
DBP	Diastolic blood pressure
FBG	Fasting blood glucose
FPG	Fasting plasma glucose
GBD	Global Burden of Disease
GDP	Gross domestic product
HbA1C	Glycated hemoglobin
HIC	High-income countries
LMIC	Low- and middle-income countries
NCD	Non-communicable disease
OR	Odds ratio
OGTT	Oral glucose tolerance test
SBP	Systolic blood pressure
SDG	Sustainable development goals
SES	Socio-economic status
SEP	Socio-economic position
SSA	Sub-Saharan Africa
T2D	Type 2 Diabetes
WHO	World Health Organization
WHR	Waist-to-hip ratio

1. INTRODUCTION

1.1. The surging rise of non-communicable diseases

The increasing number of deaths associated with non-communicable diseases (NCDs) has become a major public health concern. Globally, NCDs account for 41 million mortalities representing 71% of all deaths annually(1) and loss of 54% of healthy years calculated by the disability-adjusted life years (DALYs)(2). Every year, 63% of deaths of adults aged between 30-70 can be attributed to NCDs with almost 90% of these premature deaths occurring in low and middle-income countries (LMICs)(3). According to the World Health Organization (WHO), cardiovascular diseases (CVDs) like heart attacks and cerebrovascular accidents (CVA), along with cancers, chronic respiratory diseases and diabetes top the list of NCDs(4). The WHO prognosticates that deaths from NCDs alone in Africa will rise to 3.9 million by 2020(5). The rapid population growth rate at an average of 2.7%(6) makes the challenge even more complex with the countries in this region lacking the needed capacity to maintain and promote health.

Tobacco use, unhealthy diet, lack of physical activity, air pollution and alcohol use have been identified as the key modifiable risk factors fueling the surging rise of NCDs(3). The recent Global Burden of Disease Study (GBD) shows that majority of the 195 countries covered will not attain the Sustainable Development Goal (SDG) 3.4 for reducing by a third, deaths associated with NCDs(7). Knowing the important roles that NCDs play in national development and the possible future challenges, the United Nations (UN) held a high-level meeting in September 2018 for member states to reaffirm their commitment to the beating NCDs, implement WHO-recommended policies and accelerate responses now and for the future(8).

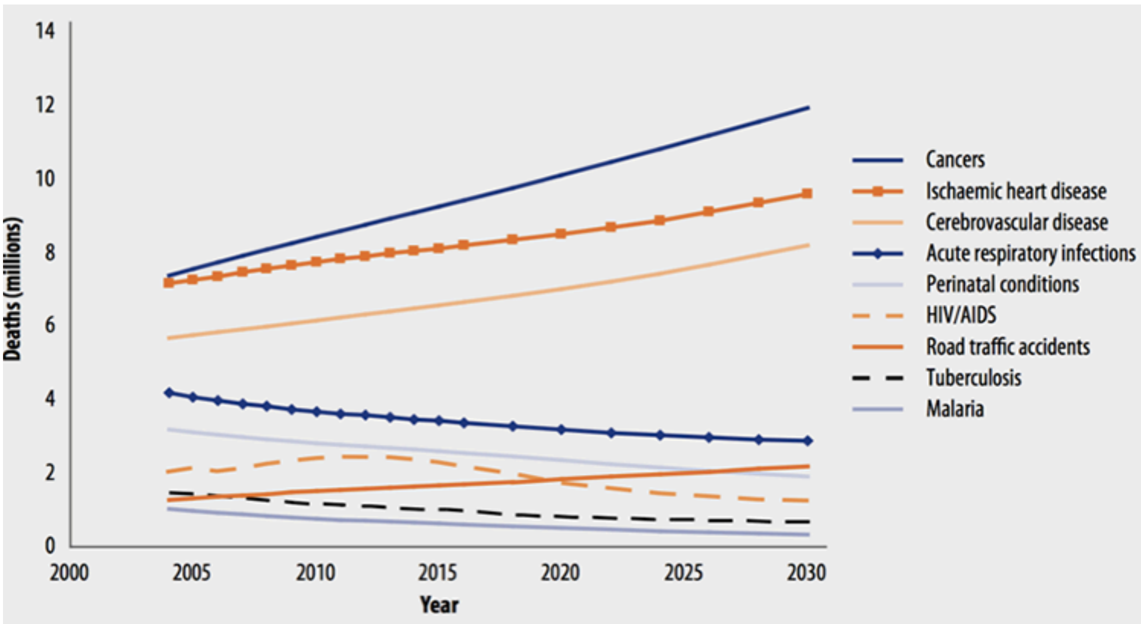


Figure 1. Projected global deaths for selected causes, 2004-2030. Global Burden of Disease. World Health Organization. Source: http://www.who.int/healthinfo/global_burden_disease/GBD_report_2004update_full.pdf?ua=1 Accessed February 1, 2019.

1.2. Global cost of non-communicable diseases

NCDs and their associated complications incur huge economic losses for the people who suffer from these diseases, their families, national health systems and the economies of the countries they live in through healthcare expenditure and inability to work. The long duration of expensive medical care diverts the restricted financial resources of families and the society at large. The economic burden of NCDs in 2010 was estimated at USD47 trillion between 2010 and 2030 (measured in real USD at base year 2010) which is equal to 75% of the global gross domestic product (GDP)(9,10). The cost of CVDs in LMICs alone was USD 3.76 trillion(11).

1.3. A global health overview of hypertension, obesity and diabetes

1.3.1 Hypertension

Hypertension (HTN) is an elevation of blood pressure. The WHO defines HTN as systolic blood pressure (SBP) is equal to or above 140 mm Hg and/or a diastolic blood pressure (DBP) equal to or above 90 mm Hg(12). The updated guidelines of the American Heart Association (AHA) even has a stricter definition at 130/80mm Hg or higher(13). Uncontrolled HTN has been identified as a key driver for CVAs, CVDs, renal diseases, premature mortality and morbidity(13–15). As at 2015, there was an estimated 900 million adults aged 25 years and older diagnosed with HTN(16).

There are major disparities with the distribution of the burden of HTN among low, middle, and high-income countries and even racially(17,18). While most high-income countries have seen a decline in the prevalence of HTN, same cannot be said about developing countries in Sub-Saharan Africa (SSA) and South East Asia. The decline in the countries that belong to the former have been attributed to the presence of robust public health policies like a decrease in salt quantity in processed foods, increase in awareness of HTN and effective case management(11,19).

HTN has seen a steady rise in SSA, (20,21) and a study suggests that the risk of developing renal diseases and CVDs as complications of HTN are more likely among black people (18). The danger of HTN is the fact that despite the associated threatening complications, there are no clear physiological symptoms of the condition; making self-monitoring or regular medical check-up very important for early detection and control.

BLOOD PRESSURE CATEGORY	SYSTOLIC mm Hg (upper number)		DIASTOLIC mm Hg (lower number)
NORMAL	LESS THAN 120	and	LESS THAN 80
ELEVATED	120 – 129	and	LESS THAN 80
HIGH BLOOD PRESSURE (HYPERTENSION) STAGE 1	130 – 139	or	80 – 89
HIGH BLOOD PRESSURE (HYPERTENSION) STAGE 2	140 OR HIGHER	or	90 OR HIGHER
HYPERTENSIVE CRISIS (consult your doctor immediately)	HIGHER THAN 180	and/or	HIGHER THAN 120

Figure 2: Blood Pressure categories by the American heart Association. Source: https://www.heart.org/en/health-topics/high-blood-pressure/understanding-blood-pressure-readings. Accessed February 1, 2019.

1.3.2. Obesity

Overweight and obesity refers to an excessive accumulation of body fat. Obesity has been identified as a vital risk factor for varying non-communicable diseases including CVDs, diabetes, cancers, and chronic pulmonary diseases(22). Obesity in the earlier days was very common to the rich high-income countries but, there has been a shift to the countries which were then considered poor and currently belong to LMICs(23). The rise in the prevalence of obesity in LMICs has generally been as a result of the rapid industrialization in these countries and the adaptation of sedentary lifestyles as they improve economically.

Body Mass Index (BMI) calculated as weight in kilograms divided by height in meters squared has widely been used to classify underweight, normal weight, overweight and obesity in adults(24). The WHO estimated that there are over 1.9 billion representing 39% of the total global adult populace aged 18 and above are overweight and obese. About 650 million of these adults were obese. The prevalence of obesity has been seen almost tripled between 1975 and 2016(24). Obesity accounted for 4 million deaths globally with 40% occurring in people who were overweight but not obese(25). Fighting obesity has been very challenging for public health experts. It has been difficult to tell if the current policies are making expected impacts because as at 2013, no national success had been recorded worldwide(26).

1.3.3. Diabetes

The WHO describes diabetes as "a chronic, metabolic disease characterized by elevated levels of blood glucose (or blood sugar), which leads over time to serious damage to the heart, blood vessels, eyes, kidneys, and nerves"(27). It is a very worrying chronic diseases that usually demands a lifetime therapy(28). When diabetes is poorly controlled, it leads to severe conditions and disabilities including, blindness, kidney failure, dementia, angina, heart attacks, peripheral artery diseases and neuropathy, and death(27,29). Diabetes is generally categorized into 3 groups. Type 1 diabetes which usually starts right from childhood and require routine insulin therapy. Type 2 diabetes (T2D) is the commonest form of diabetes(30). T2D is usually as a result of lack of physical activity and accumulation of excess body weight. People with T2D are at a greater risk of developing complications if not controlled properly. Gestational diabetes, the third type, is having high blood glucose levels (BGL) but blow a level diagnostic of diabetes during pregnancy(27).

Studies have proven that good glycemic control potentially reduces the onset of diabetes complications including CVDs, retinopathies, neuropathies and renal failure(31,32). This subsequently will lead to decline in the chances of leg amputations due to peripheral neuropathy and expensive treatment options like dialysis or kidney transplant for renal failure. About 425 million adults aged between 20 to 79 years are living with diabetes(33). This number is expected to rise up to 625 million by 2040(34). 50% of people living with diabetes did not know they had the condition. Diabetes has affected people disproportionately as 79% of adults with diabetes live in LMICs. In 2017, diabetes was responsible for 4 million deaths(33). Low-income countries are expected to suffer more from diabetes deaths as 73% of all deaths occurred in people under 60 years of age; the working age expected to boost these countries' economic development(34).

The most well-known underlying causes of diabetes are lifestyle related such as a diet high in sugar and carbohydrates and lack of physical activity. But some of these "lifestyle choices" are influenced by other factors. Some people choose to diet unhealthily because food and drinks high in sugar are more available, cheaper or more attractive. A lack of a reliable food source, termed "food insecurity", increases your risk of diabetes complications as people are more likely to choose cheaper and less healthy options(35).

Diagnosis of diabetes is based on fasting plasma glucose (FPG) test, the 2- hour plasma glucose level after 75g oral glucose tolerance test (OGTT)(28). The gold standard diagnostic testing available for diabetes is the glycated hemoglobin (HbA1C) test(28). The WHO "Global report on diabetes" highlighted an intersectoral approach and recommended national government policies in an integrated action to combat NCDs including Diabetes(36).

1.4. Risk factors of Hypertension, Obesity and Type 2 Diabetes

Risk factors of non-communicable diseases are grouped into modifiable and non-modifiable. Modifiable risk factors are the ones you can effectively control with lifestyle changes. Non-modifiable risk factors are those that you cannot change.

1.4.1. Non-modifiable risk factors

Age

Age is a known non-modifiable risk factors for many NCDs including HTN and T2D with increasing age making chances of NCDs higher (37,38). The presence of better medications including antibiotics and vaccinations, stronger health systems and increase in income have all contributed to the increased life expectancy and hence the growing ageing population. This predicts that the NCDs like HTN, obesity, and T2D will also rise steadily with the proven association between age and these diseases. Studies have shown that SBP increased steadily between 1990 to 2015(38).

Gender

Whilst the non-modifiable risk factor age is associated with members of both gender groups, gender itself is also a risk factor for HTN, obesity, and T2D. Prevalence of major risk factors for NCDs have been reported to be higher in men than in women(37). Prevalence and deaths associated with NCDs are been reported to be higher in men than women of same age groups(39,40). Reports from a meta-analysis shows that the prevalence of HTN in women is expected to rise by 2025 with countries like India prospected to have a higher prevalence in women than men (41).

Family history

An eminent family history of HTN, obesity, and T2D could be a non-modifiable risk factor for these NCDs. Parents or close relations suffering from HTN, obesity, and T2D increases chances of developing these diseases. Studies have proven the connection of positive family history and CVDs and diabetes(42,43). A person who has one or more first-degree relatives with diabetes is 2 to 6 times likely to develop the disease comparing with someone who has no relatives with the disease(44). The family history as a non-modifiable risk factor for HTN, obesity, and T2D has been hugely attributed to the genetic components of the diseases.

1.4.2. Modifiable risk factors

Regardless of the notable evidence of how non-modifiable risk factors advances chances of developing HTN, obesity, and T2D, it is important to note that the genetic predisposition, age, and gender alone cannot be blamed for the escalating steady increase in the prevalence and mortality rates of NCDs. Environmental factors and unhealthy lifestyle choices have played a more dominant role in the current situation. In a study in Beijing, mortality rates for CVDs increased by 50 % in men and 27% in women despite adjusting for age(45). The results from a prospective cohort study among women from Sweden between the ages of 49 and 83 showed a 54% reduction in CVA risk among women with a low risk lifestyle (being physically active, not smoking, moderate alcohol consumption and healthy diet) than those with high risk lifestyles(46). These findings prove the important seat modifiable risk factors have taken on the NCDs table. Lack of physical activity, excessive consumption of alcohol, tobacco smoking and poor dieting are the main modifiable risk factors for HTN, obesity, and T2D. Despite these diseases having different clinical etiologies and pathophysiology, their risk factors remain very similar.

Alcohol

Alcohol consumption has been linked to NCDs including HTN, obesity, and T2D(47–49). Annually, 3 million deaths result from excessive use of alcohol(48). Aside its relevance in the NCDs arena, excessive alcohol consumption has been linked to some infectious diseases, violence and there is evidence on how the addiction affects individuals and societies socioeconomically(48). Years back, it was common for people from developing countries to take alcohol only occasionally, but, the current existence of industrial alcoholic beverages has led to excessive drinking. Excessive alcohol consumption has caused financial loss to individuals and societies(50). With alcohol consumption on the rise in developing countries(50), the repercussions of a higher prevalence of NCDs like HTN, obesity, and T2D and their associated economic loss could be more fatal for these countries. The prevalence of alcohol consumption in the African region stands at 40.2% in men and 19.6% in women(51) with the RODAM study among Ghanaians in 2016 reporting similar results(52).

Unhealthy diet

Healthy diet decreases the risk of HTN, obesity, and T2D(53,54). A healthy diet means reducing fats, sugar, salt, and carbohydrates intake, and, eating more fruits and vegetables. Every country is affected by the negative effects of unhealthy eating(55). The importance of healthy diet in achieving the NCD reduction targets is emphasized in the SDG 2.2 which aims at ending all forms of malnutrition by 2030(56). Different studies have suggested the relationship between salt and hypertension with a minimal reduction in salt intake decreasing BP considerably and hence delaying the onset of HTN and CVD(57–59). WHO recommends reduction of dietary salts as an important action in curbing the surging rise of NCDS including HTN, CVDs, and CVAs. Research reports have been contradictory on the direct effect of carbohydrates in the development of T2D, but the effect of sugar is clear hence the reason why it is employed in the OGTT for diabetes. With this background, honey has been suggested a replacement of sugars in diets for diabetics in recent studies(60). Understanding the importance of dieting in the prevention of NCDs among the high risk populations, countries like Spain has adopted the Mediterranean diet which has proven to be effective in preventing CVD occurrence(61). Quality diet should also contain enough fruits and vegetables(62). Dietary patterns in developing countries like Ghana are changing from the traditional foods to a more westernized pattern. The unhealthy diet patterns is as a result of food environments in LMIC transitioning to look more like those in high income countries (HIC)(63).

Physical activity

Lack of physical activity increases the risk of NCDs like CVD, T2D, and obesity (64–67). Across the globe, 23% of adults and 81% of adolescents have failed to meet WHO recommended levels of physical activity(68). The rising prevalence of physical inactivity in different geographical locations have been hugely blamed on the preference of motor vehicles to walking and cycling, air pollution, violence in some areas, lack of sidewalks and facilities to encourage sports and recreation(68). Countries are putting in place national policies to encourage physical activity but not in LMICs where the prevalence of NCDs is on the rise(69). In studies in Ghana, the prevalence of low physical activity was 25.7% (70) with 10% of adults being obese and 77.6% having a high waist-to-hip ratio (WHR).

Tobacco smoking

Undeterred by the number of deaths associated with the use of tobacco, it remains generally legal. In 2015, an estimated 1.1 billion people used tobacco(71). Tobacco smoking is responsible for 7 million deaths annually(72). 890,000 of mortalities from tobacco smoking are non-smokers who died as a result of second-hand smoking(72). Out of the 1.1 billion tobacco smokers worldwide, 80% reside in LMICs. Even though this heath problem is declining globally, the WHO Eastern Mediterranean Region and the African Region have recorded increasing prevalence(71). The prevalence of tobacco smoking in 2010 in the WHO African region was 12.8% and it is expected to increase to 18.1% by 2025(71). Tobacco control has been identified as very relevant in making progress in reduction of the rapidly increasing prevalence of NCDs(73–75). There is enough and strong evidence on the effect of tobacco smoking on the health of the population hence, the World Health Assembly adopted the Framework Convention on Tobacco Control which came into effect in 2005(76). 90% of the UN members signed this treaty but its implementation has been uneven(77). According to the Demographic Health Survey from Ghana, 6.3% of males and 0.4% of females aged between 15 to 49 smoke tobacco(78). About 7000 people die annually in Ghana as a result of smoking-related causes(79).

1.5. Socio-economic factors and non-communicable diseases

There is a well understood relationship between health and socio-economic status (SES)(80–82). Individuals who belong to the lower SES are more liable to unhealthy lifestyle choices like poor diets, harmful alcohol use and tobacco smoking(83) and hence have higher risks of developing NCDs. Before the epidemiological transition, these unhealthy health behaviors were associated with individuals in higher socio-economic positions (SEP) (84). The association between SES and NCDs is poorly understood in rural contexts as it is difficult to clearly see how much the epidemiological transition has affected these areas and also, how to define the different SEPs.

1.6. Problem statement

Ghana is experiencing a surging rise in the prevalence of HTN, obesity, and T2D. T2D and HTN alone accounted for 761 551 outpatient department cases representing 3.4% of all cases in 2016(85). The two diseases and their major complication, CVA, accounted for 1408 deaths in Ghana in the year 2016 representing 11% of all causes of mortality(85). The already overly-stretched health systems and a bad doctor-to-patient ratio at 1:8481(85) could mean that the rural communities, where doctors are lacking, will suffer most of the burden. The prevalence of HTN, obesity, and T2D, and their association between socioeconomic factors has not yet been studied in the Birim central district, and therefore no data is yet available. Understanding the magnitude of these diseases and possible relationship with SES will provide insights in designing effective preventive and control interventions in the future.

2. OBJECTIVES

2.1. General Objective

The main aim of this study is to evaluate the prevalence of type 2 diabetes, obesity and hypertension among inhabitants of the Birim central district, Ghana. Additionally, this study aims to assess the possible relationship between socio-economic factors and type 2 diabetes, obesity, and hypertension.

2.2. Specific Objectives

- To determine the prevalence of type 2 diabetes by measuring fasting blood glucose levels.
- To determine the prevalence of obesity using body mass index.
- To determine the prevalence of hypertension by measuring blood pressure levels in sitting position.
- To determine the association between socio-economic factors, and type 2 diabetes, obesity and hypertension.

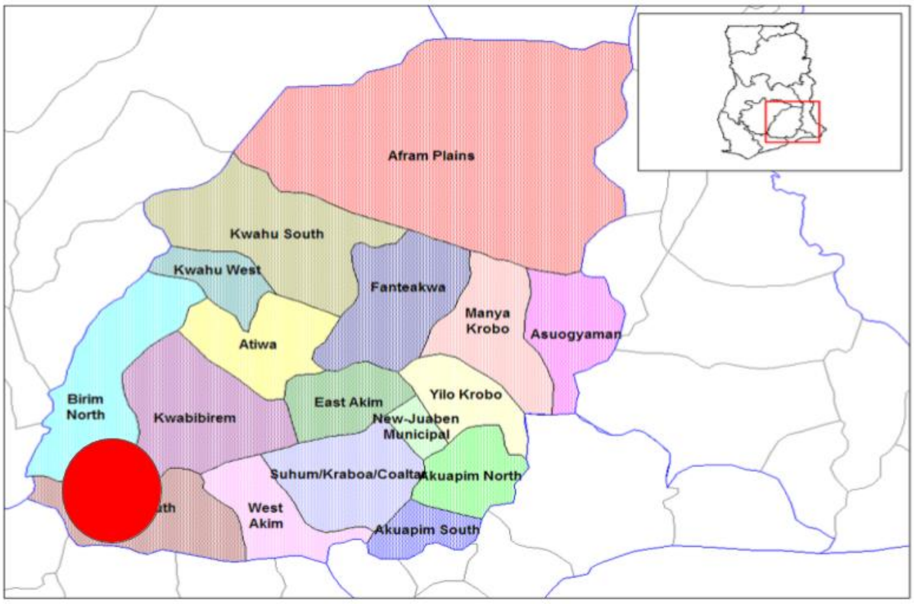
3. METHODS

3.1. Study design

A cross-sectional survey was conducted on 844 adults aged ≥ 18 residing in 5 different communities of the Birim central district in Ghana conducted in August 2018 under the DoctorsAct medical missions under the supervision of the Ghana Health Service directorate.

3.2. Study population

The Birim Central District is in the Eastern Region of Ghana. Akim Oda is the capital town of this district. It has a total land area of 1,090 km2. According to 2010 Population and Housing census of Ghana, the district has an estimated population of 144,869. Males constitute 47.1% of the population with the remaining being females. The district has a relatively lower number of elderly people at 6.9%. The total fertility rate of the district is 3.1% with a crude death rate at 6.7 per a 1000 population. 64% of the total population have access to electricity as a source of power with 23.3% using kerosene as their source of light. The economic activities of the district are predominantly agriculture (50.9%), trade and commerce (20.1%) with the remaining involved in services and industry(86).



Birim Central Municipality showed on the Map of Ghana and Eastern Region. Source: Birimcentral.ghanadistricts.gov.gh. Retrieved 29 March 2019, from http://birimcentral.ghanadistricts.gov.gh/

3.2.1. Recruitment of study participants

The study engaged the Community Hospital in the district and traditional and political community leaders to pre-inform members of the selected communities about the study. Convenience sampling was used as participants who came to the project centers were recruited for the study.

Inclusion criteria

1. Identifies as an inhabitant of the study area.
2. 18 years or more.
3. Able to give oral and written informed consent.

Exclusion criteria

1. Serious medical condition including myocardial infarction, congestive cardiac failure, and renal diseases likely to hinder accurate measurement of variables.
2. Pregnant or nursing within past 6 months.
3. Psychiatric hospitalization in last year.
4. Living outside the district.
5. Food or alcohol in the past 6 hours.

3.2.2. Data Collection

Data collection was carried out by doctors and nurses who were part of the DoctorsAct team. After training, they conducted face-to-face interviews with eligible participants. All eligible participants were given a detailed information about the project objectives and were enrolled after they have consented orally. Socio-demographic characteristics, modifiable and non-modifiable risk factors were collected using structured questionnaires. Physical measurements including fasting blood sugar (FBS), height and weight which was used to calculate BMI, and an average of two BP levels measured 15 minutes apart was recorded and used for analysis. The total time of the interviews, including clinical measurements varied from 30 to 45 minutes.

3.2.3. Sample size calculation

Sample size was estimated using "Raosoft" sample size calculator software (http://www.raosoft.com/samplesize.html). Out of the calculation with 5% margin of error and 95% confidence interval, the approximated sample size needed for the study in this population will be 384. This makes our sample size of 844 a powered enough for the analysis.

3.2.4. Measures

The structured questionnaires included information on the sociodemographic characteristics such as age, gender, education level, marital status, number of children, and occupation. We also collected data on medical history including possession on active national health insurance, family history of hypertension and diabetes, and known clinical history of hypertension and diabetes. Additionally, we collected anthropometric data such as height and weight, and measured BP and fasting blood glucose (FBG). We also took information health behavior including alcohol intake and smoking.

3.3. Outcome variables

Weight was measured in light clothing and without shoes with Omron digital scales in kg. Height was also measured without shoes to the nearest 1.0 cm. BMI was be calculated as weight in kilograms (kg) divided by height in meters squared (m2). Overweight and obesity were defined as BMI ≥ 25 to 30 kg/m2 and ≥30 kg/m2 respectively. Fasting blood glucose was measured with OneTouch ultra-glucometers. WHO diagnostic criteria of fasting glucose ≥7.0 mmol/L, or reported current use of medication prescribed to treat diabetes, or self-reported diabetes was used to determine the presence of diabetes(87). We measured blood pressure two times in comfortable sitting position with Omron M3 digital BP measuring machine with appropriate cuffs. We ensured participants had been sitting in resting position for 15 minutes which we used to engage them in answering the questionnaires. The definition of HTN was SBP of 140 mm Hg or higher and/or a DBP equal to or above 90 mm Hg(12) or on hypertensive medication.

Socioeconomic status

SES was determined by gathering data on self-reported educational level and occupation.

Education: Participants reported the highest level of education completed. We categorized the levels of education completed into 'no formal schooling' for those who have not attended any form of school, 'basic' for those having at least one year to nine years of formal schooling (primary and junior high school in local contexts), 'secondary' for those who have completed or began senior high school, "vocational" for those who have learned a trade or skill in a technical or vocational school upon completing senior or junior high school and "higher" for those who have started or completed any form of tertiary education.

Occupation: Occupation was categorized according to the International Standard Classification of Occupations scheme (ISCO-08) classified as 'non-manual' (professionals, managers, clerical support staff, higher grade routine non-manual employees service and sales-related occupations) and 'manual' (craft and related trades workers, elementary occupations and farmers)(88). Students were classified as such, and for those who reported that they were retired, unable to work and unemployed, we categorized 'unemployed (non-students)'.

Health behavior

Alcohol consumption: Information on alcohol intake was collected on those who identify as never, current and former heavy drinkers. Heavy drinkers were those having five standard drinks or more, per week.

Tobacco smoking: Information in smoking history was collected to identify those who never, current, and former smokers. To identify those who were current users, self-reported information on either smoking or using smokeless tobacco products in the past 30 days was asked. For those using tobacco products in the past, it meant before the last 30 days. Those who said they never have used tobacco products were considered never smokers or never used smokeless tobacco products.

Hypertension and Diabetes history, awareness and treatment

Self-reported questions were asked to identify the participants HTN history and history among close family relatives (parents and siblings).

3.4. Pre-testing of questionnaire

The questionnaire was tested by the principal investigator and research team at the Community Hospital, Oda out-patients department. Local healthcare workers were present to make sure the questions are asked in a suitable and polite way. 10 random patients were selected after consenting to participate in the testing. The data and identifiers were not kept.

3.5. Statistical analysis

Normal distribution of the quantitative variables was evaluated using histogram and Q-Q plots. Descriptive statistics of sociodemographic information, health behavior, and medical history was summarized. The means and standard deviations were calculated for normally distributed continuous variables, and medians with 25 and 75 percentiles for continuous variables with non-normal distribution. Numbers and percentages were calculated for categorical variables. To assess the prevalence of HTN, Obesity, and T2D, we measured proportions with 95% confidence Intervals. We used bar chats to graphically represent prevalence of HTN, obesity, and T2D across different age groups and sex. To Identify the association between socioeconomic factors HTN, Obesity, and T2D, we first tested their bivariate relationship by means of Pearson’s chi-square test or Fisher’s exact test (where cells had 4 or less observations) for categorical variables, and Students' t-test for continuous variables with normal distribution and Kruskal Wallis test for continuous variables with non-normal distribution. Secondly, we built a multivariable logistic regression model (one per outcome variable) in which all factors who had exhibited an association with p-value of 0.1 or less in the bivariable analysis were included. Stata IC 15 database management and statistical packages was used for the analysis. A p-value of less than or equal to 0.05 was considered statistically significant.

3.6. Ethics

This study complies with national and international laws and regulations on ethical issues (Law 14/2007 of July 3 of Biomedical Research; Declaration of Helsinki and Tokyo) adapted to the current regulations. National regulations on personal data protection was implemented to guarantee the highest standards in personal data management. All participants were informed verbally of their participation in the project. The project was approved and fully supervised by the District Health Directorate under the auspices of the Ghana Health Service.

Informed Consent Forms

The study team was responsible for obtaining informed consent as they were present in all sites of the project. The study team members had a strong understanding of the context in which health programs take place and administering surveys in rural settings. The interviewer read and reviewed the oral conscript with the potential participant and answer any questions he or she may have. Informed Consent was administered in English, which is the official language and is widely spoken by Ghanaians but interpretation in the local language "Twi" was offered for better understanding. Any participant who did not feel comfortable participating was allowed to redraw at any time.

Data management

Adequate measures to ensure personal data protection and confidentiality was taken. Data entry was performed as soon as possible after receipt of forms. Double-entry method was used to ensure accuracy of values. Web based data entry systems were employed, cross checked and protected with passwords accessible only to principal investigators.

4. RESULTS

4.1. Descriptive Characteristics of Study Participants by Sex

A total of 844 participants took part in the study comprising of 525 women and 319 men. Table 1 presents the demographic characteristics, socioeconomic variables, lifestyle characteristics, and physical measurements by sex. The mean age at baseline was 54 years in both sexes. Regarding socio-economic characteristics, 16.8% were single (never married), 49.5% were married, 9.6% had divorced and 24.1% were widow(er)s. Marital status was significantly different between men and women (*p*-value of 0.031). The median number of children was 4 in both sexes. 68.8% of the study population were actively registered on the national health insurance scheme (NHIS). 70.7% of female study participants were actively registered on the scheme whilst, it was 65.7% for male participants.

In comparison with men, women had lower education levels (*p*-value of <0.001). 18.1% of female study participants had no formal education and only 4.2% had received higher education. In male participants, only 4.1% had no formal education. 11.7% of male participants had received higher education.

In the overall population, 5.3% were students, 25.8% were unemployed (non-students), 57% were manual workers and 11.9% were non-manual workers. There was a significant difference in terms of occupation between men and women in the study population (*p*-value 0.012). 5.6% of the male study participants were currently studying whilst it was 5.1 among female counterparts. 19.4% of males were unemployed (non-students) and 29.7% of females belonged to this group. 61.8% of the men in the study population were involved in manual work, and it was 54.1% for women. 13.2% of male and 11.1% of female participants were involved in non-manual work.

Comparing lifestyle characteristics according to sex, 10.4% of women had a history of using alcohol whilst 34.5% of men had used alcohol. Tobacco smoking among males was 16.6% and only 4.4% among female study participants. A total of 21.8% of participants had been told by a healthcare provider that they had an elevated blood pressure and 12.3% had been told about diabetes. 34.4% of participants had a family history of hypertension and 22% reported a family history of diabetes.

The median BMI in both sexes was 23kg/m^2. Overweight (BMI of 25.0-29.9 kg/m^2) was recorded in 20.1% of men and 21.4% of women. 6.9% of male participants and 5.9% of females were obese (≥30.0 kg/m^2).

The median fasting blood glucose was 4.9mmol/L in the population. This was 5.1mmol/L in males and 4.9mmol/L in females. 17.0% of males had an impaired fasting glycemia

(5.6- – 6.9mmol/L) and this was 13.0mmol/L in females. 6.6% of males and 6.5% of females were diabetic per our definition of fasting blood glucose of 7.0mmol/L and above.

The median systolic blood pressure in males was 123 mm Hg and 124 mmHg in females. A high proportion of the population recorded a blood pressure between 120- and 139- mm Hg (pre-hypertension); 58.9% of males were pre-hypertensive and 59.7% of females belonged to this category. 7.2% of males recorded systolic blood pressure between 140 to 159 mmHg (stage 1 hypertension) with 4.4% of males and 3.2% of females recording systolic blood pressures of 160mmHg and over. We observed a significant difference in the distribution of diastolic blood pressure between men and women (p-value of 0.047). In men, 61.6% recorded a normal diastolic blood pressure of less than 80mm Hg. 31.4 % of men and 31.9% of women recorded a diastolic blood pressure of 80-89 mm Hg. 5.3% of men and 9.5% of women recorded a diastolic blood pressure of 90-99 mm. Only 2.2% of men and 0.8% of women recorded very high diastolic pressure values of 100 mm Hg or higher.

Table 1: Characteristics of study participants by sex

	Total (n=844)	Males (n=319)	Females (n=525)	P Value
Demographic factors				
Age in years, median (25%-75%)	54(41-67)	54(42-67)	54(41-67)	0.899
Age groups in years, n (%)				0.858
18 - 34	132(15.6)	49(15.4)	83(15.8)	
35 - 49	204(24.1)	73(22.9)	131(25.0)	
50 - 65	270(32.0)	107(33.5)	163(31.1)	
>65	238(28.2)	90(28.2)	148(28.2)	
Community of residence, n (%)				0.059
Ayirebi	148(17.5)	51(16.0)	97(18.5)	
Wenchi	158(18.7)	64(20.6)	94(17.9)	
Aboabo	164(19.4)	66(20.7)	98(18.7)	
Swedru	178(21.1)	53(16.6)	125(23.8)	
Nkwanta	196(23.2)	85(26.7)	111(21.4)	
Marital status, n (%)				**0.031**
Single	141(16.8)	49(15.4)	92(17.6)	
Married	417(49.5)	178(56.0)	239(45.6)	
Divorced	81(9.6)	27(8.5)	54(10.3)	
Widowed	203(24.1)	64(20.1)	139(26.5)	
Number of children, median (25%-75%)	4(3-6)	4(3-6)	4(2-6)	0.250
Number of children in groups, n (%)				0.184
0 - 3	345(40.6)	134(42.0)	211(40.2)	
4 - 6	361(42.8)	144(45.1)	217(41.3)	
7 - 10	129(15.3)	38(11.9)	91(17.3)	
>10	9(1.1)	3(1.0)	6(1.1)	

Presence of active NHIS, n (%)				0.132
Yes	578(68.8)	209(65.7)	369(70.7)	
No	262(31.2)	109(34.3)	153(29.3)	
Socio-economic factors				
Education, n (%)				**<0.001**
No formal education	107(12.8)	13(4.1)	94(18.1)	
Basic	272(32.6)	76(24.1)	196(37.8)	
Secondary	363(43.5)	182(57.6)	181(34.9)	
Vocational	34(4.1)	8(2.5)	26(5.0)	
Higher	57(7.1)	37(11.7)	22(4.2)	
Occupation, n (%)				**0.012**
Student	45(5.3)	18(5.6)	27(5.1)	
Unemployed (non-student)	218(25.8)	62(19.4)	156(29.7)	
Manual workers	481(57.0)	197(61.8)	284(54.1)	
Non-manual workers	100(11.9)	42(13.2)	58(11.1)	
Health behavior				
Alcohol use, n (%)				**<0.001**
Never	676(80.6)	209(65.5)	467(89.7)	
History of alcohol use	164(19.5)	110(34.5)	54(10.4)	
Tobacco smoking, n (%)				**<0.001**
Never	769(92.4)	268(84.0)	501(95.6)	
History of smoking	74(8.8)	51(16.0)	23(4.4)	
Medical history				
History of hypertension, n (%)				0.546
Yes	183(21.8)	73(22.9)	110(21.1)	
No	657(78.2)	246(77.1)	411(78.9)	
History of diabetes, n (%)				0.889
Yes	104(12.3)	40(12.5)	64(12.2)	
No	739(87.7)	279(87.5)	460(87.8)	
Known hypertensives on meds, n (%)				0.299
Yes	119(65.4)	51(69.9)	68(62.4)	
No	63(34.6)	22(30.1)	41(37.6)	
Known diabetics on meds, n (%)				0.087
Yes	82(79.6)	30(71.4)	52(85.3)	
No	21(20.4)	12(28.6)	9(14.8)	
Family history of hypertension, n (%)				0.146
Yes	284(34.4)	99(31.3)	185(36.3)	
No	542(65.6)	217(68.7)	325(63.7)	
Family history of diabetes, n (%)				0.607
Yes	179(22.4)	71(22.4)	108(20.9)	
No	655(78.5)	246(77.6)	409(79.1)	
Physical measurements				
BMI kg/m², median (25%-75%)	23.1(20.8-25.3)	23.1(20.8-25.3)	23.1(20.8-25.3)	0.890
BMI categories, n (%)				0.721
Underweight (<18.5 *kg/m²*)	33(4.0)	10(3.1)	23(4.4)	
Normal weight (18.5-24.9 *kg/m²*)	581(69.0)	223(69.9)	358(68.3)	
Overweight (25.0-29.9 *kg/m²*)	176(20.7)	64(20.1)	112(21.4)	
Obesity (≥30.0 *kg/m²*)	53(6.3)	22(6.9)	31(5.9)	

Blood glucose mmol/L, median (25%-75%)	4.9(4.4-5.4)	5.1(4.5-5.5)	4.9(4.3-5.4)	0.060
Blood glucose categories, n (%)				0.270
3.3 – 5.5	665(79.0)	243(76.4)	422(80.5)	
5.6 – 6.9	122(14.5)	54(17.0)	68(13.0)	
7.0 and above	55(6.5)	21(6.6)	34(6.5)	
Systolic BP mm Hg, median (25%-75%)	124(118-131)	123(117-130)	124(118-131)	0.425
Systolic BP categories, n (%)				0.699
<120	242(28.7)	94(29.5)	148(28.2)	
120 - 139	501(59.4)	188(58.9)	313(59.7)	
140 - 159	69(8.2)	23(7.2)	46(8.8)	
≥160	31(3.7)	14(4.4)	17(3.2)	
Diastolic BP mm Hg, median (25%-75%)	77(70-83)	76(70-82)	78(70-83)	0.412
Diastolic BP categories, n (%)				**0.047**
<80	498(59.1)	195(61.1)	303(57.8)	
80 - 89	267(31.7)	100(31.4)	167(31.9)	
90 - 99	67(8.0)	17(5.3)	50(9.5)	
≥100	11(1.3)	7(2.2)	4(0.8)	

Values are medians or percentages calculated at 95 % confidence intervals.
BP, blood pressure; SBP, systolic blood pressure; DBP, diastolic blood pressure; HTN, hypertension; T2D, type 2 diabetes; BMI, body mass index; NHIS, National Health Insurance Scheme.

4.2 Prevalence of Hypertension, Type 2 Diabetes and Obesity

4.2.1. Prevalence of Pre-hypertension and Hypertension

The prevalence of hypertension in men and women was 13.5 % (95% CI: 10.1% to 17.7%) and 17.0 % (95% CI: 14.0% to 20.4%), respectively. A higher proportion of the population presented with pre-hypertensive values. 59.9% (95% CI: 54.4% to 65.1%) of men and 56.4% (95% CI: 52.1% to 60.6%) of women were pre-hypertensive. According to age, hypertension was least among participants aged 18 to 34 years at 4.6% (95% CI: 3.7% to 5.4%). 12.7% (95% CI: 8.8% to 18.1%) of participants aged between 35 and 49 were hypertensive. Hypertension was highest among participants aged between 50 and 65 years at 22.6% (95% CI: 18.0% to 28.0%). The prevalence was 16.4% (95% CI: 12.2% to 21.7%) among participants aged 65 and above. Figure 3 provides a summary of the prevalence of pre-hypertension and hypertension according to sex and age categories.

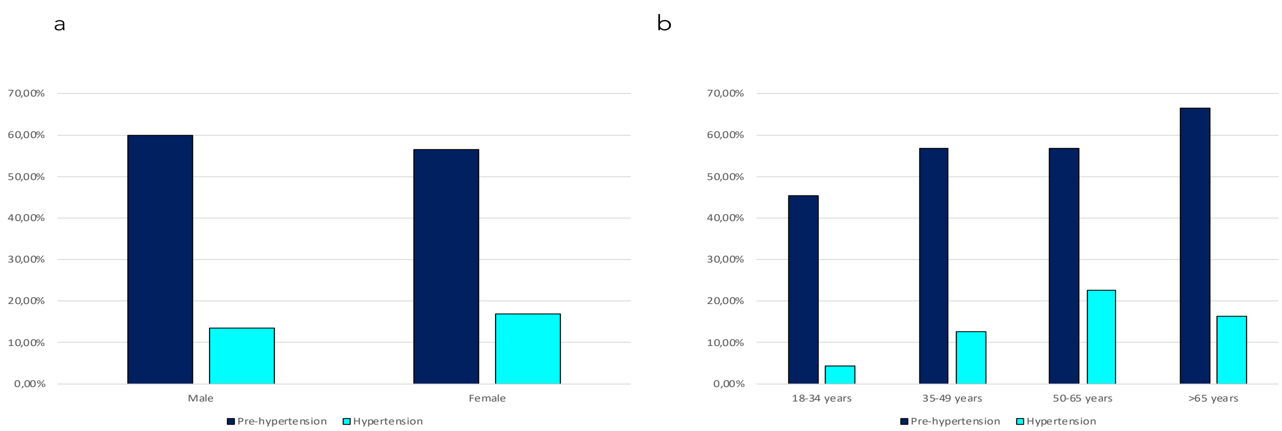


Fig. 3: Prevalence of pre-hypertension and hypertension by (a) sex and (b) age

4.2.2. Prevalence of IFG and Type 2 Diabetes

Type 2 diabetes was 7.2% (95% CI: 4.8% to 10.7%) prevalent among men and 6.8% (95% CI: 4.9% to 9.3%) among women. 13.4% (95% CI: 10.0% to 17.7%) of men and 11.3% (95% CI: 8.8% to 14.3%) of women recorded impaired fasting glucose values. 7.0% (95% CI: 3.7% to 13.0%) and 6.3% (95% CI: 3.2% to 12.0%) of participants aged 18 to 34 years had impaired fasting glycemia and type 2 diabetes respectively. Among participants aged 35 to 49 years, 12.1% (95% CI: 8.2% to 17.4%) recorded impaired fasting glycemia values and 7.0% (95% CI: 4.2% to 11.5%) had type 2 diabetes. Type 2 diabetes was highest among the 50-65 years category at 8.1% (95% CI: 5.3% to 12.1%). 13.1% (95% CI: 9.5% to 17.8%) of the participants in this category had impaired fasting glycemia. 13.7% (95% CI: 9.8% to 18.7%) and 6.0% (95% CI: 3.5% to 9.9%) of participants aged above 65 years had impaired fasting glycemia and type 2 diabetes respectively. Figure 4 provides a summary of the prevalence of impaired fasting glycemia and type 2 diabetes according to sex and age categories.

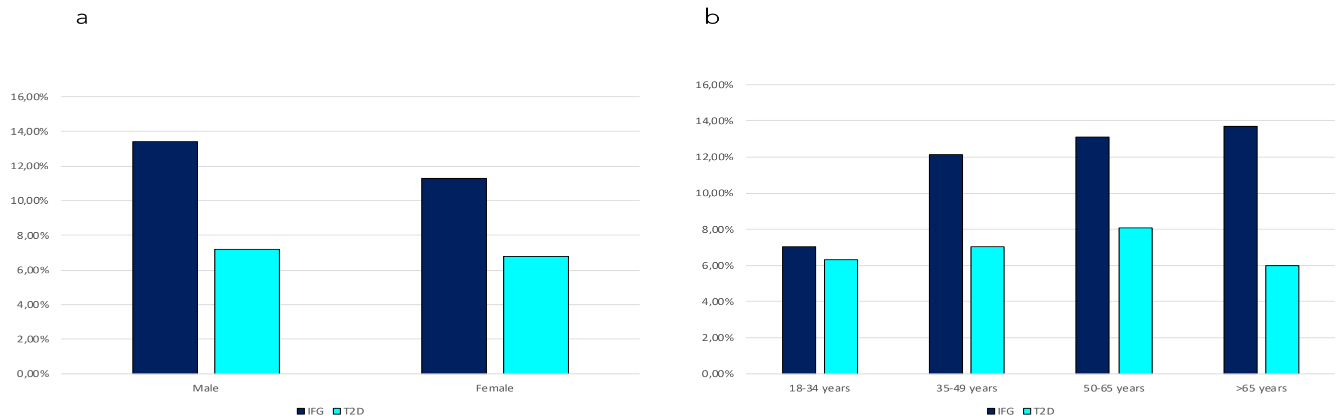
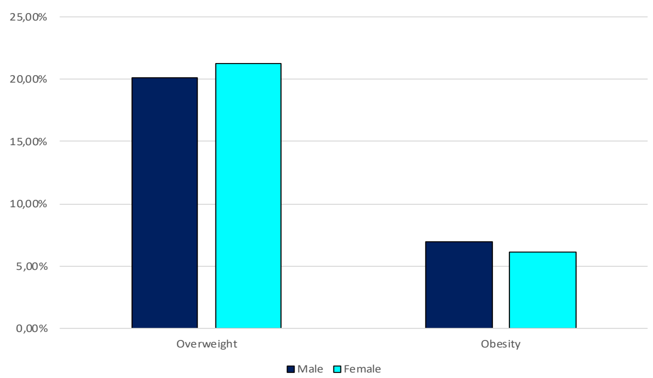


Fig. 4: Prevalence of impaired fasting glycemia (IFG) and type 2 diabetes (T2D) by (a) sex and (b) age

4.2.3. Prevalence of Overweight and Obesity

The prevalence of overweight and obesity varied between the four age groups (Fig 5b). Overweight and obesity was 12.9% (95% CI: 8.2% to 19.8%) and 0.8% (95% CI: 0.1% to 5.2%) respectively in the 18 to 34 years age group. In the 35 to 49 years age group, the prevalence of overweight and obesity was 17.2% (95% CI: 12.6% to 23.0%) and 4.9% (95% CI: 2.7% to 8.9%) respectively. Overweight and obesity was highest among the participants aged between 50 and 65 with the prevalence of overweight at 25.9% (95% CI: 21.0% to 31.5%) and obesity at 9.6% (95% CI: 6.6 % to 13.8%). Among participants who were above 65 years, the prevalence of overweight and obesity was 22.7% (95% CI: 17.8% to 28.5%) and 7.1% (95% CI: 4.4% to 11.1%) respectively. Obesity was 6.9% (95% CI: 4.5% to 10.3%) prevalent among men and 6.1% a (95% CI: 4.3% to 8.5%) among women (Fig 5a).

a



b

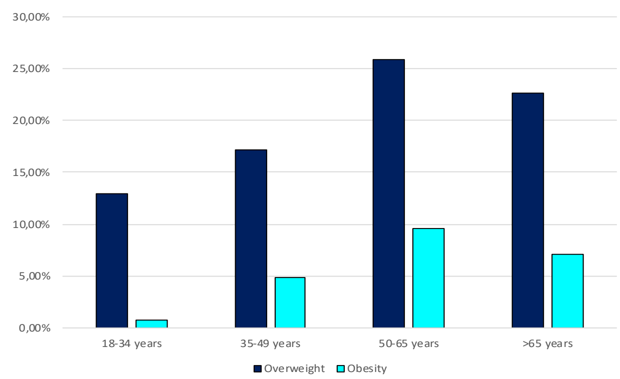


Fig. 4: Prevalence of overweight and obesity by (a) sex and (b) age

4.3. Determinants of Hypertension, Type 2 Diabetes and Obesity

4.3.1. Bivariable Analysis of Participants' Characteristics According to Blood Pressure.

A summary of a bivariable analysis of the study population are shown by levels of blood pressure in table 2. There was a significant difference in the distribution of blood pressure by age. The median age for participants with normal blood pressure (systolic blood pressure <120 and diastolic blood pressure <80) was 46. That for pre-hypertension (systolic blood pressure ≥120 to 139 and diastolic blood pressure ≥80 to 89) was 55 years and it was 58.5 years for hypertensives (systolic blood pressure ≥140 and diastolic blood pressure ≥90)

There were no substantial differences in sex even though more females (17%) reported high blood pressure as compared to males (13.5%). The blood pressure structure was similar in all communities, although Aboabo recorded slightly higher number of participants with high blood pressure.

We saw no difference in the distribution of blood pressure by education level. However, there were clear differences in the distribution according to occupation. (p-value <0.001). 54% of non-manual workers recorded high blood pressure levels. Only 2.2% of students, 18.8% of unemployed (non-students), 7.5% of manual workers recorded high blood pressure levels. 36.5% of participants with a history of tobacco smoking recorded high blood pressure levels and it was 13.5% for those who have never smoked. We however didn't observe any significant difference in among participants by alcohol consumption.

We observed a remarkable difference in blood pressure distribution by body-mass index. The median body mass index for the normotensive category was 21.1 kg/m^2. That for participants who were pre-hypertensive was 23.4 kg/m^2 and 27.2 kg/m^2 for hypertensives. 76.4% of all obese participants recorded high blood pressure.

Table 2: Bivariable analysis of participants' characteristics according to blood pressure

	Normal BP (sbp <120 & dbp<80) =225 (26.6)	Pre-HTN (sbp ≥120 & dbp≤89) =487(57.6)	HTN (sbp≥140 & dbp≥90) =133 (15.7)	P-value
Demographic factors				
Age, median (25%-75%)	46(33-60)	55(43-70)	58.5(50-67.5)	<0.001
Age groups in years, n (%)				<0.001
18 - 34	66(50.0)	60(45.5)	6(4.6)	
35 - 49	62(28.7)	116(51.7)	26(12.8)	
50 - 65	56(27.2)	153(56.7)	61(22.6)	
>65	41(17.2)	158(66.4)	39(16.4)	
Sex, n (%)				0.377
Male	85(26.7)	191(59.9)	43(13.5)	
Female	140(26.7)	296(56.4)	89(17.0)	
Communities, n (%)				0.249
Ayirebi	39(26.4)	86(58.1)	23(15.5)	
Wenchi	56(35.4)	78(49.4)	24(15.2)	
Aboabo	35(21.3)	99(60.4)	30(18.3)	
Swedru	47(26.4)	104(58.4)	27(15.2)	
Nkwanta	48(24.5)	120(61.2)	28(14.3)	
Marital status, n (%)				0.062
Single	45(31.9)	68(48.2)	28(19.9)	
Married	119(28.5)	236(56.6)	62(14.9)	
Divorced	17(21.0)	50(61.7)	14(17.3)	
Widowed	43(21.2)	132(65.0)	28(13.8)	
No. of children median (25%-75%)	4(2-6)	4(3-6)	4(2-6)	0.191
No of children groups, n (%)				0.616
0 - 3	93(27.0)	188(54.5)	64(18.6)	
4 - 6	95(26.3)	217(60.1)	49(13.6)	
7 - 10	35(27.1)	76(58.9)	18(14.0)	
>10	2(22.2)	6(66.7)	1(11.1)	
Possess active NHIS, n (%)				0.842
Yes	155(26.6)	331(57.2)	93(16.1)	
No	71(27.1)	153(58.4)	38(14.5)	
Socio-economic factors				
Education, n (%)				0.430
No formal education	26(24.3)	67(62.6)	14(13.1)	
Basic	79(29.0)	150(55.2)	43(15.8)	
Secondary	95(26.1)	216(59.5)	52(14.3)	
Vocational	7(20.6)	20(58.8)	7(20.6)	
Higher	15(25.4)	29(49.2)	15(25.4)	
Occupation, n (%)				<0.001
Student	20(44.4)	24(53.3)	1(2.22)	
Unemployed (non-student)	45(20.6)	132(60.6)	41(18.8)	
Manual workers	155(32.2)	290(60.3)	36(7.5)	
Non-manual workers	5(5.0)	41(41.0)	54(54.0)	
Health behavior				
Alcohol use, n (%)				0.666
Never	179(26.5)	394(58.3)	103(15.2)	

History of alcohol use	45(27.4)	90(54.9)	29(17.7)	
Tobacco smoking, n (%)				<0.001
Never	214(27.8)	415(58.7)	104(13.5)	
History of smoking	11(14.9)	36(48.6)	27(36.5)	
Medical history				
History of HTN, n (%)				0.002
Yes	32(17.4)	114(62.0)	38(20.7)	
No	193(29.4)	371(56.5)	93(14.2)	
History of T2D, n (%)				0.451
Yes	29(27.9)	55(52.9)	20(19.2)	
No	196(26.5)	432(58.5)	111(15.0)	
Family history of HTN, n (%)				0.290
Yes	66(23.2)	173(60.7)	46(16.1)	
No	153(28.2)	306(56.5)	83(15.3)	
Family history of T2D, n (%)				0.889
Yes	45(25.1)	105(58.7)	29(16.2)	
No	176(26.9)	378(57.7)	101(15.4)	
Physical measurements				
BMI kg/m², median (25%-75%)	21.1(19.4-23.1)	23.4(21.3-25.1)	27.2(23.7-30.6)	<0.001
BMI categories, n (%)				<0.001
Underweight (<18.5 *kg/m²*)	19(57.6)	14(42.4)	0(0)	
Normal weight (18.5-24.9 *kg/m²*)	185(31.8)	348(59.9)	48(8.3)	
Overweight (25.0-29.9 *kg/m²*)	19(10.8)	114(64.8)	43(24.4)	
Obesity (≥30.0 *kg/m²*)	2(3.6)	11(20.0)	42(76.4)	

Values are medians or percentages calculated at 95 % confidence intervals.
BP, blood pressure; SBP, systolic blood pressure; DBP, diastolic blood pressure; HTN, hypertension; T2D, type 2 diabetes; BMI, body mass index; NHIS, National Health Insurance Scheme.

4.3.2. Bivariable Analysis of Participants' Characteristics According to Blood Glucose.

A summary of a bivariable analysis of the study population are shown by levels of blood pressure in table 3. We found no significant difference in the distribution of elevated blood glucose by age and sex. The distribution of blood glucose was similar in all communities, although Aboabo recorded slightly higher number of participants with diabetes (8.9%).

The blood glucose structure was not different comparing the participants by education level, but we saw a significant difference comparing by occupation (p-value 0.002). 16.7% of non-manual workers recorded high blood glucose levels (≥ 7.0 mmol/L) whilst no student, 7.0% of unemployed (non-students) and 5.6% of manual workers recorded high blood glucose levels. We did not observe any substantial difference in blood glucose levels among participants with history of alcohol consumption and tobacco smoking; and those without.

Table 3: Bivariable analysis of participants' characteristics according to blood glucose levels.

	Normal FBG (3.3-5.5 mmol/L) = 665 (80.9%)	IFG (5.6-6.9 mmol/L) =99(12.0%)	T2D ≥ 7.0 mmol/L =58(7.1%)	P-value
Demographic factors				
Age, median (25%-75%)	54(40-67)	56(44-70)	54(4-65)	0.325
Age groups in years, n (%)				
18 - 34	111(86.7)	9(7.0)	8(6.3)	0.547
35 - 49	161(80.9)	24(12.1)	14(7.0)	
50 - 65	205(78.9)	34(13.1)	21(8.1)	
>65	188(80.3)	32(13.7)	14(6.0)	
Sex, n (%)				
Male	243(79.4)	41(13.4)	22(7.2)	0.631
Female	422(81.9)	58(11.3)	35(6.8)	
Communities, n (%)				0.129
Ayirebi	129(87.8)	10(6.8)	8(5.4)	
Wenchi	131(85.1)	13(8.4)	10(6.5)	
Aboabo	117(74.5)	26(16.6)	14(8.9)	
Swedru	137(79.7)	22(12.8)	13(7.6)	
Nkwanta	151(79.1)	28(14.7)	12(6.3)	
Marital status, n (%)				0.186
Single	112(82.4)	19(14.0)	5(3.7)	
Married	323(79.0)	48(11.7)	38(9.3)	
Divorced	69(86.3)	9(11.3)	2(2.5)	
Widowed	159(82.0)	23(11.9)	12(6.2)	
No. of children median (25%-75%)	4(2-6)	4(3-6)	4(3-6)	0.458
No. of children groups, n (%)				
0 - 3	274(81.6)	42(12.5)	20(6.0)	0.943
4 - 6	281(80.5)	43(12.3)	25(7.2)	
7 - 10	103(81.1)	13(10.2)	11(8.7)	
>10	7(77.8)	1(11.1)	1(11.1)	
Possess active NHIS, n (%)				
Yes	453(80.2)	72(12.7)	40(7.1)	0.494
No	210(83.3)	25(9.9)	17(6.8)	
Socio-economic factors				
Education, n (%)				
No formal education	83(79.8)	13(12.5)	8(7.7)	0.917
Basic	217(81.9)	30(11.3)	18(6.8)	
Secondary	289(81.9)	40(11.3)	24(6.8)	
Vocational	24(75.0)	4(12.5)	4(12.5)	
Higher	46(70.1)	9(15.5)	3(5.2)	
Occupation, n (%)				
Student	43(95.6)	2(4.4)	0	**0.002**
Unemployed (non-student)	168(78.1)	31(14.5)	15(7.0)	
Manual worker	384(82.4)	56(12.0)	26(5.6)	
Non-manual worker	70(72.9)	10(10.4)	16(16.7)	
Health behavior				
Alcohol use, n (%)				
Never	136(86.6)	15(9.6)	6(3.8)	0.106
History of alcohol use	526(79.7)	83(12.6)	51(7.7)	

Tobacco smoking, n (%)				0.368
Never	54(75.0)	11(15.3)	7(9.7)	
History of smoking	611(81.7)	88(11.8)	49(6.6)	
Medical history				
History of HTN, n (%)				0.247
Yes	525(81.9)	77(12.0)	39(6.1)	
No	138(78.0)	22(12.4)	17(9.6)	
History of T2D, n (%)				**<0.001**
Yes	60(60.0)	20(20.0)	20(20.0)	
No	605(84.0)	79(11.0)	36(5.0)	
Family history of HTN, n (%)				0.771
Yes	430(81.0)	62(11.7)	39(7.3)	
No	221(81.0)	35(12.8)	17(6.2)	
Family history of T2D, n (%)				**<0.001**
Yes	123(70.7)	26(14.9)	25(14.4)	
No	535(84.0)	71(11.2)	31(4.9)	
Physical measurements				
BMI kg/m^2, median (25%-75%)	22(20.5-24.8)	23.9(21.4-27.9)	24.9(23.4-30.1)	**<0.001**
BMI categories, n (%)				
Underweight (<18.5 *kg/m^2*)	28(87.5)	3(9.4)	11(6.4)	**<0.001**
Normal weight (18.5-24.9 *kg/m^2*)	481(84.8)	58(10.2)	28(4.9)	
Overweight (25.0-29.9 *kg/m^2*)	23(44.2)	27(15.8)	11(6.4)	
Obesity (≥30.0 *kg/m^2*)	665(80.1)	99(12.0)	58(7.1)	

Values are medians or percentages calculated at 95 % confidence intervals.
BP, blood pressure; SBP, systolic blood pressure; DBP, diastolic blood pressure; HTN, hypertension; T2D, type 2 diabetes; IFG-impaired fasting glycemia; BMI, body mass index; NHIS, National Health Insurance Scheme.

There was a significant difference in blood glucose levels among participants who reported a family history of type 2 diabetes and those without (p-value <0.001). High fasting blood glucose levels was recorded among 14.4% of participants with a family history of diabetes and 4.9% of those without or known family history of diabetes.

We observed a remarkable difference in blood glucose distribution by body-mass index (p-value <0.001). The median body mass index for participants with normal blood glucose levels was 22 *kg/m^2*. That for participants with impaired fasting glycemia was 23.9 *kg/m^2* and 24.9 *kg/m^2* for those with type 2 diabetes (fasting blood glucose of ≥7.0 mmol/L). 7.1% of all obese, 6.4 % of overweight, 4.9% of normal weight and 4.6% and 6.4% of underweight participants were diabetic.

4.3.3. Bivariable Analysis of Participants' Characteristics According to Body-mass Index. A summary of a bivariable analysis of the study population are shown by levels of blood pressure in table 4. The was a significant difference in the distribution of body-mass index by age. The median age for underweight participants was 44. That of normal weight participants was 53 years and it was 58 and 59 years for overweight and obese participants respectively.

Table 4: Bivariable analysis of participants' characteristics according to body-mass index.

	Underweight (<18.5 kg/m^2) =33(3.9%)	Normal weight (18.5-24.9 kg/m^2) = 581(68.8%)	Overweight (25.0-29.9 kg/m^2) = 176 (20.8%)	Obesity (≥30.0 kg/m^2) = 55(6.5%)	P-value
Demographic factors					
Age, median (25%-75%)	44(28-56)	53(39-68)	58(45-67)	59(52-67)	<0.001
Age groups in years, n (%)					
18 - 34	12(9.1)	102(77.3)	17(12.9)	1(0.8)	<0.001
35 - 49	10(4.9)	149(73.0)	35(17.2)	10(4.9)	
50 - 65	8(3.0)	166(61.5)	70(25.9)	26(9.6)	
>65	3(3.9)	164(68.9)	54(22.7)	17(7.1)	
Sex, n (%)					
Male	10(3.1)	223(69.9)	64(20.1)	22(6.9)	0.747
Female	23(4.4)	358(68.2)	112(21.3)	32(6.1)	
Communities, n (%)					0.051
Ayirebi	9(6.1)	96(64.9)	36(24.3)	7(4.7)	
Wenchi	9(5.7)	116(73.4)	21(13.3)	12(7.6)	
Aboabo	8(4.9)	112(68.3)	31(18.9)	13(7.9)	
Swedru	2(1.1)	121(68.0)	40(22.5)	15(8.4)	
Nkwanta	5(2.6)	136(69.4)	48(24.5)	7(3.6)	
Marital status, n (%)					
Single	5(3.6)	95(67.4)	31(22.0)	10(7.1)	0.471
Married	18(4.3)	292(70.0)	76(18.2)	31(7.4)	
Divorced	4(4.9)	51(63.0)	20(24.7)	6(7.4)	
Widowed	5(2.5)	143(70.4)	48(23.7)	7(6.4)	
No. of children, median (25%-75%)	4(3-6)	4(2-6)	4(3-6)	4(3-6)	0.672
No. of children groups, n (%)					0.152
1 - 3	12(3.5)	232(67.3)	76(22.0)	25(7.3)	
4 - 6	13(3.6)	247(68.4)	79(21.9)	22(6.1)	
7 - 10	6(4.7)	97(75.2)	20(15.5)	6(4.7)	
>10	2(22.2)	5(55.6)	1(11.1)	1(11.1)	
Possess active NHIS, n (%)					
Yes	23(4.0)	398(68.9)	126(21.8)	31(5.4)	0.204
No	10(3.8)	182(69.5)	47(17.9)	23(8.3)	
Socio-economic factors					
Education, n (%)					0.668
No formal education	3(2.8)	83(77.6)	15(14.0)	6(5.6)	
Basic	13(4.8)	179(65.8)	62(22.8)	18(6.6)	
Secondary	15(4.1)	248(68.3)	79(21.8)	21(5.8)	
Vocational	0	22(64.7)	8(23.5)	4(11.8)	
Higher	2(3.4)	41(69.5)	11(18.6)	5(8.5)	
Occupation, n (%)					
Student	5(11.1)	32(71.1)	7(15.6)	1(2.2)	<0.001
Unemployed (non-student)	4(1.8)	154(70.6)	41(18.8)	19(8.7)	
Manual worker	23(4.8)	347(72.1)	100(20.8)	11(2.3)	
Non-manual worker	1(1.0)	48(48.0)	28(28.0)	23(23)	
Health behavior					
Alcohol use, n (%)					
Never	6(3.7)	108(65.9)	37(22.6)	13(7.9)	0.743

History of alcohol use, *n (%)*	27(4.0)	469(69.4)	139(20.6)	41(6.1)	
Tobacco smoking					<0.001
Never	5(6.8)	39(52.7)	15(20.3)	15(20.3)	
History of smoking, *n (%)*	28(3.6)	542(70.5)	161(20.9)	38(4.9)	
Medical history					
History of HTN, n (%)					0.023
Yes	29(4.4)	453(69.0)	142(21.6)	33(5.0)	
No	4(2.2)	126(68.5)	34(18.5)	20(10.9)	
History of T2D, n (%)					
Yes	1(1.0)	76(73.1)	21(20.2)	6(5.8)	0.404
No	32(4.3)	505(68.3)	155(21.0)	47(6.4)	
Family history of HTN, *n (%)*					
Yes	26(4.8)	368(67.9)	117(21.6)	31(5.7)	0.256
No	7(2.5)	199(69.8)	57(20.0)	22(7.7)	
Family history of T2D, n (%)					
Yes	8(4.5)	130(72.6)	30(16.8)	11(6.2)	0.468
No	24(3.7)	445(67.9)	144(22.0	42(6.4)	

Values are medians or percentages calculated at 95 % confidence intervals.
HTN, hypertension; T2D, type 2 diabetes; IFG- impaired fasting glycemia; BMI, body mass index; NHIS, National Health Insurance Scheme.

We observed no difference in the distribution of body-mass index by education level. But there were notable differences according to occupation (p-value <0.001). 15.6% and 2.2% of students were overweight and obese respectively. 18.8% and 8.7% of unemployed (non-students) were overweight and obese. Among manual workers, 20.8% were overweight and only 2.3% were obese. 23% of non-manual workers were obese and 28% were overweight.

20.3% of participants with a history of tobacco smoking were obese and it was 4.9% for those who have never smoked. We however didn't observe any significant difference in body-mass index distribution among participants by alcohol consumption. The proportion of participants who were obese and with a medical history of hypertension was higher than those with no such history (p-value 0.023).

4.4. Multivariate logistic regression analysis

To study the association between hypertension, overweight (including obesity) and elevated blood glucose, and socioeconomic factors, logistic regression analyses (one model per outcome) were used. Table 5 shows the association between hypertension and other factors. In a fully adjusted model, there were suggestions of a higher prevalence of hypertension among men and women who are aged 50 years and above in our study population which was statistically significant. Being between 50 and 65 years (odds ratio (OR): 3.67; 95% CI: 1.39 to 9.72) and above 65 years (OR = 3.36; 95% CI: 1.24 to 9.11). Borderline statistically significant association between hypertension and sex was observed. The model suggested that manual work was negatively associated with hypertension (OR = 0.46; 95% CI: 0.26 to 0.84). However, the association between non-manual work and hypertension was positive and statistically significant (OR = 4.87; 95% CI: 2.45 to 9.66). As expected, we observed an association between overweight and hypertension (OR = 5.25; 95% CI: 3.38 to 8.17). Compared to non-smokers, the odds of developing hypertension were found to be higher in participants with a history of smoking (OR = 2.45; 95% CI: 1.26 to 4.78). No other statistically significant associations were observed between other factors and hypertension prevalence in this population.

Table 5: Multivariable logistic regression analysis of factors associated with hypertension

	OR	95% CI		*P*-value
Characteristics				
Age groups in years				
18 - 34	1.00(ref)			
35 - 49	2.62	0.92	7.43	0.069
50 - 65	3.67	1.39	9.72	0.009
>65	3.36	1.24	9.11	0.017
Sex				
Male	1.00(ref)			
Female	1.61	0.98	2.64	0.058
Occupation				
Unemployed (including students)	1.00(ref)			
Manual workers	0.46	0.26	0.84	0.011
Non-manual workers	4.87	2.45	9.66	<0.001
Tobacco smoking				
Never	1.00(ref)			
History of smoking	2.45	1.26	4.78	0.008
BMI categories				
Normal & underweight (<25.0 kg/m^2)	1.00(ref)			
Overweight (≥25.0 kg/m^2)	5.25	3.38	8.17	<0.001

Table 6 summarizes the association between diabetes and other factors. Unlike hypertension, we observed no significant association between elevated blood glucose and age. We found no statistically significant suggestions of an association with sex and occupation as well. We however observed an increased odd of developing diabetes with a history of alcohol consumption (OR = 1.94; 95% CI: 1.14 to 3.30). A family history of diabetes was also found to have an association with developing diabetes (OR = 2.29; 95% CI: 1.53 to 3.44). Compared to normal and underweight participants, the odds of developing diabetes were found to be higher in overweight participants (OR = 2.45; 95% CI: 1.26 to 4.78).

Table 7 shows the association between overweight and other factors. We found suggestions of a higher prevalence of obesity among participants who are aged 50 and 65 years (OR: 2.91; 95% CI: 1.61 to 5.23) and above 65 years (OR = 3.25; 95% CI: 1.51 to 5.30). No statistically significant association between obesity and sex was observed.

Studying the association between occupational class and overweight, non-manual work was associated with a statistically significant prevalence of overweight (OR = 4.87; 95% CI: 1.24 to 7.75).

Table 6: Multivariable logistic regression analysis of factors associated with elevated blood glucose.

	OR	95% CI		*P*-value
Characteristics				
Age groups in years				
18 - 34	1.00(ref)			
35 - 49	1.45	0.76	2.80	0.263
50 - 65	1.35	0.72	2.52	0.349
>65	1.43	0.75	2.71	0.280
Sex				
Female	1.00(ref)			
Male	1.41	0.95	2.07	0.086
Occupation				
Unemployed (including students)	1.00(ref)			
Manual workers	0.88	0.55	1.42	0.615
Non-manual workers	1.19	0.62	2.31	0.598
Alcohol consumption				
Never	1.00(ref)			
History of alcohol use	1.94	1.14	3.30	0.015
Family history of Diabetes				
No family history	1.00(ref)			
Positive family history	2.29	1.53	3.44	<0.001
BMI categories				
Normal & underweight (<25.0 kg/m^2)	1.00(ref)			
Overweight (≥25.0 kg/m^2)	2.44	1.64	3.61	<0.001

Table 7: Multivariable logistic regression analysis of factors associated with overweight.

	OR	95% CI		*P*-value
Characteristics				
Age groups in years				
18 - 34	1.00(ref)			
35 - 49	1.53	0.82	2.87	0.180
50 - 65	2.91	1.61	5.23	<0.001
>65	3.25	1.51	5.30	0.001
Sex				
Male	1.00(ref)			
Female	1.14	0.81	1.60	0.451
Occupation				
Students	1.00(ref)			
Unemployed (non-students)	0.98	0.41	2.36	0.960
Manual workers	1.01	0.43	2.34	0.976
Non-manual workers	4.87	1.24	7.75	0.016
Tobacco smoking				
Never	1.00(ref)			
History of smoking	0.64	0.92	2.68	0.101

5. DISCUSSION

5.1. Key findings of the study

This study found (1) a prevalence of hypertension in men and women as 13.5 % and 17.0%, respectively; (2) a prevalence of type 2 diabetes at 7.2% among men and 6.8% among women; (3) a prevalence of obesity as 6.9% among men and 6.1% among women; (4) older age, alcohol, non-manual work, smoking and overweight or obesity as main risk factors for these conditions, and (5) manual work was a protective factor for hypertension.

Our findings show a relatively low prevalence of hypertension comparing with other studies in the in both rural and urban Ghana(89–93) and this could be contrary to the general notion of the rising epidemic in rural settings(94). The lower prevalence is highlighted by a median systolic blood pressure of 124 mm Hg even though that is similar to some earlier studies that were conducted in rural Ghana (95,96). The disparity in the findings could be attributed to the differences in the populations studied. The comparatively lower prevalence of hypertension in this population might be as a result of the kind of occupation of the majority. We found out that manual work was a significant protective factor for hypertension, and this is the type of work for 57% of our study population. Another reason is because we did not include self-reported hypertension or diabetes in calculating our prevalence. This was to reduce the possible information bias.

The study was consistent with other studies that report an increasing hypertension prevalence associated with increasing age (93) but the trend slightly drops among participants aged above 65. The hypothesis that the elderly living in rural areas have a better healthcare seeking behavior than the employed in the urban areas could be a contributing factor(97). The prevalence was slightly higher in women (17%) than in women (13.5%). Majority of studies in Ghana report a higher prevalence in men(93) but the findings of the Women's Health Study of Accra showed a very high crude prevalence of 54.6% among women(98).

Studies had reported an association between elevated blood pressure and older age, menopause before age 50 years, no formal education, overweight or obesity, urban residence, land ownership, and male sex in different combinations (89–91,93,96,98); but, no independent association with the nature of work has been reported. The result of our study suggests that manual work protects against developing hypertension and non-manual work increases your odds of developing hypertension. The simple explanation will be the physical inactivity associated with these types of jobs. People with non-manual work in rural settings are also likely to belong to a higher socio-economic class and therefore more prone to sedentary lifestyles.

Another important finding of our study is the association of tobacco smoking with hypertension. This is in line with other studies previously conducted in the region which proves a relationship between smoking and stroke, a major complication of hypertension (99,100). The relationship between hypertension and overweight or obesity has been proven in many different studies (90,93) and was not different in our population. The odds of developing hypertension was five times higher with a body-mass index of 25 kg/m^2 or more.

The prevalence of type 2 diabetes was 7.2% in men and 6.8% in women. This is higher than the recent report from the RODAM study which reported a prevalence of 3.6% and 5.5% in men and women in rural Ghana respectively(101). Impaired fasting glycemia was rather similar to the findings of the RODAM study which reported 13% prevalence in men and 11% in women(101).

Like we observed with hypertension, increasing age is associated with the development of type 2 diabetes but the trend slightly halts in participants aged 65 years and above. However, we found no association between age as a categorical variable and type 2 diabetes. A case-control study conducted by Horlali *et al* in the Volta region of Ghana showed a similar pattern(102).

Our findings suggest that a history of alcohol consumption increases the odds of developing diabetes. Even though other studies have concluded that alcoholism provide a reduced risk against type 2 diabetes(103–105), the contrary in our study could also be explained by the reduced insulin sensitivity caused by alcohol intake(106,107). Overweight or obesity and a family history of type 2 diabetes are well established risk factors of type 2 diabetes and our findings proved same. Similar results on this association were reported in a study conducted in urban Ghana (108).

The prevalence of overweight and obesity in our population was lower than national estimates which is at 25.4% and 17.1% respectively(109). Our findings however show a higher prevalence of obesity in men than the reports from the RODAM study which showed prevalence of obesity in men at 1.3% in rural Ghana(101). We observed no significant differences in the prevalence of obesity according to sex which is contrary to the findings of a systematic review and meta-analysis from Ofori-Asenso and colleagues reporting the prevalence to be 6% in men and 21.9% in women(109). The RODAM study also reported similar differences in prevalence of obesity according to sex(101). Age of 50 years and above and non-manual work was associated with overweight and obesity. This can be explained by reduced mobility related to ageing and non-manual work leading to accumulation of excess fat and an increase in body-mass index.

5.2. What does this study add?

- This study adds to the scanty data available on the prevalence of non-communicable diseases in rural Ghana and their determinants.
- The study also demonstrates patterns of association between non-communicable diseases and different age groups and gender.
- The study supports the growing need for education on the importance of physical activity and avoiding tobacco and alcohol use as preventive and control tools for non-communicable diseases.

5.3. Strengths and limitations

There are different strengths of this study worth mentioning. This is the first study to estimate the prevalence of hypertension, type 2 diabetes, and obesity in the Birim Central municipality, Ghana. We had a good sample size of 844 participants making it powered enough to draw conclusions. Questionnaires were validated from previous studies and tested in a community hospital prior to the study. And finally, all of our analyses were adjusted for potential confounding, minimizing the probability of residual confounding.

Regarding limitations of this study, we did not take into account residential history of participants before recruitment. Apart from anthropometric, blood pressure and blood glucose measurements, all the other information assessed in this analysis was based on self-reporting. It is possible that certain behaviors and medical history were over- or underreported.

Additionally, participants were recruited as a convenience sample which does not make our sample representative of the local population. Randomized sampling may yield more reliable estimates of hypertension, type 2 diabetes and obesity prevalence. The nature of cross-sectional studies has its limitations on causal inference between socio-economic factors and prevalence non-communicable diseases. Further studies preferably a cohort study with follow-up are necessary to strengthen the evidence.

5.4. Implications for public health policy

Results of this thesis showed a persistence need for national health policies and educational programs on non-communicable diseases prevention and control. These results contribute to a better understanding of role of other determinants of the burden non-communicable diseases in rural contexts. Our findings suggest that non-manual work is a risk factor for developing non-communicable diseases whilst manual-work is a protective factor. This means government work and other non-manual forms of work in rural communities should implement physical activity routines at work places and educate staff on health-related behaviors.

6. CONCLUSION

This cross-sectional study has provided insights on the burden of hypertension, type 2 diabetes and obesity in the Birim central municipality of Ghana. The study found the prevalence of hypertension, type 2 diabetes and obesity higher still on the rise in rural communties. The study also shows that majority of the population have non-optimal levels of blood pressure and glucose. Different risk factors, including socio-economic factors (older age, non-manual work), body weight (overweight or obese), health behavior (alcohol consumption, tobacco smoking) have been identified to increase the prevalence of these non-communicable diseases in rural settings and this can guide in designing intervention programmes. Context-specific and community-based intervention programmes in a multisectoral approach are crucially needed to increase the awareness, prevention, and control of non-communicable diseases.

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ANNEXES

Appendix 1: Information and consent form for study

REQUEST TO PARTICIPATE IN A RESEARCH PROJECT

Please read this form carefully

This is a request for you to participate in a research project that intends to measure blood pressure, blood glucose, weight and height among the adult population in your district.

You have the right to take your time in making decisions about participating in this research. If you have any questions about the research or any portion of this form, please ask. If you decide to participate in this research, you will be asked to sign this form. A copy of the signed form will be provided to you for your records.

Background and purpose

Hypertension and Diabetes increases the risk for heart disease, stroke, kidney disease, blindness and death. People like the elderly and overweight might be at a higher risk. Little is known about the relationship between hypertension and its association with socio-economic factors such as education and occupation in your community. To study how we can prevent high blood pressure in rural communities it is important to understand this relationship.

Aim

1. To determine how prevalent type 2 diabetes, obesity and hypertension are in the Birim Central district of Ghana.
2. To assess the possible relationship between socio-economic factors and type 2 diabetes and hypertension.

What does participation in the study entail for you?

The study population will consist of adults (18 years or older) who reside in Ayirebi, Nkwanta, Wenchi, Aboabo and Swedru.

We will ask you questions about your age, sex, marital status, number of children. whether you are registered on health insurance or not, smoking status, alcohol consumption, education level, occupation and medical history. Thereafter, we will measure your blood pressure twice, blood glucose, height and weight. The interview and measurement will last 30 minutes at most.

Potential advantages and disadvantages

Advantages

The research findings will help us to better understand the extend of high blood pressure among the adult population in the rural area of the Birim Central district in Ghana. It will also increase our knowledge about the relation between high blood pressure and socio-economic factors, such as education and occupation, in rural areas. In the future, this might help us in designing interventions and awareness programs, which eventually might reduce the burden of high blood pressure and glucose and diseases associated with them. You will also learn about your blood pressure and glucose levels and we will advise on how to keep them at good levels.

Disadvantages

You might feel uncomfortable answering some of the questions in the questionnaire. If so, please feel free not to respond those questions.

What will happen to the samples and the information about you?

The data registered about you will only be used for the research purpose described above. All the data will be processed without name. An ID number will be generated and linked to your questionnaire with respective answers. We will not reveal your name or any other information that will identify you in future publications or presentations. Only authorized project personnel will have access to this data. For audit purpose, the project data will be stored for five years after completion of the project.

Privacy

De-identification the data

We will collect the identifiers in separate page (name and telephone number) with a code. We will use the codes in the data collection form. The identifiers page will be kept in a safe locker. All the data will be entered with a code. The de-identified data will be taken to Norway for data-analysis, while the identifiers will be kept in a safe locker at the Community Hospital, Oda and only the project managers will have access to these files.

Right to access and right to delete your data and samples

If you agree to participate in the study, you are entitled to have access to the information that is registered about you. You are further permitted to correct any mistakes in the information we have registered. If you wish to withdraw consent to participate at any point of time, you are allowed to claim that the information collected about you must be deleted unless the data have already been incorporated in the analyses or used in scientific publications.

Voluntary participation

Participation in this study is voluntary. You are free to withdraw your consent to participate at any time without stating any reason. The data that has been collected about you will then be deleted, except if it has already been included in analysis. If you wish to participate, please sign the declaration of consent on the final page, using your signature or alternatively your thumb print. In the future, if you wish to withdraw your consent or have questions concerning the study, you may contact:

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Criteria for participation

Inclusion criteria

1. Inhabitant of Ayirebi, Nkwanta, Wenchi, Aboabo or Swedru.
2. 18 years or more.

Exclusion criteria

1. Serious medical condition including myocardial infarction, congestive cardiac failure, and renal diseases likely to hinder accurate measurement of variables.
2. Pregnant or nursing within past 6 months.
3. Psychiatric hospitalization in last year.
4. Living outside the district.
5. Food or alcohol in the past 6 hours.

Consent for participation in the study

I am willing to participate in the study.

(Signed by the project participant using signature or thumb print/date)

I confirm that I have given information about the study.

(Signed, role in the study/ date)

Appendix 2: Questionnaire form for study

Beauty in Small Deeds Project 2018

On

Hypertension and Diabetes in Birim Central District, Eastern Region, Ghana

Participant ID number:

Questionnaire filled in on:

1 Demographic information

1.1 What is your sex? □ Male □ Female

1.2 Village/community name: ____

1.3 How old are you? |__|__| years old

1.3 What is your relationship status?
0 Married (or registered partnership)
1 Single (never married)
2 Divorced
3 Widow/widower

1.4 How many children have you given birth to? |__|__|

1.5 What is the highest level of education you completed, and for which you received a diploma?
0. No formal schooling
1. Primary school
2. Secondary (junior or senior) school
3. Vocational/Technical training
4. College/University

1.6 What has been your job or profession over the past 12 months?
Please describe this with as much detail as you can.
____
____

1.7 Are you actively subscribed to the National Health Insurance Scheme (NHIS)?
0. Yes
1. No

2. Lifestyle
Tobacco smoking:
2.1 Do you currently smoke any tobacco products, such as cigarettes, cigars, pipes (past 30 days)?
1. Yes________
0. No_________

2.2 In the past, did you ever smoke any tobacco products?
1. Yes _______
0. No ________

2.3 When you stopped smoking, how old were you? (only ask if participant only smoked in the past)
Years________

2.4 Alcohol drinking:
Have you ever consumed any alcohol such as beer, wine, spirits or gin?
1. Yes________
0. No_________

2.5 Have you consumed any alcohol within the past 30 days?
1. Yes________
0. No_________

3. Medical History

3.1 Have you ever been told by a doctor or other health worker that you have raised blood glucose or diabetes?
1. Yes_________
0. No__________(Go to 3.4)

3.2 In the past two weeks, have you taken any medication for diabetes prescribed by a doctor or other health worker?
1. Yes_________
0. No__________

3.3 Are you currently taking insulin for diabetes prescribed by a doctor or other health worker?
1. Yes_________
0. No__________

3.4 Has anyone in your immediate family (your parents, brothers, sisters, or children) ever been diagnosed with diabetes?
2. I don't know_________
1. Yes_________
0. No__________

3.5 Have you been told by a doctor or other health worker that you have raised blood pressure or hypertension?
1. Yes_________
0. No__________(go to 3.7)

3.6 During the past two weeks, have you been taken any drugs (medication) prescribed by a doctor or other health worker for raised blood pressure?
1.Yes___
0.No___

3.7 Has anyone in your immediate family (your parents, brothers, sisters, or children) ever been diagnosed with hypertension?
2. I don't know_________
1. Yes_________
0. No__________

Thank you for your participation. Now our colleagues from DoctorsAct will measure your height, weight, blood pressure and glucose.

Physical measurements

Cuff size used
Small________
Medium________
Large________
Reading1
Systolic (mmHg)______
Diastolic (mmHg)______
Reading2
Systolic (mmHg)______
Diastolic (mmHg)______
Height in centimeters (cm)_______
Weight in kilograms (kg)_________
Weight 2 in kilograms (kg)__________
Fasting blood glucose (mmol/L) _______