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ASSOCIATED RISK FACTORS OF TYPE 2 DIABETES MELLITUS AMONG ADULTS IN THE HOHOE MUNICIPALITY OF GHANA

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Keywords: *Type 2 Diabetes, Controls, Awareness, Hypertension, Risk factors, Hohoe Municipality, Volta Region, Ghana.*

Abstract

Background: Diabetes Mellitus is a major cause of morbidity globally. Type 2 diabetes is more common and is increasingly becoming an important medical and public health issue. This study identified the risk factors associated with Type 2 Diabetes Mellitus in the Hohoe Municipality.

Method: This was an unmatched case-control study that recruited 75 cases and 151 controls to trace various exposures of type 2 diabetes mellitus. A face-to-face interview was employed to administer semi-structured questionnaires to participants. Fasting/random blood glucose and blood pressure levels, weight and height were measured with appropriate instruments.

Findings: Diabetes prevalence rate was 70.7% in the cases and 8.6% in the controls. Controlled diabetes was 29.3%. Approximately, 69.3% of diabetics had hypertension as compared to 53.6% among non-diabetics (p=0.031). Prevalence of hypertension among controls was also 53.6%. Married respondents were 88% times less likely to have diabetes as compared to those who were single (AOR=0.12, p<0.001). Artisans and were 5.21 times more likely to develop diabetes as compared to those who were unemployed (AOR=5.21, p=0.032). Those who consumed fruits 1-3 times and more than 3 times per week were 82% and 92% times less likely to develop diabetes (AOR=0.18, p=0.039) and (AOR=0.08, p=0.007) respectively. Participants whose occupation involved vigorous exercise were 69% times less likely to develop diabetes as compared to those whose work did not (AOR=0.3, p= 0.039).

Conclusion: Uncontrolled diabetes was high with 3 out of 4 diabetics not able to control their blood sugar levels. About 7 out of every 10 diabetics had hypertension. A very high (8.6 %) proportion of adults had diabetes and were not aware. Married adults were 83% less likely to have diabetes. We recommend that intensive education of the management and control of diabetes and periodic screening for diabetes be instituted to curb the incidence among adults in the Hohoe Municipality

Introduction

Over the past three decades, the number of people with diabetes mellitus (DM) has more than doubled globally, making it one of the most important public health challenges to all nations [1]. It is associated with reduced life expectancy, significant morbidity due to specific diabetes-related microvascular complications, increased risk of macrovascular complications (ischaemic heart disease, stroke and peripheral vascular disease) and diminished quality of life. Among the types of diabetes mellitus, it must be noted that type 2 diabetes (DM2) affects more than 90% of the diabetic population worldwide [2]. Type 2 diabetes is a medical condition characterized by an elevation of blood glucose level. This metabolic disorder occurs as a result of insulin deficiency [3]. It is characterized by hyperglycaemia resulting from defects in insulin secretion and action or both.

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Diabetes is a condition that occurs when the body cannot utilise glucose. The levels of glucose in the blood are controlled by a hormone called insulin made by the Pancreas, and insulin helps glucose to enter the cells. In diabetes, the Pancreas does not make sufficient insulin (Diabetes type 1) or the body cannot act normally in response to the insulin that is made (Diabetes type 2); this causes the glucose levels in the blood to rise, leading to symptoms such as frequent urination, lethargy, excessive thirst and hunger [4].

The prevalence of DM2 is widespread in both developing and developed countries and is of great public health concern. WHO estimates that, globally, 422 million adults aged 18 years and above were living with diabetes in 2014. They also estimated worldwide deaths of 1.5 million as a result of diabetes. In 2013, the majority of individuals with diabetes in Africa (43.2%) were aged 40–59 years [5].

Over the past decade, diabetes prevalence has risen faster in low and middle-income countries than in high-income countries [6]. African countries together with poor countries of Asia and Latin America bear a significant proportion of the global diabetes burden [7]. In sub-Saharan Africa (SSA), growth rates of Diabetes Mellitus (DM) and hypertension are among the highest worldwide [8]. Diabetes already contributes considerably to morbidity and mortality rates in the African region. The highest global age-specific mortality rate is recorded in this continent [5]. WHO estimated a jump from 4 million diabetic patients in 1980 to 25 million diabetic patients in 2014; an increase in prevalence from 3.1% to 7.1%, of which the type 2 accounts for 90% of the cases [6].

WHO reported that 171 million people in the world were diabetic in the year 2000 and this is projected to increase to 366 million by 2030 [6]. It is predicted that by 2030, the number of people aged above 64 with diabetes will be around 82 million, of which about 48 million will come from developing countries [2]. DM2 is however largely preventable.

The number of people with diabetes in Africa is projected to increase substantially in the next two decades, due to factors including rapid urbanisation, adoption of unhealthy diets and exercise patterns, and the aging of the population [5].

The increasing burden of DM2 is attributed to general population growth coupled with associated modifiable risk factors such Obesity/Overweight, smoking, unhealthy dietary intake, physical inactivity/sedentary lifestyles, level of education as well as irreversible risk factors such as age, sex and ethnicity, which may influence the development of insulin resistance and disease progression [9]. Unhealthy diet, previous gestational diabetes combined with older age and family history of diabetes are also risk factors of DM2 [6].

In Ghana, a research done in rural and urban Accra showed that the overall prevalence of overweight and obesity was 23.4% and 14.1% respectively among adults aged above 25 years. The rates were higher in females than in males [10]. Ghana has a significant diabetes burden similar to that of other African countries. Most studies in Ghana on DM2 were conducted in the Greater Accra, Ashanti and Brong-Ahafo regions of Ghana [7].

Hypertension is said to affect 7 in 10 of every diabetes patient and is also twice as common in diabetic as compared to non-diabetics. About 4 out of 10 of all DM2 patients will develop hypertension at age 40 and this will increase to 6 in 10 at the age of 75. It also becomes difficult for these patients to control their blood pressure levels. A study conducted in Ethiopia showed that, out of the 679 respondents, 47 (6.9%) were diabetic and 7 in 10 of the diabetic population had HPT [11].

In urban Ghana, however, DM2 affects at least 6% of adults and is associated with age and obesity of which some 23% of adults are overweight, and this has been related to advanced age, female gender, urban environment, high income and even level of education [8]. “The prevalence of *D. Mellitus* in some parts of Ghana has been identified as higher than the world average (2.8%). For example, Greater Accra region has a prevalence rate of 6.3% and that

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of the Central region is 6.7%. Both prevalence rates are higher than that of the world average, which raises concern that needs to be critically looked at" [12].

The prevention and management/control of DM2 in developing countries has not received the needed attention as a result of lifestyle-related diseases and conditions creating a dual burden, given that the country already has a high number of infectious diseases that require major human and financial resources to manage. This creates a need to change people's knowledge, attitudes, and actions to enable them to adopt healthy ways of living.

According to the 2013 Annual Report of the Hohoe Municipal Health Directorate, diabetes cases show an increasing trend with time. The high prevalence of both out-patient and in-patient diabetic cases led to the establishment of a diabetic clinic in the Hohoe Municipal Hospital in June 2011. Statistics from the clinic shows that over the past five years, cases of diabetes have doubled. Sixty-seven cases of diabetes were recorded in 2010, 100 in 2011, 473 in 2012 and 952 in 2013; 818 diabetic cases were reported between January and September 2014 [13]. The current study presents associated risk factors in terms of socio-demographic factors and lifestyle activities responsible for DM2, as well as the prevalence of hypertension among adults in Hohoe Municipality in the Volta region of Ghana.

Materials and methods

Study area

This study was carried out in Hohoe Municipality. It is one of the twenty-five districts/municipalities in the Volta Region of Ghana having a total land surface area of 1,172 km². It is the second most populated district in the region, after the regional capital Ho with an estimated population of 167,019 from the 2010 population census. Hohoe municipality shares borders with Jasikan district to the north, Afadjato-South district to the south, the Republic of Togo to the East, Kpando municipality to the southwest and Biakoye district to the North West. The Municipality boasts of the highest peak in Ghana, Mt. Afadjato which is located between Liati Wote and Gbledi communities, including the Wli waterfalls (the highest in West Africa). This makes the municipality a largely tourist centre. The Ewes, Likpes, Lolobis, Akpafus and Santrokofis are the tribes in the municipality. Common dialects spoken are Ewe, Twi and Hausa. The municipality has also been divided into seven health sub-municipalities namely: Akpafu/Santrokofi, Alavanyo, Agumatsa, Lolobi, Gbi-Rural, Hohoe-sub and Likpe. In addition, the municipality has a total of thirty-four (34) health facilities providing clinical care, reproductive health and child health services. Complicated cases are mostly referred to the municipal hospital at Hohoe.

Study Population

The population of the study consisted of adults aged 18-64+ years within the Hohoe municipality. Adults living in the Hohoe municipality who consented to be participants in the study were included. Adults who did not live in the municipality were seriously ill, pregnant women and those who did not give consent were excluded.

Study Design

The study design was an unmatched case-control study, which was carried out in January 2017 to determine risk factors of DM2 among adults (18-64+ years) in the Hohoe municipality. The cases included respondents who were diabetics and were attending the diabetic clinic at the Hohoe municipal hospital. Two controls were selected from the communities which the cases came from. The study used pre-tested structured questionnaire modified from the WHO STEPWISE approach to non-communicable disease risk factor surveillance (STEPS) (instrument 3.1). Information included socio-demographic characteristics, dietary behaviour and lifestyle of participants. There was also the measurement of anthropometric indices such as weight and height. Finger-prick blood (0.04ml) was collected from each participant to test for blood glucose level.

Sample Size Determination

The required sample size for this study was determined using Fleiss' formula for unmatched case-control study [14]. Reliability coefficient (Z_α) of 1.96 at 95% confidence level, power of 80% (Z_β=.84), an expected prevalence of 6%,

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Odds Ratio (OR) of 1 in the control and OR of 3.56 among cases and a ratio of proportionality of 1 case: 2 controls were plugged into the formula. Thus the sample size determined was 225 (75 cases, 150 controls)

Sampling method

Multistage sampling technique was used for the study. Firstly, the entire municipality was stratified into six (6) sub-municipalities. The names of all communities in each sub-municipality were listed to form a sampling frame. Names of communities were written on pieces of paper and grouped into corresponding sub-municipality and shaken to ensure they mix well. Using lottery method of simple random sampling, one person was blinded and made to randomly select two communities from each sub-municipality. The selected communities were used for the screening.

In the chosen community a screening centre was mounted to screen adults (18-64+ years). A convenience sampling technique was employed to select controls from the various communities. A one to two (1:2) ratio was employed to select controls with similar characteristics who also resided in the same communities as cases.

Furthermore, the cases were selected from the diabetic clinic at Hohoe Municipal Hospital using simple random sampling technique (lottery).

Data collection

Data were collected using the WHO STEPWISE approach for the assessment of risk factors for non-communicable disease surveillance. **STEP 1** (SELF-REPORT) was used to capture information on socio-demographic characteristics, nutritional habits, sedentary lifestyles and others by the use of a questionnaire which was administered face-to-face. **STEP 2** (PHYSICAL) was used to capture information on height & weight (for BMI calculation), waist circumference and blood pressure level. Weighing scales, Tape measure and blood pressure apparatus were used in this step. **STEP 3** (BIOCHEMICAL) entailed taking blood samples for biochemical assessment. Blood glucose meters were used to measure the level of random blood glucose of respondents for the detection of diabetes. The height of participants was measured with a Stadiometer (SECA Leicester height measure with a fixed footplate and movable headboard) to the nearest 0.1 centimetres. Weight was measured using a digital weighing scale (BednBath model BB-3018A) with participants, not in shoes and also dressed in light clothing to the nearest 0.1 kilogrammes. All measurements were done in accordance with the standard anthropometry guidelines. Blood pressure levels of participants were checked with the aid of (Omron M2 Basic) digital blood pressure monitor. Participants were made to rest for 10 minutes before blood pressure was checked. Random blood glucose levels were measured using (OneTouch Ultra Easy) glucometer and the (OneTouch Ultra Easy) test strips. Trained health personnel and physicians helped in the data collection.

Classification of diabetes

Blood Glucose levels cut off (American Diabetes Association)

- **Fasting blood glucose levels**: Diabetes diagnosed at fasting blood glucose of ≥ 7 mmol/L (This test is for participants who had not taken anything except water for at least 8 hours before the test.
- **Random blood glucose levels**: Diabetes diagnosed at a blood glucose of ≥ 11 mmol/L (This test is a blood glucose check at any time of the day).

Data Analysis

Data were entered into EpiData version 7 and analysed with STATA statistical software version 12. Data were analysed for frequency distribution, proportion and percentages for qualitative variables, mean, standard deviation, correlations and rates, for quantitative variables. Results were calculated based on 95% Confidence level (alpha=0.05). Binary logistic regression analysis was used to measure associations between dependent and

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independent variables. A p-value less than 0.05 was considered statistically significant. Results were displayed in graphs and tables.

Ethical Issues

Before the study began, approval was sought from the Ethical Review Committee (ERC) of the Ghana Health Service (GHS). Permission was sought from the Hohoe Municipal Health Directorate. A written informed consent was obtained from all subjects. The objectives of the study and its processes were clarified to all participants. In addition, prospective participants were made to know that participation was entirely voluntary and that they had the right to reject participation or to withdraw from the study at any stage. Participants were informed of the results of their blood glucose levels, Body Mass Index (BMI) and blood pressure readings. Controls found to be diabetic were counselled and directed to attend the nearest health facility for confirmation and treatment.

Results

Table 1 shows the background characteristics of participants who were involved in the study. Out of the total of 226 participants, 75 were cases and 126 were controls. The overall mean age of the participants was 58.0± 10.8. The mean age for the cases was 59.89± 9.92 and that for the controls was 57.02 ±11.15. Participants below 40 years were 9, out of which 1 (1.3%) was a case and 8 (5.3%) were controls. Participants aged between 40-50 years were 50 (22.1%) out of which 12 (16.0%) were cases and 38 (25.2%) were controls. A total of 82 (36.3%) participants were aged between 51-60 years, out of which 27 (36.0%) were cases and 55 (36.4%) were controls. Participants who were 60 years and above were 85 (37.6%) of which, 35 (46.7%) were cases and 50 (33.1%) were controls.

A total of 73 (32.3%) were males out of which 25 (33.3%) were cases and 48 (31.8%) were controls. Female participants were 153 (67.7%) out of which 50 (66.7%) were cases and 103 (68.2%) were controls.

The majority, 114 (50.4%) of the participants attained JHS level of education of which 32 (42.67) were cases and 82 (54.3%) were controls. This was followed by tertiary, 31 (13.7%) out of which 20 (26.7%) were cases and 11 (7.3%) were controls. Senior High School (SHS) level of education attainment was 30 (13.3%) out of which 9 (12.0%) were cases and 21 (13.9%) were controls; the rest 51 (22.6%) did not have any formal education of which 14 (18.7%) were cases and 37 (24.5%) were controls.

The least of the participants, 30 (13.3%) had been to SHS, with 9 (12.0%) as cases and 21 (13.9%) as controls. A total of 41 (18.1%) participants were single out of which 6 (8.0%) were cases and 35 (23.2%) were controls. The majority, 143 (63.27%) of the participants were married out of which 51 (68.0%) were cases and 92 (60.9%) were controls, 35 (15.5%) were widowed of which 16 (21.3%) were cases and 19 (12.6%) were controls. Participants who were divorced were only 7 (3.1%), of which 2 (2.7%) were cases and 5 (3.3%) were controls. A total of 60 (26.6%) participants were unemployed/retired, out of which 28 (37.3%) cases and 32 (21.19%) were controls. The majority, 67 (29.75%) of the participants were traders, out of which 19 (25.3%) were cases and 48 (31.8%) were controls. Participants who were farmers were 46 (20.4%), of which 16 (21.3%) were cases and 30 (19.9%) were controls. Artisans were 26 (11.5%) out of which 3 (4.0%) were cases and 23 (15.2%) were controls and Civil servants were also 27 (12.0%), of which 9 (12.0%) were cases and 18 (11.9%) were controls. The majority 220 (97.35) of the participants were Christians, out of which 71 (94.7%) were cases and 149 (98.7%) were controls and the rest 6 (2.7%) were Muslims, of which 4 (5.3%) were cases and 2 (1.3%) were controls.

Table 1 Background characteristics of respondents

Characteristics	Cases [n=75] n(%)	Controls [n=151] n(%)	Total (%) N = 226

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Number Recruited	75 (33.2)	151 (66.8)	226 (100)
Mean Age (SD)	59.89 (9.9)	57.02 (11.2)	58.0 (10.8)
Age Group			
< 40 years	1 (1.3)	8 (5.3)	9 (4.0)
40-50 years	12 (16.0)	38 (25.1)	50 (22.1)
51-60 years	27 (36.0)	55 (36.4)	82 (36.3)
>60 years	35 (46.8)	50 (33.1)	85 (37.6)
Sex of Respondents			
Male	25 (33.3)	48 (31.8)	73 (32.3)
Female	50 (66.7)	103 (68.2)	153 (67.7)
Highest Level of Education attained			
None	14 (18.7)	37 (24.5)	51 (22.6)
JHS	32 (42.7)	82 (54.3)	114 (50.4)
SHS	9 (12.0)	21 (13.9)	30 (13.3)
Tertiary	20 (26.7)	11 (7.3)	31 (13.7)
Marital Status of Respondents			
Single	6 (8.0)	35 (23.2)	41 (18.1)
Married	51 (68.0)	92 (60.9)	143 (63.3)
Divorced	2 (2.7)	5 (3.3)	7 (3.1)
Widowed	16 (21.3)	19 (12.6)	35 (15.5)
Occupation of Respondents			
Unemployed/Retired	28 (37.3)	32 (21.2)	60 (26.6)
Trading	19 (25.3)	48 (31.8)	67 (29.7)
Farming	16 (21.3)	30 (19.9)	46 (20.4)
Artisan	3 (4.0)	23 (15.2)	26 (11.0)
Civil servant	9 (12.0)	18 (11.9)	27 (12.0)

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Religious Affiliation			
Christians	71 (94.7)	149 (98.7)	220 (97.4)
Muslims	4 (5.3)	2 (1.3)	6 (2.6)

Classification of diabetes

Figure 1 shows the classification of DM2. Participants who had fasting blood glucose (FBS) less than 7.0mmol/l were classified as normal and those who had FBS > 7.0 were classified as diabetics. At the time of the survey, 29.3% of the cases had normal blood glucose levels (controlled diabetes) whilst 70.7% still had high blood glucose (Uncontrolled diabetes). Among the controls, 8.6% had high FBS (Undiagnosed diabetic) and 91.4% had normal blood glucose (non-diabetic).

Figure 1, therefore, shows the classification of DM2 among cases and controls. Type 2 diabetes was higher among the cases than in the controls (70.7% vs. 8.6%).

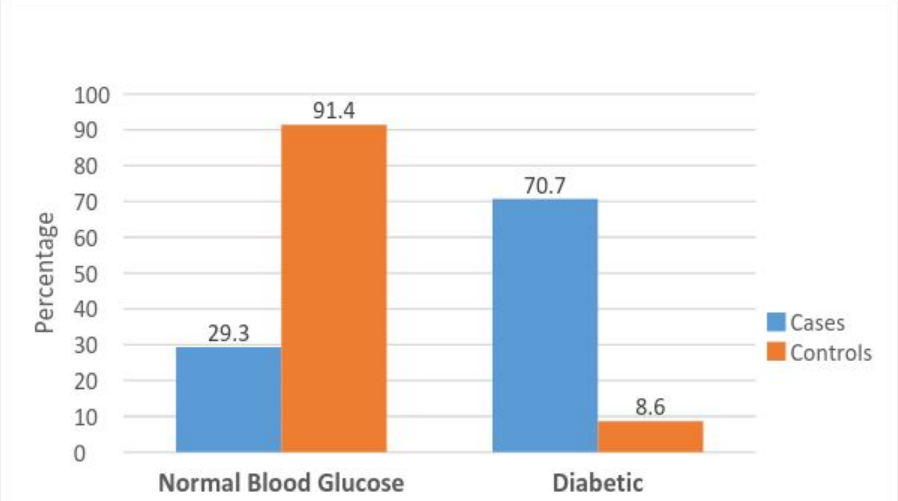

Figure 1: Comparison of Diabetic status among cases and controls

Association between background characteristics and diabetes

Table 2 shows the association between background characteristics and diabetes. There was no significant association between age, sex and DM2 (χ^2 = 6.33, p= 0.097, α = 0.05) and (χ^2 = 0.05, p= 0.815, α= 0.05) respectively. There was also no significant association between religion and DM2 (χ^2 = 3.12, p= 0.078, α= 0.05). There was however, a significant association between occupation and DM2 (χ^2 =11.1, p=0.025, α= 0.05), and between level of education attained and DM2 (χ^2 = 15.96, p= 0.001, α= 0.05). There was also a significant association between marital status and DM2 (χ^2 =9.31, p=0.025, α= 0.05).

Association between Anthropometric measurements, HPT and DM2

Table 2 shows the association between anthropometric measurements, Hypertension (HPT) and DM2. There was no significant association between Body Mass Index (BMI) and DM2 (χ^2 = 5.47, p= 0.140, α= 0.05), and also between HPT and DM2 (χ^2 = 5.17, p= 0.075, α= 0.05).

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Association between Lifestyle and DM2

Table 2 summarizes the associations between lifestyle and DM2. There was no significant association between smoking and DM2 (χ^2= 0.11, p=0.743, α= 0.05), and also between vigorous exercise and DM2 (χ^2=0.46, p=0.498, α= 0.05). However, there was a significant association between moderate exercise and DM2 (χ^2 =10.85, p=0.004, α= 0.05), and also between alcohol consumption and DM2 (χ^2 =7.04, p=0.030, α= 0.05). There was also a significant association between fruit intake, vegetable intake, oil intake and DM2 (χ^2 =18.42, p< 0.001, α= 0.05) and (χ^2 =6.48, p= 0.039, α= 0.05) (χ^2 =16.35, p< 0.001, α= 0.05) respectively. There was also a significant association between salt intake and DM2 (χ^2 =16.40, p< 0.001, α= 0.05).

Table 2 shows the association between awareness of DM2 and Diabetes. There was a significant association between awareness of DM2 and DM2 (χ^2 =200.95, p< 0.001, α= 0.05).

Table 2 also summarizes the association between risk factors and DM2. Participants aged between 40-50 and 51-60 were 1.50 and 1.04 times more likely to develop DM2 as compared to those below the age of 40 years; however, the difference was not statistically significant (AOR= 1.50, CI= 0.24, 9.55, p= 0.666) and (AOR= 1.04, CI= 0.19, 5.8, p= 0.961) respectively. Participants aged 60 years and above were 0.63 times less likely to develop DM2 as compared to those below the age of 40 years; however, the difference was not statistically significant (AOR= 0.63, CI= 0.10, 3.78, p= 0.613).

Respondents who were married were 0.12 times less likely to develop DM2 as compared to those who were single and the difference was statistically significant (AOR= 0.12, CI= 0.03, 0.88, p< 0.001). Respondents who were divorced were 0.31 time less likely to develop DM2 as compared to those who were single; however, the difference was not statistically insignificant (AOR= 0.31, CI= 0.07, 1.32, p= 0.113).

There was no significant association between Trading and DM2. Traders were 2.51 times more likely to develop DM2 as compared to those who were unemployed/retired (AOR= 2.51, CI= 0.91, 6.90, p= 0.076). However, there was no significant association between farmers, Civil servants and DM2. Respondents who were farmers, and civil servants were 2.20 and 1.31 times more likely to develop DM2 as compared to those who were unemployed/retired and the difference was statistically significant (AOR= 2.20, CI= 0.72, 6.72, p= 0.164) and (AOR= 1.31, CI= 0.39, 4.35, p= 0.663), respectively. Respondents who were artisans were 5.21 times more likely to develop DM2 as compared to those who were unemployed/retired (AOR= 5.21, CI= 1.16, 23.48, p= 0.032)

Also, current and ex-consumers of alcohol were 2.24 and 2.29 times more likely to develop DM2 as compared to those who did not consume alcohol. However, the result was statistically not insignificant (AOR= 2.24, CI= 0.94, 5.35, p= 0.068) and (AOR= 2.29, CI= 0.45, 11.60, p= 0.317) respectively.

Participants who consumed fruit 1.3 times per week were 0.20 times less likely to develop DM2 as compared to those who did not consume fruits within a week but the difference was not statistically insignificant (AOR= 0.20, CI= 0.04, 1.05, p=0.058). Those who consumed fruit more than 3 days per week were 0.10 times less likely to develop DM2 as compared to those who did not consume fruits within a week and the difference was statistically insignificant (AOR= 0.10, CI= 0.02, 0.62, p=0.013).

Participants whose work involves vigorous exercises were odds 0.31 less likely to develop DM2 than those who did not do any vigorous exercise. The difference was statistically insignificant (AOR= 0.31, CI= 0.10, 0.94, p=0.039).

Underweight individuals were 0.70 time less likely to develop DM2 than those who had normal weight (AOR= 0.70, CI= 0.04, 12.21, p= 0.810). Overweight individuals were 1.93 times more likely to develop DM2 as compared to those who had normal weight (AOR= 1.93, CI= 0.84, 4.43, p= 0.120).

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Participants who were obese were 0.37 time less likely to develop DM2 than those who had a normal weight and the difference was statistically significant (AOR= 0.37, CI= 0.15, 0.95, p= 0.0.038).

The family history of DM2 was significantly associated with DM2. Those who did not have family history of diabetes or were not aware of any family member having DM2 were 2.62 and 2.87 times less likely to develop DM2 as compared to those who had family history of DM2 (AOR= 2.62, CI= 1.17, 5.87, p= 0.020) and (AOR= 2.87, CI= 1.04, 7.93, p= 0.042)

Participants with HPT were 1.46 times more likely to develop DM2 as compared to those who had normal blood pressure (AOR= 1.46, CI= 0.57, 3.69, p= 0.426).

Prevalence of HPT among Participants

Figure 2 shows the prevalence of HPT was higher among the cases than the controls (69.3% vs. 53.6%, p= 0.031)

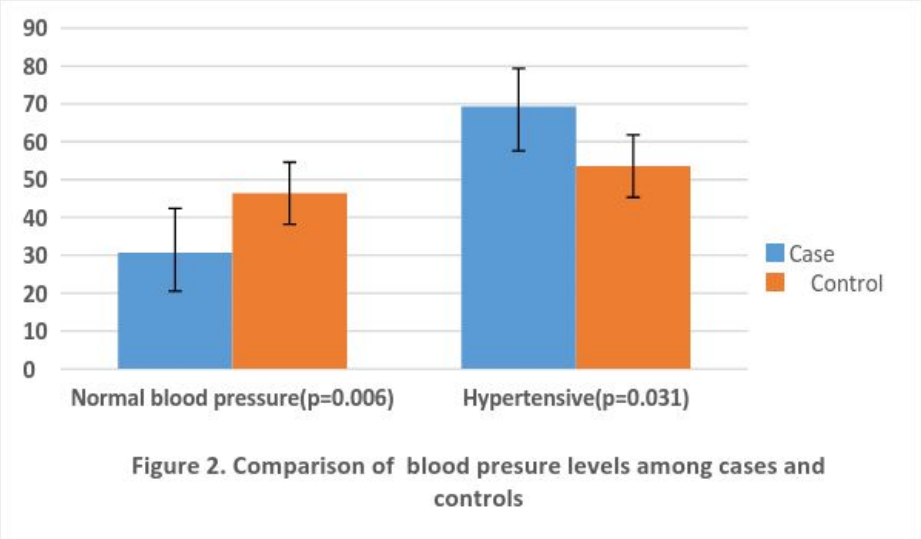

Figure 2. Comparison of blood presure levels among cases and controls

Table 2. Association between risk factors and odds of Diabetes

Characteristics	Cases [n=75] n(%)	Controls [n=151] n(%)	Total [n=226] n(%)	Chi -2 (χ^2) (p-value)	COR(95% CI) p-value	AOR (95% CI) p-value
Age of Respondents in years						
< 40 years	1 (1.3)	8 (5.3)	9 (4.0)			
40-50 years	12 (16.0)	38 (25.2)	50 (22.1)		2.28 (0.48, 10.87) 0.302	1.50 (0.24, 9.55) 0.666
51-60 years	27 (36.0)	55 (36.)	82 (36.3)		1.36 (0.31, 5.93) 0.679	1.04 (0.19, 5.81) 0.961
>60 years	35 (46.7)	50 (33.1)	85 (37.6)	6.33(0.097)	0.83 (0.19, 3.54) 0.799	0.63 (0.10, 3.78) 0.613
Sex of Respondents						
Male	25 (33.3)	48 (31.8)	73 (32.3)			

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Female	50 (66.7)	103 (68.2)	153 (67.7)	0.05(0.815)	1.06 (0.58, 1.97) 0.831	
Highest Level of Education attained						
None	14 (18.7)	37 (24.5)	51 (22.6)			
JHS	32 (42.7)	82 (54.3)	114 (50.4)		0.90 (0.42, 1.95) 0.793	
SHS	9 (12.0)	21 (13.9)	30 (13.3)		0.84 (0.30, 2.38) 0.752	
Tertiary	20 (26.7)	11 (7.9)	31 (13.3)	15.96(<0.001)	0.25 (0.10, 0.66) 0.005	
Marital Status of Respondents						
Single	6 (8.0)	35 (23.2)	41 (18.1)			
Married	51 (68.0)	92 (60.9)	143 (63.3)		0.20 (0.07, 0.58) 0.003	0.12 (0.04, 0.42) 0.001)
Divorced	18 (24.0)	24 (15.9)	42(18.6)	9.31(0.025)	0.30 (0.09, 1.05) 0.060	0.31(0.07, 1.32) 0.113
Occupation of Respondents						
Unemployed/Retired	28 (37.3)	32 (21.2)				
Trading	19 (25.3)	48 (31.8)	60 (26.6)		2.13 (0.99, 4.58) 0.053	2.51 (0.91, 6.90) 0.076
Farming	16 (21.3)	30 (19.9)	67 (29.7)		1.69 (0.74, 3.86) 0.211	2.48 (0.84, 7.37) 0.101
Artisan	3 (4.0)	23 (15.2)	46 (20.4)		5.11 (1.38, 18.93) 0.015	5.21 (1.16, 23.48) 0.032
Civil servant	9 (12.0)	18 (11.9)	26 (11.5)	11.17(0.025)	1.13 (0.44, 2.89) 0.793	1.31 (0.39, 4.35) 0.663
Religion			27 (12.00)			
Christianity	71 (94.)	149 (98.7)	220 (97.4)			
Islam	4 (5.33)	2 (1.3)	6 (2.7)	3.12(0.078)	0.08(0.01, 0.67) 0.020	
Alcohol Intake						
Never Drink	56 (74.7)	95 (62.9)	151 (66.8)			
Current Drinker	13 (17.3)	50 (33.1)	63 (27.9)		1.63 (0.82, 3.24) 0.162	2.13 (0.91, 5.00) 0.080
Ex-Drinker	6 (8.0)	6 (4.0)	12 (5.1)	7.04(0.030)	0.93 (0.27, 3.25) 0.912	1.89 (0.42, 8.59) 0.408
Fruits						
No fruits per week	2 (2.7)	20 (13.3)	22 (9.7)			
1-3 days	54	120	174		0.26 (0.05,	0.18 (0.03, 0.91)

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	(72.0)	(79.5)	(77.0)		1.13) 0.072	0.039
More than 3 days	19 (25.3)	11 (7.3)	30 (13.3)	18.42(<0.001)	0.10 (0.20, 0.51) 0.005	0.08 (0.01, 0.51) 0.007.
Vegetables						
No vegetables per week	1 (1.3)	5 (3.3)	6 (2.65)			
1-3 days	30 (40.0)	84 (55.6)	114 (50.4)		0.75 (0.08, 6.73) 0.797	
More than 3 days	44 (58.7)	62 (41.1)	106 (46.9)	6.48(0.039)	0.31 (0.04, 2.81) 0.302	
Oil Usage						
Palm oil	29 (38.7)	98 (64.9)	127 (56.2)			
Vegetable Oil	37 (49.3)	48 (31.8)	85 (37.6)		0.65 (0.39, 1.21) 0.176	
Coconut oil	9 (12.0)	5 (3.3)	14 (6.2)	16.35(<0.001)	0.32 (0.11, 0.99) 0.049	
Salt Intake	38 (50.7)	36 (23.8)	74 (32.7)			
Low	32 (42.7)	98 (64.9)	130 (57.5)			
Moderate	5 (6.7)	17 (11.3)	22 (9.7)	16.40(<0.001)		
High						
Moderate Exercise						
None	29 (38.7)	32 (21.2)	61 (27.0)			
1-3 days per week	32 (42.7)	64 (42.4)	96 (42.5)		1.30 (0.67, 2.53) 0.444	
More than 3 days a week	14 (18.7)	55 (36.4)	69 (30.5)	10.85(0.004)	3.83 (1.64, 8.90) 0.002	
Vigorous Exercise						
No	62 (82.7)	130 (86.1)	192 (85.0)			
Yes	13 (17.3)	21 (13.9)	34 (15.0)	0.46(0.498)	0.84(0.38, 1.84) 0.662	0.31 (0.10, 0.90) 0.039
(BMI)						
Normal	1 (1.3)	2 (1.3)	3 (1.3)			
Underweight	30 (40.0)	63 (41.7)	93 (41.1)		0.78(0.07, 8.92) 0.839	0.70 (0.04, 12.21) 0.810
Overweight	21 (28.0)	59 (39.1)	80 (35.4)		1.68(0.81, 3.45) 0.158	1.93 (0 .84, 4.43) 0.120
Obese	23 (30.7)	27 (17.9)	50 (22.1)	5.47(0.140)	0.42(0.20, 0.86) 0.018	0.37 (0.15, 0.95) 0.038
Hypertension						
Normal	23 (30.7)	70 (46.4)	93 (41.2)			
Hypertensive	52 (69.3)	81 (53.6)	133 (58.9)	5.17(0.075)	0.82(0.46, 1.49) 0.521	1.46(0.57, 3.69) 0.426

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Discussion

Type 2 diabetes (DM2) is an important cause of morbidity and mortality worldwide. This unmatched case-control study which was carried out in the Hohoe Municipal Hospital and some selected communities in the Municipality examined the associations between socio-demographic characteristics (gender, education, marital status, occupation), lifestyle (alcohol consumption, smoking, dietary practices, exercise) and DM2. It also examined the prevalence of HPT among diabetic and none-diabetic patients. The results of this study were therefore discussed from two aspects: risk factors associated with DM2 and prevalence of HPT among diabetic and none-diabetic individuals.

For socio-demographical characteristics, there were independent significant associations between occupation, the level of education, marital status, religion and DM2. Lifestyle characteristics showed independent significant associations between moderate exercise, fruit consumption, oil usage and DM2. These are all in line with other studies [15-18]. The outcome of the current study showed no statistically significant association between HPT, BMI and DM2, with p-values of 0.521 and 0.539 respectively. The key findings of this study were the significant association between being married and DM2 (p= 0.034). This finding is similar to studies conducted in Croatia [19]. This, however, contradicts cohort studies conducted in the United States over a 20-year period [20]. They observed a significantly increased risk of DM2 among unmarried men. Using a more nuanced assessment of marital status, they realized that widowers, in particular, were at elevated risk of DM2. The outcome of the study also showed a significant association between Artisans and the increasing prevalence of DM2 (p= 0.032). Artisans were 5.21 times more likely to develop DM2 as compared to the other working groups. In a community-based cross-sectional study among the rural population of north Karnataka in India, an association between occupation in general and DM2 was found [21]. This could be attributed to the combined effect of physical inactivity and the stress of being a housewife [17].

The current study also examined the prevalence of hypertension in both cases and controls. Prevalence was higher in cases than in controls (69.3% against 53.6%). However, the prevalence of HPT among controls was unexpectedly high in the municipality. At the time of the survey, more than half of the controls were hypertensive. This was higher than studies done by Bani et al [22], where a prevalence rate of 28.4% was observed among traders in the Hohoe municipality. The difference could be attributed to the target population used in the study since it focused on only traders. The prevalence of HPT among diabetics was 69.3% in the current study, which is comparable to the 70.4%, 74% and 73% rates of HPT in Moroccan, UK Caucasians and Spanish populations [21], [23] and [24] respectively.

Conclusions

Diabetes is a growing public health problem in the developing countries. Its high prevalence continues to increase daily from the global point of view. The risk factors that were strongly associated with DM2 in this study were marital status and occupation. Other independent associations were the level of education, dietary behaviour and physical inactivity. Although the cases in this study have been receiving medicine and counselling on how to manage DM2, the prevalence rate was still high (70.7%). More work, therefore, needs to done in this area. Moreover, the prevalence of DM2 among controls in this unmatched study was 8.6% which was unexpectedly high, which may also need to be investigated again for confirmation.

Recommendations

Health education programmes would be intensified within populations, especially at the marketplaces where most of the individuals at risk can be found. It should focus on educating the public on the need to engage in physical activities which reduce the risk of developing DM2. Also, screening of populations should be used as an avenue to screen at-risk individuals, considering that 96.0% of controls had no idea about their diabetic status. These screening programs will provide enough information to alert people to live healthy lifestyles and also seek timely medical attention as needed to reduce complications associated with DM2.

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List of Abbreviations

DM: Diabetes Mellitus, DM2: Type 2 diabetes mellitus, HPT: Hypertension, BP: Blood Pressure, WHO: World Health Organization, BMI: Body Mass Index, SSA: Sub-Saharan Africa, NCD's: Non-communicable Diseases, CVD's: Cardiovascular Diseases, GDHS: Ghana Demographic and Health Survey, UHAS: University of Health and Allied Sciences, SPH: School of Public Health, GHS-ERC: Ghana Health Service- Ethical Review Committee.

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