Journal of Advances in Medicine and Medical Research

23(2): 1-12, 2017; Article no.JAMMR.33846
ISSN: 2456-8899
(Past name: British Journal of Medicine and Medical Research, ISSN: 2231-0614, NLM ID: 101570965)

Risk Factors Associated with Diabetes Mellitus among Adults in the Hohoe Municipality of Ghana

Joseph Wolorm Kwame Fiagbe[1], Wisdom Takramah[1], Wisdom Kudzo Axame[1], Richard Owusu[1], Phyllis Atta Parbey[1], Martin Adjuik[1], Mohamed Takase[2], Elvis Tarkang[3*] and Margaret Kweku[1]

[1]Department of Epidemiology and Biostatistics, School of Public Health, University of Health and Allied Sciences, Ho, Ghana.
[2]School of Biological Sciences, University of Cape Cast, Cape Coast, Central Region, Ghana.
[3]Department of Population and Behavioural Sciences, School of Public Health, University of Health and Allied Sciences, Ho, Ghana.

Authors' contributions

This work was carried out in collaboration between all authors. Authors JWKF and MK conceived the study. Authors JWKF, MK, WT, MA, WKA, PAP and RO did the data analysis and wrote the methods section. Authors JWKF, MK, MT, WT and ET were responsible for the initial draft of the manuscript. All authors reviewed and approved the final version of the manuscript.

Article Information

DOI: 10.9734/JAMMR/2017/33846
Editor(s):
(1) Kate S Collison, Department of Cell Biology, King Faisal Specialist Hospital & Research Centre, Saudi Arabia.
(2) Mohamed Essa, Department of Food Science and Nutrition, Sultan Qaboos University, Oman.
(3) Salomone Di Saverio, Emergency Surgery Unit, Department of General and Transplant Surgery, S. Orsola Malpighi University Hospital, Bologna, Italy.
Reviewers:
(1) Mohamed Najimudeen, Melaka Manipal medical college, Malaysia.
(2) Anonymous, StemRx Bioscience Solutions Pvt. Ltd. R - 831, India.
(3) Chaitanya Malladi, Sheridan College, Canada.
(4) Eze Ejike Daniel, Kampala International University, Uganda.
Complete Peer review History: http://www.sciencedomain.org/review-history/20311

Original Research Article

Received 1st May 2017
Accepted 3rd July 2017
Published 1st August 2017

ABSTRACT

Background: Diabetes Mellitus (DM), one of the Non-Communicable Diseases (NCDs) is a major cause of morbidity and mortality worldwide and is increasingly becoming an important public health concern. This study examined the prevalence, control and risk factors associated with DM2 among adults in the Hohoe Municipality.
Methods: This was a hospital-based case control study that involved 70 cases and 140 controls.

**Corresponding author: E-mail: ebeyang1@yahoo.com;*

Data was collected using a face-to-face interview with structured questionnaires. Blood pressure, fasting blood glucose and anthropometric indices were measured with appropriate instruments following standard procedures. Differences in means were determined using t-test. The Chi-square test and the conditional logistic regression model were used to determine association and the strength of the association between independent categorical variables and DM2 respectively.

Results: Uncontrolled diabetes among cases was 78.6%. Prevalence of hypertension among cases was higher (64.3%) than in controls (60.0%). Adults with overweight and obesity were 13.03 and 12.81 times more likely to develop diabetes (AOR=13.02, p=0.011) and (AOR=12.81, p=0.015) respectively. Civil servants were 0.15 times less likely to have diabetes (AOR=0.15, 0.048). Adults who recently tested their blood glucose, or current/ex-smokers were 12.03 and 12.88 times more likely to develop diabetes (OR=12.03, p<0.001) and (OR=12.88, p=0.037) respectively.

Conclusion: One out of 5 diabetics could not control their blood glucose levels. Six out of 10 diabetics had hypertension. Recent testing of blood sugar, overweight and obesity, smoking and occupation were factors found to be associated with diabetes in the Hohoe Municipality.

Keywords: Type 2 diabetes mellitus; hospital-based; hypertension; cases; controls; risk factors; Hohoe; Ghana.

ABBREVIATIONS

BMI: Body Mass Index; BP: Blood Pressure; DALYs: Daily Adjusted Life Years; DHIMS: District Health Information Management System; DKA: Diabetic Ketoacidosis; DM: Diabetes Mellitus; DM 2: Diabetes Mellitus Type 2; GBDs: Global Burden Disease Study; GDM: Gestational Diabetes Mellitus; GDHS: Ghana Demographic and Health Survey; GHS: Ghana Health Service; GHS-ERC: Ghana Health Service- Ethical Review Board; HBP: High Blood Pressure; HPT: Hypertension; IFG: Impaired Fasting Glycaemia; IGT: Impaired Glucose Tolerance (IGT); IHME: Institute for Health Metrics and Evaluation; MOH: Ministry of Health; NCDs: Non-Communicable Diseases; SPH: School of Public Health; SSA: Sub-Saharan Africa; UHAS: University of Health and Allied Sciences; WHO: World Health Organization; WHR: Waist to Hip Ratio.

1. INTRODUCTION

Diabetes Mellitus (DM) is a metabolic disease characterized by hyperglycaemia resulting from defects in insulin secretion and action or both. Diabetes is a condition that occurs when the body cannot utilize glucose. The levels of glucose in the blood are controlled by a hormone called insulin produced by the pancreas, and insulin helps glucose to enter the cells.

The effects of DM include long-term damage, dysfunction and failure of various organs [1]. Diabetes Mellitus occurs either when the pancreas does not produce sufficient insulin (a hormone that regulates blood glucose) (Diabetes Type 1), or when the body cannot effectively use the insulin it produces (Diabetes type 2) [2]. This causes the glucose levels in the blood to rise, leading to symptoms such as frequent urination, lethargy, excessive thirst and hunger [3].

Type 2 Diabetes Mellitus (DM2) is a principal cause of morbidity and mortality and 422 million adults live with diabetes globally [4]. The number of people with diabetes has risen from 108 million in 1980 to 422 million in 2014 [4]. The global prevalence of diabetes among adults over 18 years of age has risen from 4.7% in 1980 to 8.5% in 2014 and is said to be the major cause of blindness, kidney failure, heart attacks, stroke and lower limb amputation [5]. In 2012 alone, diabetes and high blood glucose globally killed 1.5 and 2.2 million people respectively [6]. In 2014, 8.5% adults aged 18 years and older had diabetes [5]. The International Diabetes Federation (IDF), reported that persons affected by Diabetes worldwide in 2015 were 415 million, of which 14million were from Sub-Saharan African and 266,200 cases from Ghana [7].

When diabetes is not well managed, complications which threaten health and life may develop. Over time, diabetes can damage the heart, blood vessels, eyes, kidneys and nerves, and increase the risk of heart disease and stroke. Such damages can result in reduced blood flow, which when combined with nerve damage (neuropathy) in the feet, increases the chance of foot ulcers, infection and the eventual need for

limb amputation. Diabetic retinopathy is an important cause of blindness and occurs as a result of long-term accumulated damage to the small blood vessels in the retina. Diabetes can increase rates of specific cancers and physical and cognitive disability [6].

There are numerous factors that affect the management of diabetes. Several dietary practices are related to unhealthy body weight and/or DM2 risk. High intake of saturated fatty acids, high total fat intake, sugar-sweetened beverages which contain substantial amounts of free sugars and inadequate consumption of dietary fibre increase the likelihood of being overweight or obese, particularly among children [1].

Studies have shown that Hypertension has a high prevalence in diabetic patients and contributes to the risk of renal disease and heart failure [8-10]. Shanthi and colleagues reported that only 1 in 4 diabetic patients attained optimal DM2 controls [9]. A study by the third National Health and Nutritional Examination Survey (NHANES-III) revealed that 31% of all diabetics and nearly 60 in every 100 of diabetics had HPT [11,12]. Similarly, it was found among Moroccan Sahraoui women that, about 7 in 10 of the diabetics had HPT [13]. In Nigeria, it was found that 75% of adults with diabetes also had HPT [14].

Socio-economic and demographic factors such as age, sex, ethnicity, education level, marital status, employment, retirement status and Health Insurance are said to be associated with DM2.Age has shown to be associated with diabetes. Age and family history have been found to be associated with diabetes [1,9,15,16]. A study conducted in Senegal revealed females to be more prone to DM2 than males (9% vs. 6%) [15].

Lifestyle behaviours play a major role in DM2, and their effect on Diabetes have been given increasing attention in the past decade. Studies have shown that exercise or weight control and adherence to prescribed medication, diet and appointment schedule, improve DM2 in patients with diabetes. Exercise or weight loss as well as diet helps to regulate the production of glucose in the body. Diet has been proven to be associated with diabetes. A study conducted in Algeria reported that, those who do not follow recommended eating patterns were 1.8 times more likely to develop DM2 [10,12,14,17,18].

Early childhood nutrition can affect the risk of DM2 later in life and that, factors that appear to increase risk include poor foetal growth, low birth weight and high birth weight. The report also indicated that active smoking increases the risk of DM2, especially among heavy smokers and the risk remains elevated for about 10 years after smoking cessation [19].

The prevention and control of DM2 have not received much attention in many developing countries like Ghana despite the fact that it is one of the most modifiable risk factors for Metabolic (Endocrine) diseases. Data from the District Health Information Management System 2 (DHIMS 2) (2014) indicates that in the Volta Region, DM2 cases rose from 16,472 in 2013 to 16,549 in 2015. Type 2 diabetes is ranked fourth among the non-communicable diseases in Ghana.

After the establishment of a diabetic clinic at the Hohoe Municipal hospital (HMH) in 2011, DM2 has received attention in the Hohoe Municipality. The Annual Report of the Hohoe Municipal Health Directorate (HMHD) (2015) indicated that DM2 increased from 952 in 2013 to 1,751 in 2015. Diabetes Mellitus accounted for 3.7% and 6.6% in Out Patient Department (OPD) cases of morbidity in 2013 and 2015 respectively [20]. This study determined risk factors associated with DM2 among adults in the Hohoe municipality. It also assessed how DM2 is controlled and the prevalence of HPT among diabetics.

2. MATERIALS AND METHODS

2.1 Study Area

Hohoe Municipality is one of the 25 administrative districts/municipalities in the Volta Region of Ghana. The municipality has a total land surface area of 1,172 km square, which is 5.6% of the regional and 0.05% of the National land surface area. It shares boundary to the East with The Republic of Togo, forming part of the International borders, on the South East by the Afadzato District and the SouthWest with Kpando Municipal, on the North East with Jasikan District and on the North West with Biakoye District. The capital, Hohoe, is located about 78 km away from Ho, the Regional Capital and 220 km from Accra, the National Capital of Ghana. According to the 2010 population census, Hohoe had a total population of 167,016, representing 7.9% of the total population of the Volta Region. The major

ethnic groups in the municipality are Ewes, Lolobis, Sankrokofis and Likpes. Economic activities engaged by the people in the municipality include agriculture, petty trading, construction and formal sector.

2.2 Study Population

The study population was adults aged 18 years and above residing in the Hohoe municipality.

2.3 Exclusion and Inclusion Criteria

2.3.1 Inclusion criteria for cases

Adults residing in the Hohoe Municipality who were attending the Diabetic Clinic at the Hohoe Municipal hospital and consented to participate in the study were included.

2.3.2 Inclusion criteria for controls

Adults residing in the Hohoe Municipality and attending the Hohoe Municipal Hospital with other conditions apart from diabetes who consented to participate in the study were included.

2.3.3 Exclusion criteria for cases

Adults with diabetes but who did not reside within the Hohoe Municipality, pregnant women, seriously ill patients requiring admission and unable to give consent were excluded in the study.

2.3.4 Exclusion criteria for controls

Adults not having diabetes and outside Hohoe Municipality, pregnant women and seriously ill patients requiring admission for other conditions apart from diabetes and not able to give consent were excluded from the study.

2.4 Study Design

This was a hospital-based age and sex-matched case-control study and involved adults aged 18 years and above attending Hohoe Municipal hospital in January 2017. The cases included respondents who were diabetics and were attending the diabetic clinic at the Hohoe Municipal Hospital. Two controls were selected from the Out-Patient Department (OPD) to match each case. The controls were patients with similar characteristics such as age and sex and resided within the municipality and had visited the hospital with other conditions apart from Diabetes Mellitus.

2.5 Sample Size Determination

A sample size of 210 participants (70 cases and 140 controls) was obtained using the sample size formula for unmatched case-control study [21]. Reliability coefficient (Z_α) of 1.96 at 95% confidence level, the power of 80% (Z_β=0.84), an expected prevalence of 6%, Odds Ratio (OR) of 4.2 and a ratio of proportionality of 1 case: 2 controls were plugged into the formula.

2.6 Sampling Method

The cases were selected from the diabetic clinic at Hohoe Municipal Hospital using simple random sampling technique (lottery). However, a convenience sampling technique was employed to select the controls. A one-to-two (1 case: 2 controls) ratio was adopted to select controls with similar characteristics (age ±5 years and sex) in the same hospital who resided within the Municipality. The controls were those who reported at OPD with other disease conditions such as malaria, hypertension, eye problems, dental problems, chest infections and abdominal pains. Seriously ill patients requiring hospital admission and pregnant women were not included in the study.

2.7 Data Collection

Data was collected with reference to WHO STEPWISE [22] approach for non-communicable disease surveillance (Diabetes Mellitus) on risk factors assessment with particular emphasis on steps 3.Step 1 was used to capture information associated with nutritional habit, sedentary lifestyle, socio-demographic characteristics and many others with the use of a questionnaire which was administered through a face-to-face interview. Step 2 was used to collect information on weight, height, waist to hip ratio, blood pressure level and BMI (This was carried out with the use of tools such as an electronic weighing scale, Stadiometer, Glucometer, tape measure and digital blood pressure monitor) including Step 1.Step 3 was used to collect finger-prick blood samples which were used to measure the level of both random and fasting blood glucose using a digital Glucometer (*ONETOUCH* Ultra Easy blood glucose monitoring system, *LIFESCAN Johnson & Johnson company*New Jersey-USA).

2.7.1 Anthropometric measurements

Heights of respondents were measured with a Stadiometer (SECA Leicester height measure with a fixed footplate and movable headboard made in the United Kingdom) to the nearest 0.1 centimetres. Weight was measured with digital weighing scale (Bed and Bathroom model BB-3018A manufactured by Conair Company based in the USA) with respondents dressed in light clothing to the nearest 0.1 kilogrammes. All anthropometric measurements were taken in triplicates and in accordance with WHO standard anthropometry guidelines.

2.7.2 Measurement of blood pressure

Blood pressure levels of respondents were measured with the aid of digital blood pressure monitor (Omron M2 Basic manufactured in India by Omron Company). Respondents were made to rest for at least 10 minutes before their blood pressures checked. BP was checked atone-minute intervals for 3 three times of which the average reading was recorded.

2.8 Classifications of Blood Glucose and Blood Pressure

Classifications of blood glucose levels were done using the cut-off standard point of American Diabetes Association.

2.8.1 Fasting blood glucose levels (FBS)

Diabetes diagnosed at fasting blood glucose of ≥ 126 mg/dl or FBS >7.0 mmol/L. Fasting means not having anything to eat or drink (except water) for at least 8 hours before the test).

2.8.2 Random blood glucose levels (RBS)

Diabetes is diagnosed with a blood glucose value of ≥ 200 mg/dl or RBS> 11.0 mmol/L. Random blood sugar test means the test was done at any time of the day when one had eaten.

2.8.3 Classification of diabetes

Diabetes was classified based on recommended cut-offs [5] as follows:

Normal (FBG <6.0 mmol/dl); Pre-diabetic (FBG = 6.1-6.9 mmol/dl); Diabetic (FBG≥7.0 mmol/dl).

2.8.4 Classification of hypertension

Hypertension was classified based on recommended cut-offs [5] as follows:

Normal (Systolic BP <120 and Diastolic BP <80 mmHg);

Pre-hypertension (Systolic BP = 120-139 and/or Diastolic BP = 80-89 mmHg);

Hypertension- Stage I hypertension (Systolic BP = 140-159 and/or Diastolic BP = 90-99 mmHg) and Stage II hypertension (Systolic BP > 160 and/or Diastolic BP > 100 mmHg).

2.9 Data Management and Analysis

Data from the field was checked for completeness and accuracy. Data was entered using EpiData version 3.1 data entry software and was later exported to STATA® SE version 13 for data analysis. Data was analysed in frequency distributions, proportions and percentages for categorical variables. The Chi-square test was used to determine the associations between DM2 and demographic characteristics as well as BMI and HPT. Odds ratios, generated through conditional logistic regression, were used to test the strengths of the associations between DM2 and some lifestyle risk factors. A p-value less than 0.05 was considered statistically significant.

2.10 Ethical Issues

Before the commencement of the study, approval was sought from the Ethical Review Committee (ERC) MoH/GHS of the Ministry of Health. Permission was sought from the Hohoe Municipal Health Directorate to carry out the study. A written informed consent was obtained from all respondents. In addition, respondents were informed that participation in the study was entirely voluntary and that they had the right to withdraw from the study if they chose to do so. Controls found to be diabetic or hypertensive were advised to visit the diabetic or hypertension clinic at the Municipal hospital for further investigations, management and counseling.

3. RESULTS

3.1 Background Characteristics of Respondents

Table 1 summarizes the background information of the respondents. Out of a total of 210 respondents, 70 were cases and 140 were controls. Only 19 (9.1%) of the respondents were aged less than 40 years with 3(4.3%) as cases and 16 (11.4%) as controls. The majority of

cases 49 (70.0%) and controls 97 (69.3%) were females while 21 (30.0%) of cases and 43 (30.7%) of controls were males. Only 19 (9.1%) respondents were single out of whom 8 (11.4%) were cases and 11 (7.9%) were controls. The majority 117 (55.7%) of the respondents were married or co-habiting with 37 (52.9%) cases and 80 (57.1%) controls. The respondents with no formal education were 21 (10.0%) of which 5 (7.1%) were cases and 16 (11.4%) were controls. A total of 18 (8.6%) respondents had a primary level of education. However, all of them 18 (12.9%) were controls. A total of 39 (18.6%) of the respondents were unemployed or had retired out of which 21 (30.0%) were cases and 18 (12.8%) were controls. The majority of the respondents were Christians 197 (93.8) with 66 (94.3%) cases and 131 (93.6%) controls. Muslim respondents were 13 (6.2%) out of this, 4 (5.7%) were cases and 9 (6.4%) were controls.

Fig. 1 shows the classification of diabetes among cases. At the time of the survey, 21.4% of the cases had normal blood glucose levels (controlled diabetes) whilst 78.6% had high blood glucose levels.

At the time of the survey, prevalence of HPT among the cases was 64.3% whilst among the controls HPT was 60.0 % as shown in Fig. 2.

3.2 Association between Demographic Characteristics and Diabetes

Table 2 shows the results of the crude and adjusted conditional logistic regressions. In these results educational level was not a risk factor for DM2 since χ^2=5.22 and p=0.156. This implies that respondents who had no education were not different from those who had completed JHS or SHS or Tertiary level in being DM2.

In terms of occupation, traders were 82% less likely to be DM2 compared to those who were unemployed, AOR=0.18, 95% CI (0.06, 0.57), p=0.004 and farmers were 83% less likely to be DM2 compared to those who were unemployed, AOR=0.18, 95% CI (0.06, 0.57), p=0.004. Civil servants were 95% less likely to be DM2 compared to those who were unemployed, AOR=0.05, 95% CI (0.01, 0.57), p<0.001. All above were statistically significant. However, artisans were 62% less likely to be DM2 compared to those who were unemployed, AOR=0.38, 95% CI (0.10, 1.39), p=0.144, but this is not statistically significant.

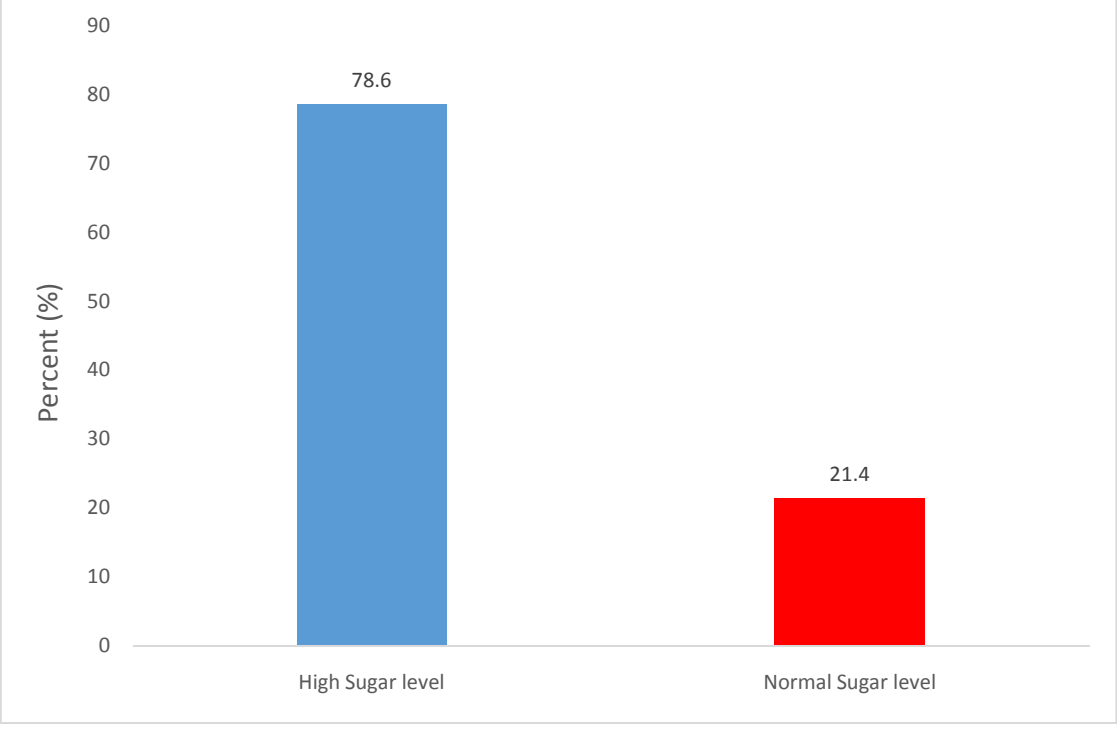

Fig. 1. Classification of diabetes among cases

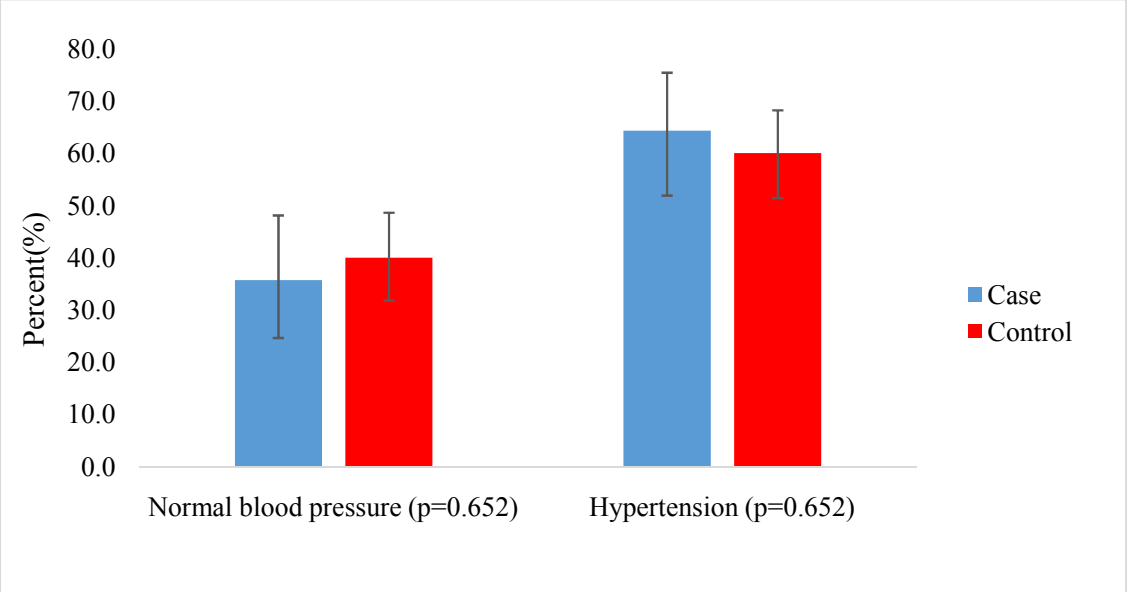

Fig. 2. Prevalence of hypertension among cases and controls

Table 1. Background characteristics of respondents and associations between background characteristics and diabetes

Characteristics	Cases [n=70] n (%)	Controls [n=140] n (%)	Total (%) N=210
Age group (in years)			
< 40	3 (4.3)	16 (11.4)	19 (9.1)
40 – 49	7 (10.0)	13 (9.3)	20 (9.5)
50 – 59	17 (24.3)	35 (25.0)	52 (24.8)
>60	43 (61.4)	76 (54.3)	119 (56.7)
Sex			
Female	49 (70.0)	97 (69.3)	146 (69.5)
Male	21 (30.0)	43 (30.7)	64 (30.5)
Marital status			
Single	8 (11.4)	11 (7.9)	19 (9.1)
Married / Co-habitation	37 (52.9)	80 (57.1)	117 (55.7)
Divorced	9 (12.9)	19 (13.6)	28 (13.3)
Widow/Widower	16 (22.9)	30 (21.4)	46 (21.9)
Educational level			
None	5 (7.1)	16 (11.4)	21 (10.0)
JHS	43 (61.4)	81 (57.9)	124 (59.1)
SHS	10 (14.3)	9 (6.4)	19 (9.0)
Tertiary	12 (17.1)	34 (24.3)	46 (21.9)
Occupation			
Unemployed/Retired	21 (30.0)	19 (13.6)	40 (19.1)
Trading	22 (31.4)	40 (28.6)	62 (29.5)
Farming	10 (14.3)	29 (20.7)	39 (18.6)
Civil servant	5 (7.1)	33 (23.6)	39 (18.1)
Artisan	12 (17.2)	19 (13.6)	31 (14.8)
Religion			
Christianity	66 (94.3)	131 (93.6)	197 (93.8)
Muslims	4 (5.7)	9 (6.4)	13 (6.2)

Table 2. Risk factors associated with diabetes

Characteristics	Normal [n=140] n (%)	Diabetes [n=70] n (%)	Total [n=210] N (%)	Chi -2 (χ^2) (p-value)	COR (95% CI) p-value	AOR (95% CI) p-value
Educational level						
None	16 (11.4)	5 (7.1)	21 (10.0)			
JHS	81 (57.9)	43 (61.4)	124 (59.1)		1.88 (0.57, 6.08) 0.294	
SHS	9 (6.4)	10 (14.3)	19 (9.0)		4.85 (1.01, 23.34) 0.048	
Tertiary	34 (24.3)	12 (17.2)	46 (21.9)	5.22 (0.156)	1.26 (0.33, 4.79) 0.729	
Occupation						
Unemployed	19 (13.6)	21 (30.0)	40 (19.1)			
Trading	40 (28.6)	22 (31.4)	62 (29.5)		0.50 (0.21, 1.21) 0.126	0.18 (0.06, 0.57) 0.004
Farming	29 (20.7)	10 (14.3)	39 (18.6)		0.31 (0.11, 0.86) 0.023	0.17 (0.5, 0.59) 0.005
Civil servant	33 (23.6)	5 (7.1)	38 (18.1)		0.11 (0.03, 0.38) 0.001	0.05 (0.01, 0.24) <0.001
Artisan	19 (13.5)	12 (17.2)	31 (14.7)	15.14 (0.004)	0.53 (0.20, 1.44) 0.216	0.38 (0.10, 1.39) 0.144
Marital status						
Single	11 (7.9)	8 (11.4)	19 (9.1)			
Married/Cohabitation	80 (57.1)	37 (52.8)	117 (55.7)		0.63 (0.23, 1.76) 0.380	
Divorced	19 (13.6)	9 (12.9)	28 (13.3)		0.64 (0.18, 2.23) 0.482	
Widow/Widower	30 (21.4)	16 (22.9)	46 (21.9)	0.87 (0.832)	0.71 (0.20, 2.53) 0.597	
BMI						
Normal weight	61 (43.6)	17 (24.3)	78 (37.2)			
Overweight	38 (27.1)	28 (40.0)	66 (31.4)		2.67 (1.27, 5.61) 0.010	3.48 (1.31, 9.29) 0.013
Obese	41 (29.3)	25 (35.7)	66 (31.4)	7.74 (0.021)	2.30 (1.05, 5.03) 0.037	5.71 (1.71, 19.1) 0.005
Hypertension						
Normal	56 (40.0)	25 (35.7)	81 (38.6)			
Hypertensive	84 (60.0)	45 (64.3)	129 (61.4)	0.36 (0.548)	1.22 (0.66, 2.28) 0.528	
Smoking status						
Never Smoke	130 (92.9)	63 (90.0)	193 (91.9)			
Current /Ex-Smoker	10 (7.1)	7 (10.0)	17 (8.1)	0.51 (0.474)	1.52 (0.51, 4.49) 0.452	
Alcoholic status						
Never consumed Alcohol	65 (46.4)	35 (50.0)	100 (47.6)			
Current/ex-consumers	75 (53.6)	35 (50.0)	110 (52.4)	0.24 (0.625)	0.87 (0.48, 1.54) 0.627	

Characteristics	Normal [n=140] n (%)	Diabetes [n=70] n (%)	Total [n=210] N (%)	Chi -2 (χ^2) (p-value)	COR (95% CI) p-value	AOR (95% CI) p-value
Oils usage						
Don't use oil	1 (0.7)	4 (5.7)	5 (2.4)			
Vegetable oil	50 (35.7)	38 (54.3)	88 (41.9)		0.22 (0.02, 2.03) 0.181	
Palm oil	89 (63.6)	28 (40.0)	117 (55.7)	13.39 (0.001)	0.09 (0.01, 0.81) 0.032	
Salts intake						
Low	47 (33.6)	21 (30.0)	68 (32.4)			
Moderate	68 (48.6)	40 (57.1)	108 (51.4)		1.29 (0.68, 2.44) 0.430	
High	25 (17.8)	9 (12.9)	34 (16.2)	1.57 (0.456)	0.80 (0.32, 2.03) 0.639	
Work involving vigorous physical activity						
No	98 (70.0)	35 (50.0)	133 (63.3)			
Yes	42 (30.0)	35 (50.0)	77 (36.7)	8.04 (0.005)	2.31 (1.28, 4.19) 0.006	3.67 (1.58, 8.50) 0.002
Family history of DM2						
No	89 (63.6)	26 (37.1)	115 (54.8)			
Yes	51 (36.4)	44 (62.9)	95 (45.2)	13.15 (<0.001)	3.08 (1.65, 5.76) <0.001	2.50 (1.13, 5.56) 0.24

Marital status was not considered a risk factor for DM2 since χ^2=0.87 and p=0.832. This implies that single respondents were not different from married/cohabiting, divorced or widowed respondents in being DM2.

Adults who were overweight were 3.48 times more likely to have DM2 compared to those who were normal [AOR=3.48 (95% CI: (1.31-9.29); p=0.013]. Also, adults who were obese were 5.71 times more likely to have DM2 compared to those who were normal [AOR=5.71 (95% CI: (1.71-19.1); p=0.005]. All were statistically significant. Hypertensive status was not a statistically significant risk factor with DM2 as adults who were hypertensive were 22.7% more likely to have DM2 compared to normal adults [AOR=1.27 (95% CI: (0.56-2.89); p=0.567]. Current/Ex-smokers were 18% more likely to have DM2 compared to adults who never smoked [AOR=1.18, 95% CI: (0.28-0.493); p=0.817]. This also was not statistically significant.

Alcohol consumption and salt intake were not considered to be risk factors of DM2 since χ^2 =0.24 and p=0.625 and χ^2 =1.57 and p=0.456 respectively. This implies that, current/ex adult consumers were not different from adults who never consumed in being DM2. Also, there was no difference between low, moderate and high salt consumers χ^2 =1.57, p=0.456.

Respondents who did work involving vigorous physical activity were over 3 times more likely to be DM2 compared to those who did not [AOR= 3.67, 95% CI (1.58, 8.50), p= 0.002].

Respondents with a family history of DM2 were over 2 times more likely to have DM2 compared to those with no family history of DM2 [AOR=2.50 (95% CI: (1.13-5.56); p=0.24], and the result is statistically significant.

4. DISCUSSION

This study investigated the risk factors associated with type 2 Diabetes Mellitus (DM2) among adults in the Hohoe Municipality. The study involved 70 cases and 140 controls. Risk factors identified to be significantly associated with DM2 were occupation, BMI, a family history of DM2 and work involving vigorous physical activity.

This current study revealed that the prevalence of hypertension among cases was 64.3%, even though the association was not statistically significant. This implies that about 6 out of every 10 diabetics had HPT. This is in agreement with what was found by Rgubi in Morocco who found that 7 in every 10 diabetics had HPT. A study in Nigeria also found that 75% of diabetics had HPT [14]. The NHANESS also reported that 60% of diabetics had HPT. Hypertension among diabetics could be due to a defect in the mechanism by which Angiotensin II which activates renin-angiotensin-aldosterone system (RAAS) thereby affecting the function of the pancreas leading to insulin resistance [23].

The current study showed that, only 15 (21.4%) (1 in 5) of individuals among cases had normal blood glucose, that is, had their blood glucose level under control whilst 78.6% still had high blood glucose levels. This is in agreement with what was found by Shanthi where only 1 in 4 attained optimal DM2 controls among diabetic patients [9]. The high rate of uncontrolled DM2 among diabetics could be due to inability to buy drugs, inconsistent medical checkup at the clinic, poor dietary diversity and physical inactivity.

The current study found the family history of DM2 to be associated with DM2. Those with a family history of DM2 were 2.35 times more likely to develop DM2. Similarly, in Kumasi Ghana, it was revealed that individuals with a family history of DM2 were 3.97 times more likely to develop DM2 [22]. Similar findings were also reported in Punjab, India. It was reported that people with a family history of DM2 were 1.4 times more likely to develop the disease [24]. This implies that, the disease has a genetic component and therefore could occur in families.

5. LIMITATIONS OF THE STUDY

Limitation of this study included the case-control design, which recalls bias because some of the respondents found it difficult to recall some information since they were sick. This study was a hospital-based type and results may not reflect what happens in the general population.

6. CONCLUSION

This study has shown that diabetes control among the cases was very poor. Uncontrolled DM2 was 55 (78.6%) in the Hohoe Municipality. Only 1 out of 5 diabetics were able to control their blood glucose level. About 8 (5.7%) of adults were walking about with diabetes and were not aware. Increasing age, marital status, smoking and family history of DM2 were factors found in this study to be associated with DM2.

7. RECOMMENDATIONS

Further studies are required to identify reasons for the poor DM control.

CONSENT

As per international standard or university standard, patient's written consent has been collected and preserved by the authors.

ETHICAL APPROVAL

As per international standard or university standard, written approval of Ethics committee has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Global Report on Diabetes; 2011.
2. Krishnadath ISK, Venrooij LMN, Jaddoe VWV, Toelsie JR. Ethnic differences in prediabetes and diabetes in the Suriname Health Study; 2016.
   Available:http://doi.org/10.1136/bmjdrc-2015-000186
3. Muktabhant B, Sanchaisuriya P, Sarakarn P, Tawityanon W, Trakulwong M, Worawa S, Schelp FP. Use of glucometer and fasting blood glucose as screening tools for diabetes mellitus type 2 and glycatedhaemoglobin as clinical reference in rural community primary care settings of a middle-income country. BMC Public Health. 2012;12(1):349.
4. WHO Global Diabetes Scorecard, N. C. D. The International Diabetes Federation (IDF) response to the WHO first draft of the Framework for country action across sectors for health and health equity; 2015.
5. WHO Diabetes Fact sheet; 2016.
6. WHO World Health Day Report; 2016.
7. International Diabetes Federation (IDF). Response to the WHO first draft of the Framework for country action across sectors for health and health equity; 2015.
8. Poon AK, Juraschek SP, Ballantyne CM, Steffes MW, Selvin E. Comparative associations of diabetes risk factors with five measures of hyperglycemia. BMJ. 2014;1–10.
   Available:http://doi.org/10.1136/bmjdrc-2013-000002
9. Shanthi M, Stephen Davis BN. WHO Global Status Report on NCDs. 2015; (7):2014–2016.
   Available:http://doi.org/10.1161/STROKEAHA.115.008097
10. Kinalska I, Bednarska-chabowska D, Adamiec-mroczek J, Hak Ł. The influence of incretin mimetics on cardiovascular risk factors in diabetes; 2012.
    Available:http://doi.org/10.5402/2012/625809
11. Min H, Chang J, Balkrishnan R. Sociodemographic risk factors of diabetes and hypertension Prevalence in the Republic of Korea. 2010;15–17.
    Available:http://doi.org/10.4061/2010/410794
12. Lexis CPH, Horst-schrivers ANA, Van Der LE, Valente MAE, Kobold ACM, Boer RA, DeIG. The effect of metformin on cardiovascular risk pro file in patients without diabetes presenting with acute myocardial infarction: Data from the Glycometabolic Intervention as adjunct to Primary Coronary Intervention in ST Elevation Myocardial Infarction (GIPS-III) Trial. 2015;1–10.
    Available:http://doi.org/10.1136/bmjdrc-2015-000090
13. Rguibi M, Belahsen R. Prevalence and associated risk factors of undiagnosed diabetes among adult Moroccan Sahraoui women. 2006;9(6):722–727.
    Available:http://doi.org/10.1079/PHN2005866
14. Forlani G, Giorda C, Manti R, Mazzella N, De Cosmo S, Rossi MC. The burden of NAFLD and its characteristics in a nationwide population with type 2 diabetes. J Diabetes Res. 2016;2931985.
    Available:http://doi.org/10.1155/2016/2931985
15. Seck SM, Dia DG, Doupa D, Diop-Dia A, Thiam I, Ndong M, Gueye L. Diabetes burden in urban and rural senegalese population: A cross sectional study in 2012. International Journal of Endocrinology; 2015.
    DOI:10.1155/2015/163641.16878345/26491437/
16. Nchanchou MV. Type 2 diabetes and its association aith lifestyle factors table of contents; 2008.

17. Melorose J, Perroy R, Careas S. World health statistics. Statewide Agricultural Land Use Baseline. 2015;1. Available:http://doi.org/10.1017/CBO9781107415324.004
18. Fayza BR. Diabetes & metabolism risk factors associated with type 2 diabetes mellitus in West Region. 2011;2(7). Available:http://doi.org/10.4172/2155-6156.1000148
19. World Health Organization. Global Report on Diabetes; 2016
20. Hohoe Municipal Health Directorate Annual Report; 2015.
21. Fleiss JL. Statistical Methods for Rates and Proportions. 2nd Ed. New York: John Wiley; 1981. Print
22. World Health Organization. STEPS Fact Sheet. Brazzaville: WHO AFRO; 2008.
23. Danquah I, Bedu-addo G, Terpe K, Micah F, Amoako YA, Awuku YA, Mockenhaupt FP. Diabetes mellitus type 2 in urban Ghana: Characteristics and associated factors. BMC Public Health. 2012;12(1): 210.
Available:http://doi.org/10.1186/1471-2458-12-210
24. Tripathy JP, Thakur JS, Jeet G, Chawla S, Jain S, Pal A, Prasad R. Prevalence and risk factors of diabetes in a large community ‐ based study in North India: results from a STEPS survey in Punjab. Diabetology & Metabolic Syndrome. 2017; 1–8.
Available:https://doi.org/10.1186/s13098-017-0207-3

Peer-review history:
The peer review history for this paper can be accessed here:
http://sciencedomain.org/review-history/20311