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Assessing the Prevalence of Hypertension and Obesity among Diabetics in the Tamale Metropolis, Ghana

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Authors' contributions

This work was carried out in collaboration between all authors. Authors KOA, SFM and LQ developed the concept and designed the study. Authors KOA, YA, SOS, LQ, PPMD, EK, RK and LAG administered the questionnaire, analyzed and interpreted the data. Authors KOA, SFM, LQ and PPMD drafted the manuscript. Authors KOA, SFM, LQ and VM revised the manuscript for intellectual content. All authors read and approved the final manuscript.

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ABSTRACT

Aims: The study assessed the prevalence of hypertension and obesity and their associated risk factors among diabetics in the Tamale Metropolis.
Study Design: Cross-sectional study.
Place and Duration of Study: Diabetic Clinics of the Tamale Teaching Hospital, Tamale West

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Hospital and the Tamale Central Hospital, Ghana, between January to June 2016.
Methodology: A self-designed structured questionnaire was used to collect data on socio-demographic information, medical and family history of 122 Type II diabetic patients. Anthropometric measurements were determined using standard protocols. Data from the participants at the diabetic centers of the various hospitals were evaluated regarding their association with the outcome variables: general obesity, abdominal obesity and hypertension using logistic regressions. The odds ratio and its 95% confidence interval for the univariate and multivariate models were reported with the level of significance set at 5%.
Results: Seventy-two out of the one-hundred-twenty-two (59%) participants were female with 41% (50/122) being male. The mean age of the participants was 51.9±14.5 years. The prevalence of general obesity, abdominal obesity and hypertension was 19.7%, 49.2% and 55.7% respectively, In a univariate logistic regression analysis, occupational status (OR = 0.3, 95% CI = 0.1-0.9, *P* =.036) was associated with general obesity; being female (OR = 10.8, 95% CI = 4.5-26.1, *P* <.001), smoking (OR = 0.1, 95% CI = 0.01-0.5, *P* =.010) and drinking of alcohol (OR = 0.3, 95% CI = 0.1-0.8, *P* =.020) were significant factors for abdominal obesity. Variables associated with hypertension were: age (≤50 years) (OR = 3.7, 95% CI 1.7-7.9, *P* <0.001), high educational level (OR = 2.2, 95% CI = 1.0-4.6, *P* =.047) and smoking (OR = 3.7, 95% CI = 1.1-12.4, *P* =.037). Upon adjusting for age in a multivariate logistic regression being female, smoking and drinking of alcohol were still significantly associated with abdominal obesity
Conclusion: This study highlights the increased prevalence of obesity and hypertension among Type II diabetics. Employed participants were less likely to be generally obese but this is modifiable by age. Smoking and alcohol drinking remained negatively associated with abdominal obesity in the multivariate model, while female sex remained positively associated. Smoking remained as a marginally significant variable regarding the development of hypertension but this is largely modified by age.

Keywords: Type 2 diabetes; obesity; hypertension; Tamale; Ghana.

ABBREVIATIONS

BMI : Body mass index
CVD : Cardiovascular diseases
LDL : Low density lipoprotein
kg/m^2 : Kilogram per metre square
T2 DM : Type 2 Diabetes mellitus
WC : waist circumference
WHO : World Health Organization

1. INTRODUCTION

Diabetes, hypertension and obesity are principal risk factors for kidney failure, heart failure, stroke and other cardiovascular disorders [1]. Cardiovascular disease (CVD), which could result from hypertension and diabetes and their interrelation, is the leading cause of death in developing countries and contributes to 30% of all global deaths [2]. The presence of hypertension in diabetic patients substantially increases the risks of coronary heart disease, stroke, nephropathy and retinopathy. When hypertension coexists with diabetes mellitus, the risk of CVD is increased by 75%, which further contributes to the overall morbidity and mortality of already high risk population [3].

Obesity has been an issue of concern in many countries in Africa and all over the world. Estimates show that over 115 million people suffer from obesity related health conditions in developing countries [4,5]. The risk of developing elevated blood pressure is 2- 6 times higher in overweight people than in normal-weight persons [5]. Therefore, maintaining a healthy body weight may be an effective preventive measure.

Obesity is a well-established risk factor for hypertension [6,7]. Obesity is associated with increased blood flow, vasodilatation, cardiac output, and hypertension. Although cardiac index (cardiac output divided by body weight) does not increase, cardiac output and glomerular filtration rate do. However, renal sodium retention also increases, leading to hypertension [6-8].

Poor control of diabetes and hypertension contributes to cardiovascular morbidity and mortality and improving control of both has been found to be effective in reducing these endpoints [9]. Factors such as healthcare delivery systems, co-morbidities, cultural and socioeconomic factors vary from one country to another. Therefore, identifying specific factors for each disease will help improve patients' outcomes.

Preventing as well as setting control measures to curb each of this havoc is associated with a large reduction in morbidity and mortality in Ghana, as has been noted in earlier works by Danquah et al. [10] and Frank et al. [11] in a similar urban settlement. The prevalence of hypertension and obesity have been noted to be high in urban settlements, with Danquah et al. [10] reporting a prevalence of 63% among diabetics in Kumasi, Ghana and Unadike et al. [12] reporting a prevalence of 54.2% in Benin City, Nigeria.

The prevention and control of hypertension in the adult diabetic population in Tamale Metropolis have been hampered by scarcity of data on prevalence and risk factors influencing the occurrence of hypertension among diabetic subjects, thus affecting awareness, treatment, prevention and control in the various facilities. This study aims at assessing the prevalence of hypertension and obesity among diabetics in the Tamale Metropolis, Ghana.

2. METHODOLOGY

2.1 Study Participants

This cross-sectional study was conducted between January and June 2016. The participants included adult diabetics seeking care at the diabetes clinics of the Tamale Teaching Hospital, Tamale West Hospital and Tamale Central Hospital, Ghana. Permission was obtained from the heads of diabetic clinics to assess the participants and their clinical records. The participation of the respondents was voluntary and informed consent was obtained from each of them. One hundred and forty questionnaires were administered out of which 122 participants responded giving a response rate of 87%. Cochran's formula [13] was used to estimate the sample size using a Type 2 diabetes prevalence of 7% [2,10]. A sample size of 100 was determined for which an additional 30 was added to account for non-response and non-participation. Ethical approval for the study was obtained from the Ethical Review Board of the School of Medicine and Health Sciences, University for Development Studies, Ghana.

2.1.1 Inclusion criteria

Participants were eligible if they were diagnosed as having Type 2 diabetes, registered with the specific facility and sought care from the diabetic clinic as and when relevant.

2.1.2 Exclusion criteria

All patients attending the diabetic clinic and diagnosed before age 30 years.

2.2 Data Collection

A self-designed structured questionnaire was used to collect data from the participants at the diabetic centers of the various hospitals. The items for the questionnaire were obtained from a previously validated work [14]. The items were reviewed by a panel of experts on nutrition, diabetes care and diabetes research who found the items to be content valid. They were pretested on a sample of 10 participants to assess comprehension and understanding of the items. Pretest responses were excluded from the final analysis. The items had a Cronbachs's alpha score of 0.8 indicating good validity. Data collected from the respondents included socio-demographic and lifestyle activities information, detailed information about drinking and smoking habits, anthropometric measurements and clinical information.

2.2.1 Sociodemographic and lifestyle activities

Sociodemographic information including age, gender, marital status, occupation, and educational level were obtained through direct interview. A history of hypertension and/or use of anti-hypertensive drugs was taken as well as a family history of hypertension and diabetes.

2.2.2 Anthropometric measurements

Anthropometric measurements of weight, height, and waist circumference (WC) were taken. Weight was taken to the nearest 0.1 kilograms using a weighing scale (Seca, Germany). Height was measured to the nearest 1 centimetre using a stadiometer (Seca, Germany). The Body Mass Index (BMI) was calculated as weight over height squared and expressed as kg/m^2 and categorized using the current World Health Organization (WHO) definitions. BMI of <18.5 kg/m^2, 18.5- 24.9 kg/m^2, 25-29.9 kg/m^2 and 30 kg/m^2 were used to define underweight, normal, overweight and obese respectively [15].

Waist circumference was measured in centimetres using a stretch-resistant measuring tape (Butterfly, China) between the midpoint of the lower margins of the 12th rib and the topmost part of the iliac crest to the nearest 0.1 cm.

Participants stood in an upright position with their feet close together and their arms by their side with an evenly distributed body weight, while the measurements were done. Abdominal obesity was determined as a waist circumference >102 cm in men and >88 cm in women according to the World Health Organization cut-off points and risk of metabolic complications for waist circumference [15].

2.2.3 Clinical variables

Clinical variables such as systolic and diastolic blood pressures were obtained from the clinical records of all participants. Systemic hypertension was defined as systolic blood pressure of ≥140 mmHg and/or diastolic blood pressure of ≥90 mmHg [16].

2.3 Statistical Analysis

All data were entered into and analyzed using IBM SPSS v 23. Continuous data were expressed as means and standard deviations (SD). A univariate logistic regression analysis was conducted with general obesity, abdominal obesity and hypertension as dependent variables and all other variables as independent variables. Dependent variables were dummy coded as '1' for the presence of a factor and '0' for the absence of the factor. For all the independent variables, the outcome (response) variable was tested against a reference variable and the odds ratio (OR) and 95% confidence interval (CI) reported. A multivariate logistic regression with adjustment for age as a confounding variable was conducted to test the true predictability of all the study variables. For all statistical tests, a *P*-value < .05 was considered statistically significant.

3. RESULTS

3.1 General Characteristic, Anthropometric and Clinical Variables of Study Population

Table 1 shows the general characteristics, anthropometric and clinical variables of the participants. A total of 122 diabetes patients participated in the study. The mean ± SD age of the participants was 51.9 ± 14.5 years. Forty-one percent of the participants were males, 61.5% married, 63.1% employed and 36.9% had no formal education. Mean ± SD BMI, WC, systolic and diastolic blood pressures of the participants were 26.4 ± 7.0 kg/m^2, 92.6 ± 13.1 cm, 141.8 ± 15.0 mmHg and 85.9 ± 19.1 mmHg respectively. One fifth of the participants had general obesity as measured by BMI, 49.2% abdominal obesity (measured by WC) and 55.7% hypertension.

Table 1. General characteristics, anthropometric and clinical variables of study population

Variable	n (%)
Gender	
Men	50 (41.0)
Women	72 (59.0)
Marital status	
Married	75 (61.5)
Not married	47 (38.5)
Age	
Mean age	51.9 ±14.5
≤ 50 years	54 (44.3)
> 50 years	68 (55.7)
Occupational status	
Employed	77 (63.1)
Not employed	45 (36.9)
Educational level	
Low	76(62.3)
High	4 (37.7)
Smoking status	
Yes[a]	16 (13.1)
No	106 (86.9)
Drinks alcohol	
Yes[b]	20 (16.4)
No	102 (86.6)
Family history of diabetes	
Yes	46 (37.7)
No	76 (62.9)
General obesity	24 (19.7)
Abdominal obesity	60 (49.2)
Hypertension	68 (55.7)

a: defined as intake of at least one bottle of alcoholic beverage per week
b: defined as smoking at least one cigarette a day

3.2 Univariate Analysis of Study Variables Associated with General Obesity, Abdominal Obesity and Hypertension Stratified by General Characteristics

From Table 2, it was observed that there was equal percentage distribution of both sexes among participants who were generally obese. Of this (n=24), 66.7% were married while 79.2% were employed. Those who reported smoking at least one cigarette a day formed 20.8% and 16.7% drink at least a bottle per day. Participants who were employed were less likely to be generally obese (OR = 0.3, 95% CI = 0.1-0.9, *P*=.036) and this finding was statistically significant. However, upon adjusting for age in a multivariate analysis the observed significance associated with employment was lost, thus showing the impact of age as a significant confounding variable in the relationship between employment and general obesity (Table 5).

From Table 3, among the study participants who were abdominally obese (n=60), females were approximately 11 times more likely to be abdominally obese compared to males (OR = 10.8, 95% CI = 4.5-26.1, *P*<.001). Upon adjusting for age, being female significantly predisposes participants to abdominal obesity by about 10 times (OR = 10.4, 95% CI = 4.3-25.4, *P*<.001). Abdominal obesity was less likely to occur in study participants who smoke (OR = 0.1, 95% CI = 0.01-0.5, *P*=.010) and those who drink at least a bottle of alcohol a day (OR = 0.3, 95% CI = 0.1-0.8, *P*=.020). On adjusting for age, smoking (OR = 0.1, 95% CI = 0.01-0.5, *P*=.011) and alcohol drinking (OR = 0.4, 95% CI = 0.1-0.9, *P*=.030) were still less likely to be associated with abdominal obesity and the findings were significant (Table 5).

Table. 2. Univariate analysis of study variables associated with general obesity

Variables	Obese (n=24)	Not obese (n=98)	OR (95% CI)	*P*-value
Sex				
Female	12 (50.0%)	60 (61.2%)	1.6 (0.6-3.9)	.318
Age				
≤50	11 (45.8%)	43 (43.9%)	0.9 (0.4-2.3)	.858
Marital status				
Married	16 (66.7%)	59 (60.2%)	0.8 (0.3-1.9)	.561
Occupational status				
Employed	19 (79.2%)	57 (58.2%)	0.3 (0.7-0.9)	.036
Educational level				
High	13 (54.2%)	62 (63.3%)	0.7 (0.3-1.7)	.382
Smoking status				
Yes	5 (20.8%)	11 (11.2%)	0.5 (0.2-1.9)	.347
Drinks alcohol				
Yes	4 (16.7%)	26 (26.5%)	2.5 (0.7-9.0)	.170
Family history of diabetes				
Yes	8 (33.3%)	37 (37.8%)	1.1 (0.4-2.9)	.791

Table 3. Univariate analysis of study variables associated with abdominal obesity

Variables	Abdominal obese (n=60)	Non abdominal obese (n=62)	OR (95% CI)	*P*-value
Sex				
Female	51 (85.0%)	22 (35.5%)	10.8 (4.5-26.1)	<.001
Age				
≤ 50	36 (60.0%)	32 (51.6%)	0.8 (0.4-1.7)	.554
Marital status				
Married	23 (38.3%)	24 (38.7)	1.0 (0.5-2.2)	.114
Occupational status				
Employed	37 (61.7%)	39 (62.9%)	0.9 (0.4-1.9)	.741
Educational level				
High	42 (70.0%)	34 (54.8%)	0.5 (0.2-1.1)	.081
Smoking status				
Yes	2 (3.3%)	14 (22.6%)	0.1 (0.01-0.5)	.010
Drinks alcohol				
Yes	9 (15.0%)	20 (32.3%)	0.3 (0.1-0.8)	.020
Family history of diabetes				
Yes	22 (36.7%)	24 (38.7%)	0.9 (0.4-1.8)	.671

Table 4 presents the univariate analysis of study variables associated with hypertension within the study participants. It was observed that more females than males (61.8% vs. 39.2%) were hypertensive but this finding was not significant. Study participants who were aged ≤ 50 years were significantly four times more likely to be hypertensive than those who were >50 years (OR = 3.7, 95% CI = 1.7-7.9, *P*<.001). Furthermore, participants with high educational level and those who smoke at least one cigarette a day were significantly more likely to be hypertensive (OR = 2.2, 95% CI = 1.0-4.6, *P*=.047) and (OR = 3.7, 95% CI = 1.1-12.4, *P*=.037) respectively. On adjusting for age, participants who smoke at least a cigarette a day were almost four times more likely to be hypertensive but this finding was not significant (OR = 3.6, 95% CI = 1.0-12.8, *P*=.053).

4. DISCUSSION

This study aimed to assess the prevalence of obesity and hypertension and their associated risk factors among diabetics in the Tamale metropolis of Ghana. The prevalence of general obesity, abdominal obesity and hypertension was 19.7%, 49.2% and 55.7% respectively.

Table 4. Univariate analysis of study variables associated with hypertension

Variables	Hypertension (n=68)	Non hypertension (n=54)	OR (95% CI)	*P*-value
Sex				
Female	42 (61.8%)	30 (55.6%)	0.8 (04-1.6)	.489
Age				
≤ 50	48 (70.6%)	20 (37.0%)	3.7 (1.7-7.9)	<.001
Marital status				
Married	29 (42.7%)	18 (33.3%)	1.5 (0.7-3.1)	.295
Occupational status				
Employed	38 (55.9%)	38 (70.4%)	1.8 (0.8-3.9)	.124
Educational level				
High	48 (70.6%)	29 (53.7%)	2.2 (1.0-12.4)	.047
Smoking status				
Yes	4 (5.9%)	10 (18.5%)	3.7 (1.1-1.4)	.037
Drinks alcohol				
Yes	14 (20.6%)	16 (29.6%)	1.5 (0.6-3.4)	.372
Family history of diabetes				
Yes	20 (29.4%)	25 (46.3%)	2.0 (0.9-4.3)	.064

Table 5. Multivariate logistic regression analysis of study variables adjusted for age

Variables	General obesity		Abdominal obesity		Hypertension	
	aOR (95%CI)	P-value	aOR (95%CI)	P-value	aOR (95%CI)	P-value
Sex						
Female	1.6 (0.6 - 4.0)	.314	10.4 (4.3 - 25.4)	<.001	1.0 (0.4 - 2.1)	.898
Marital status						
Married	0.7 (0.2 - 1.8)	.441	1.1 (0.5 - 2.3)	.839	1.1 (0.5 - 2.5)	.789
Occupation						
Employed	0.3 (0.1 - 1.0)	.055	1.2 (0.5 - 2.7)	.631	1.0 (0.4 - 2.5)	.911
Educational level						
High	0.6 (0.2 - 1.7)	.348	0.5 (0.2 - 1.2)	.127	1.4 (0.6 - 3.3)	.385
Smoking						
Yes	0.5 (0.2 - 1.9)	.344	0.1 (0.01 - 0.5)	.011	3.6 (1.0 - 12.8)	.053
Alcohol drinking						
Yes	2.5 (0.7 - 9.2)	.169	0.4 (0.1 - 0.9)	.030	1.2 (0.5 - 3.0)	.642
Family history of diabetes						
Yes	1.0 (0.4 - 2.7)	.941	0.8 (0.4 - 1.8)	.604	1.9 (0.9 - 4.3)	.112

aOR: Age-adjusted odds ratio

The prevalence of general and abdominal obesity in this study was found to compare well to the 20.1% and 46.6% rates of general and abdominal respectively reported earlier on in a similar socio-demographic setup by Mogre et al. [14]. The high prevalence of abdominal obesity (49.2%) compared to general obesity (19.7%) as found in this study confirmed earlier findings by Mogre et al. [17]. Also, Frank et al. [18] identified a higher prevalence of abdominal obesity as compared to general obesity among Ghanaian populations. Abdominal obesity has been reported to be a better predictor of obesity as compared to general obesity as it is made up of retroperitoneal, visceral and subcutaneous fat which increase in abdominally obese individuals than in generally obese individuals [19,20].

From the present study, the 19.7% prevalence of general obesity using BMI as a criterion for classification was lower compared to an earlier report in a similar study among Ghanaian adults previously diagnosed with diabetes [21]. Participants who were gainfully employed were less likely to be generally obese but upon adjusting for age this finding was marginally significant. This observation could be as a result of the rigorous physical activities associated with the work regimen of the study participants. Kriska et al. [22] in their study reiterated the role of physical activity in weight reduction in Type II diabetics. Findings from this study also confirms earlier assertions by Steeves et al. [23] that physical activity reduces the likelihood of being generally obese. Choi et al. [24] also noted a similar trend of the positive influence of employed status on the development of general obesity.

The prevalence of abdominal obesity in this study was however higher than the 25.0% earlier reported by Müller and Krawinkel [25]. Being female, predisposed participants to abdominal obesity while smoking and alcohol drinking were less likely to be associated with abdominal obesity. An important finding of this study was the high prevalence of abdominal obesity in females than in males. This finding agrees with several other studies from other parts of the world [26,27]. High obesity prevalence in females could result from biological changes in female hormones and child birth [28].

The prevalence of hypertension estimated from this study (55.7%) was higher compared with the prevalence of 21.0% reported earlier by Mogre et al. [14] among previously diagnosed Type 2 diabetes patients in Ghana and also the prevalence of 40.4% reported by Nakano et al. [29], However, findings from this study confirmed a similar prevalence of hypertension among diabetics (54.6%) reported previously by Tseng [30]. On the contrary, the prevalence was lower than the 64.2% prevalence reported by Isezuo and Ezunu [31] in a cohort study of Nigerian diabetics.

A key finding in this study was the significant association of participants aged ≤50 years with hypertension. Study participants who were ≤ 50 years of age were noted to be four times likely to develop hypertension. This category of participants are middle-aged workers whose job characteristics include pressures and demand at the work place with its attendant physical and emotional stress. Generally, early onset of hypertension has been associated with black population [32] and this fact could have impacted positively on the findings from study.

Findings from earlier studies reporting the association of smoking with hypertension [33] were confirmed in this study. Cigarette smoking is known to induce and cause changes in both peripheral and central vascular function leading to arterial stiffness thereby causing hypertension [34]. Danquah et al. [10] and Edwards et al. [32] in separate studies reported a strong association between smoking and hypertension. This study observed a similar trend in the univariate analysis and this was marginally significant after adjusting for age. This important finding establishes the role of age in defining the development of hypertension in type II diabetics who smoke.

The major strength of the study was that, participants were thoroughly screened and systematically selected. The limitation of the study was that, participants were all from secondary and tertiary health facilities and thus the findings cannot be generalized for all diabetics in Tamale and Ghana. The study was a cross-sectional so we could not determine or predict causality.

5. CONCLUSION

This study highlights the increasing prevalence of obesity and hypertension among diabetics. Employed participants were less likely to be generally obese but this is modifiable by age. Female gender and alcohol drinking were found to be major risk variables associated with abdominal obesity after adjusting for age. Smoking was identified as a marginally significant risk variable for the development of hypertension among Type 2 diabetics but this is largely modifiable by age.

CONSENT

Written consent was obtained from all participants.

ETHICAL APPROVAL

Ethical approval for the study was obtained from the Ethical Review Board of the School of Medicine and Health Sciences, University for Development Studies, Ghana.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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