Research Article

Integrative Diabetes and Cardiovascular Diseases

Hyperglycemia in Rural Dwellers: A cross sectional study of the Effutu Municipality, Ghana

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Received: May 15 2018; Accepted: September 10, 2018; Published: September 15, 2018

Abstract

Background: Despite increasing prevalence of hyperglycemia leading to a type 2 diabetes mellitus (T2DM) in the urban areas, relatively little is known about its actual prevalence and associations in the rural population. This study sought to determine hyperglycemia and its associated risk factors among rural dwellers in the Effutu Municipality.

Method: A simple-random cross-sectional study was conducted from January 2015 to May 2015 at the Effutu Municipality, in the Central region of Ghana. One hundred and forty-nine (149) participants were enrolled onto the study. A structured questionnaire was administered to obtain information on demography, alcohol use, tobacco use, educational status, visual challenges, sugary food intake and late-night eating. Blood samples were obtained for determination of fasting blood glucose (FBG). Body mass index (BMI), waist to hip ratio (WHR) and waist circumference (WC) were determined and hip circumference (HC) using standard protocols. Data obtained was analyzed with Statistical Package for Social Sciences (SPSS) and $p < 0.05$ was considered statistically significant.

Results: The study showed 8.1% hyperglycemia among the rural dwellers and advanced age showed significant association with glycemic status ($P = 0.0376$). BMI, gender, waist hip ratio, waist circumference and hip circumference were higher in hyperglycemic participants than in normoglycaemic participants, however there was no significant difference when these parameters were compared by glycemic status.

Conclusion: The prevalence of hyperglycemia in rural dwellers was 8.1% and it was significantly associated with advanced age. BMI, gender, HC, WC, WHR showed no association with hyperglycaemia.

Keywords: Hyperglycemia, Diabetes mellitus, Rural dwellers, Body mass index, Waist circumference

Introduction

Hyperglycemia is a common risk factor especially for the development of type 2 diabetes mellitus [1]. It is characterized by excessive amount of glucose circulating in the blood plasma and a glucose level higher than 11.1 mmol/L and may be asymptomatic until even higher values such as 15 to 20 mmol/L [2]. Sustained higher levels of blood glucose cause damage to blood vessels and organs leading to a complication of diabetes mellitus. It is a significant global health problem and

predisposes affected individuals to markedly increased morbidity and mortality [3]. Diabetes mellitus is a steadily growing global epidemic and in sub-Saharan Africa, the number of people with diabetes mellitus was projected to increase from 7 million in 2000 to an alarming number of 18 million in the year 2030 which accounts to regional increase of 161% [4]. Age-adjusted prevalence of diabetes mellitus, impaired fasting glucose (IFG) and impaired glucose tolerance (IGT) were 6.4%, 6.0% and 10.7%, respectively for Ghanaian adults aged 25 years and above [2]. The epidemiology studies on diabetes

mellitus in Ghana focused mainly on cities where the burden of diabetes mellitus is thought to be higher due to reduced physical activity and unhealthy eating habits [5]. Despite the increasing prevalence of hyperglycemia in the urban areas, relatively little is known about its prevalence in the rural setting [1]. Hyperglycemia is usually asymptomatic [2] thus many may report to the hospitals only when they begin to show symptoms due to the complications of diabetes mellitus. Poor access to primary health care facilities and poor health seeking behaviours is a bane of rural dwellers [6]. Hyperglycemia may progress to overt diabetes mellitus before detection among the rural population. It is therefore necessary to screen rural dwellers for hyperglycemia to know their glycemic status to ensure detection of this condition. This study determined hyperglycemia and its associated risk factors among rural dwellers in the Effutu Municipality.

Materials and Methods

Study design/study site

This purposive cross-sectional study was conducted amongst inhabitants of Atetu, Nsuekyir, Sankor and Gyaadze all in the Central region of Ghana from January 2015 to May 2015. Each village has a population of about 900 people (Population and housing census, 2010) with farming and fishing being the main occupation of the inhabitants.

Study population

One hundred and forty-nine (149) healthy rural dwellers from local religious groups in the selected rural communities were recruited for the study. A structured questionnaire was administered to each participant through interview, to obtain information on demography, alcohol use, tobacco use, educational status, eye problems, intake of sugary foods and late-night eating. Inhabitants of the selected villages, within the ages of 18 to 70 years and who are not on hypoglycemic agents or on diet therapy and insulin therapy were eligible for recruitment into the study. Participants below and above age 18 and 70 respectively, diagnosed with diabetes mellitus, pregnant women and participants who were not residents of the selected communities were excluded.

Ethical consideration

The study obtained approval from religious leaders and opinion leaders of the selected communities and the University of Cape Coast Institutional Review Board (UCCIRB). Informed written consent was also obtained

from the participants before enrollment into the study.

Anthropometry

Body weight (to the nearest 0.1 kg) in light clothes and bare foot was measured with a digital weighing scale (Health line, Vankatachalam PF Series, India). Height (to the nearest 0.1 meter) was measured with a wall-mounted graduated ruler. Body Mass Index (BMI) was calculated using the formula: $BMI = \text{Weight (kg)} / \text{Height}^2 \text{m}^2$. Overall obesity was defined as a BMI of $\geq 30 \text{ kg/m}^2$, normal weight as $18.5 - 24.9 \text{ kg/m}^2$, underweight as $<18.5 \text{ kg/m}^2$ and overweight as $25.0 - 29.9 \text{ kg/m}^2$ in adults. Waist and hip circumference were measured in centimeters using a plastic tape measure at the level of the umbilicus and of the greater trochanters.

Blood glucose estimation

After an overnight fast (8-12 hours) blood glucose was estimated for each participant with an electronic glucometer (Sensocard 77 kft electronica, Hungary). The procedure was repeated for each participant after 4 days for accuracy and precision and the average blood glucose level was recorded in mmol/L.

Statistical analysis

Analysis was performed using Statistical Package for Social Sciences program (SPSS, version 21.0 for Windows). Values were expressed as means $\pm$ SD and frequencies. Continuous variables and categorical variables were determined using unpaired *t*-test and Chi-square (χ^2) test statistic. Multivariate logistic regression and Pearson's correlation was performed to determine factors which may be associated with hyperglycemia. $P < 0.05$ was considered statistically significant.

Results

Table 1 shows the association between socio-demographic variables of participants in relation to normoglycaemia and hyperglycaemia. The mean age of participants was 46 years ($P = 0.0379$) with hyperglycemic participants older (51 years) than normoglycemic participants (41 years). There were more females (108) than male participants (41) with females being more hyperglycemic ($p = 0.5124$). Glycaemic status showed no significant relationship with levels of education ($P = 0.5723$)

Table 2 describes the anthropometric parameters of participants stratified by glycaemic status of participants.

Hyperglycemic participants had a higher WC, HC, WHR and an increased BMI compared to normoglycaemic participants ($P > 0.05$).

Table 3 presents the multivariate logistic regression of predictive factors associated with hyperglycaemia among our participants. Logistic regression models after adjusting for age indicated that alcoholic intake, sugar intake, physical inactivity and late eating were not significant independent risk factors of hyperglycaemia. As shown in figure 1, the overall prevalence of hyperglycaemia was 8.1% (12/149).

Figure 1: prevalence of normoglycaemic and hyperglycaemic participants.

Discussion

Hyperglycemia is a major risk factor for diabetes mellitus [2]. In this study, we determined the prevalence of hyperglycemia and its related risk factors among rural dwellers in the Effutu municipality in the Central region of Ghana. The results of this study revealed that 8.1% of the rural dwellers had hyperglycemia and advanced age showed significant association with glycemic status ($P = 0.0376$). Our study also showed that body mass index, gender, waist hip ratio, waist circumference and hip circumference were similar when the participants were classified by glycaemic status. The prevalence of hyperglycemia in our study was 8.1%. This was slightly at variance with studies by Shen et al. [7] and Geriga et al. [8] which reported a prevalence of 26.9% and 28% in the rural communities in China and Uganda respectively. The inconsistencies in these results were due to participants and epidemiological characteristics, methods employed, sample size, and study design and probably diets variation. Shen et al. [7] examined the prevalence among people diagnosed with HIV with a sample size of 2006 adults in a Chinese rural community and collected their sample into vacuum tube containing sodium fluoride.

Their study again employed an enzymatic method to estimate the fasting blood glucose. Geriga et al. [8] used random blood glucose to assess the glycaemic status of 384 children who visited the Mulago hospital in Uganda.

We reported advanced age as a risk factor of hyperglycaemia among inhabitants of the Effutu municipality. This finding agreed with studies by Shnipper et al. [9], Robert et al. [10], Ceriello et al. [11] and Kahn et al. [12] which reported hyperglycemia increased with increasing age in China and USA respectively. Similar to the Chinese and American studies, we used the glucometer to estimate the glycaemic status of the studied participants.

Visceral obesity plays an important role in the development of hyperglycemia in adults by mobilizing free fatty acids and certain inflammatory cytokines promoting insulin resistance. Anthropometric variables (WHR, BMI, WC and HC) measured in this work showed no significant association with hyperglycemia, however, all these variables were relatively higher in both normoglycemic and hyperglycemic participants. Other factors that might contribute to hyperglycemia such as alcohol and sugar intake levels, eating late at night and rate of exercising the body all showed no significant association when compared by glycemic status. This contradicts the studies of Hong et al. [13], Yang et al. [14] and Liu et al. [15] in China who reported that the risk of developing hyperglycemia increased along with the increase in WHR, BMI, WC and HC and were positively associated with hyperglycemia ($P < 0.01$). This difference might be due to variation in sample sizes, participants and epidemiological characteristics, methods employed and probably variations in participant's diet. In contrast to our study which was conducted among 149 rural dwellers, Hong et al. [13] and Liu et al. [15] had a larger sample size of 3727 participants and 1280 participants respectively and were conducted in an urban community. A major limitation of this study is the use of the point of care glucose test kit rather than the enzymatic spectrophotometric technique, glycated hemoglobin or glucose tolerance test to assess the glycaemic status of our participants. Nonetheless, this is the first study to report the prevalence of hyperglycemia and its associated factors among rural dwellers in Ghana

Conclusion

The prevalence of hyperglycemia in rural dwellers was 8.1% and it was significantly associated with advanced age. BMI, gender, HC, WC, WHR showed no association

Table 1: Sociodemographic variables in relation to normoglycaemic and hyperglycaemic participants.

Variables	Total (N=149)	Normoglycaemia (N=137)	Hyperglycaemia (N=12)	p-value
Age (years) Mean $\pm$ SD	46.57 $\pm$ 2.85	41.88 $\pm$ 1.26	51.25 $\pm$ 4.44	0.038
Gender				0.512
Male	41	39(95.1)	2(4.9)	
Female	108	98(90.7)	10(9.3)	
Highest Levels of education				0.572
No	42	40(95.2)	2(4.8)	
Primary	84	75(89.3)	9(10.7)	
Secondary	16	15 (93.8)	1(6.3)	
Tertiary	6	6(100.0)	-	

Values are presented as frequency;

Frequency (proportion) and Mean $\pm$ SD.

Association are significant at p-values less than 0.05.

Association between categorical variables were tested using chi-square test.

Un-paired t-test was used to test significance difference between continuous variables.

Table 2: Anthropometric parameters stratified by Normoglycaemic and hyperglycaemic participants.

Parameters	Normoglycaemia (n=137)	Hyperglycaemia (n=12)	p-value
WC	91.45 $\pm$ 1.08	96.50 $\pm$ 3.43	0.185
HC	104.0 $\pm$ 1.22	108.3 $\pm$ 3.05	0.302
WHR	0.87 $\pm$ 0.01	0.88 $\pm$ 0.02	0.592
BMI	27.06 $\pm$ 0.50	28.45 $\pm$ 1.91	0.436

Values are presented as frequency;

Frequency (proportion) and Mean $\pm$ SD.

Un-paired t-test was used to test significance difference between continuous variables.

p-value less than 0.05 was considered as statistically significance difference.

with hyperglycaemia. Further research should consider a larger sample size to establish the determinants of hyperglycemia.

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Table 3: Logistic regression model of factors associated with hyperglycaemia.

Variables	Glycaemia status		adjusted OR (95% CI)	p-value
	Hyperglycaemia (n=12)	Normoglycaemia (n=137)		
Alcohol intake				
Yes (n=35)	4(11.4)	31(88.6)	1.629 (0.5213 to 5.088)	0.477
No (n=114)	8(7.0)	106(93.0)	1.0*	
Sugar intake				
Yes(n=134)	9(6.7)	125(93.3)	0.3358 (0.1019 to 1.107)	0.104
No (n=15)	3(20.0)	12(80.0)	1.0*	
Regular exercise				
Yes (n=31)	1(3.2)	30(96.8)	1.0*	
No (n=118)	11(9.3)	107(90.7)	2.890 (0.3876 to 21.55)	0.461
Late eating				
Yes(n=111)	9(8.1)	102(91.9)	1.027 (0.2931 to 3.599)	0.994
No(n=38)	3(7.9)	35(92.1)	1.0*	

aOR: adjusted Odds ratio; 95% CI (95% confidence interval). Logistic regression model was adjusted for age.
1.0*: reference point

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