RELATIONSHIP OF BLOOD GLUCOSE LEVELS WITH WAIST CIRCUMFERENCE, HIP CIRCUMFERENCE AND WAIST-HIP RATIO AMONG RURAL ADULTS IN NIGERIA

ETIOBONG A. ETUKUMANA*[1], FABIAN H.PUEPET[2], MICHAEL O.OBADOFIN[3]

[1]Department of Family Medicine University of Uyo Teaching Hospital Uyo – Akwa Ibom State., [2]Department of Internal Medicine University of Jos Teaching Hospital Jos – Plateau State., [3]Department of Family Medicine University of Jos Teaching Hospital Jos – Plateau State. **Email:** etukumana@gmail.com

ABSTRACT

Objective

Anthropometric measurements such as waist circumference, hip circumference and waist-hip ratio give risk information on diabetes mellitus. However, there are mixed reports on the relationship of these anthropometric indexes with the levels of glucose in the blood. The objective of this study was to determine the relationship between random blood glucose levels with waist circumference, hip circumference, and waist-hip ratio among rural adults in Nigeria.

Methods

We carried out a cross-sectional descriptive study of 750 subjects aged ≥15years using systematic sampling technique. Data were collected with a structured questionnaire. Subjects were measured for waist circumference and hip circumference; the waist-hip ratio was calculated. Blood samples of subjects were used for the estimation of blood glucose concentration using the glucose oxidase method of Trinder

Results

Subjects consisted of 385(51.3%) males and 365(48.7%) females (male: female= 1.05:1). The mean age was 39.42±16.17years (males 35.23±14.09years and females 43.83±17.04years; t=7.55, p<0.001). The mean Random Plasma glucose level (RPGL) was 5.68(±2.16) mmol/L [males 5.69(±2.42)mmol/L and females 5.67(±1.86) mmol/L, t=0.11, P=0.91]. The range (median) of the waist circumference, hip circumference and waist-hip ratio of the subjects were 52-115cm (83cm), 60-130cm (93cm) and 0.59-0.99 (0.89) respectively. There were positive relationship between blood glucose levels with waist circumference (r=0.1, P=0.004) and waist-hip ratio (r=0.1, P=0.002). There was no relationship between blood glucose levels and hip circumference (r=0.0, P=0.13).

Conclusion

We found positive relationship between the random blood glucose levels with waist circumference and waist-hip ratio in this study. Therefore, waist circumference and waist-hip ratio would be good predictors of diabetes mellitus among rural adults.

Keywords: Diabetes mellitus is classified into type 1, type 2, lipogenesis, hyperglycaemia,

INTRODUCTION

Diabetes Mellitus is one of the non-communicable diseases and public health problems facing the world [1, 2]. Diabetes Mellitus (DM) is define as a metabolic disorder of multiple aetiology characterized by chronic hyperglycaemia with disturbances of carbohydrate, fat, and protein metabolism resulting from defects in secretion and /or insulin actions[3,4]. Diabetes mellitus is classified into type 1, type 2, other specific types and gestational [4]. Diabetes mellitus which may be asymptomatic, especially type 2, can be diagnosed by estimating the level of glucose in the blood [3, 4]. Several treatment options for diabetes mellitus are available including hormone based therapy [5, 6]. Diabetes mellitus in the world is increasing, and it is estimated to rise by 300 million by 2030 [1,7]. In addition, sub-Sahara Africa accounts for a large proportion of diabetes mellitus in the world with overall prevalence rate of 1-2% and this burden is expected to increase by 161% by 2030 [8]. Anthropometric indexes such as waist circumference, hip circumference and waist-hip ratio are anthropometric measurements that could give risk information on diabetes mellitus [9]. Waist circumference, hip circumference and waist-hip ratio have been shown to be positively predictive of type 2 diabetes mellitus [10, 11]. Fatty acids which constitutes the body fat contents can be synthesized from simple carbohydrate such as glucose; thus, an increase in blood glucose levels have been associated with increase in lipid biosynthesis (lipogenesis) resulting in changes in anthropometric indexes [12]. Thus, it would be beneficial to assess the relationship of these anthropometric measurements with the levels of glucose in the blood because of its use in the diagnosis of diabetes mellitus. Therefore, the objective of the study was to determine the relationship of blood glucose levels with waist circumference, hip circumference, and waist-hip ratio among rural adults in Nigeria.

MATERIALS AND METHODS

Study setting

This was carried out in Zawan community, a rural settlement about 20 kilometers outside Jos city, North Central Nigeria. The population of Zawan community was 4,443(National Population Commission Census 1991, Plateau State) [13]. By the end of 2004, its population was estimated at 6520 based on an expected annual increase of 3%. The majority of the inhabitants of Zawan are Berom natives, and they share similar cultural beliefs and practices. The church, the market square and the community leaders were used to mobilize the members of this community to Our Lady's of Apostles Hospital, Zawan. The hospital has a 90-bed capacity and provides primary and secondary health care.

Research subjects

We carried out a cross-sectional descriptive study between February and May 2005. The sample size of the study was obtained using the national diabetes mellitus prevalence rate of 2.2% and 1% sampling error [14]. Seven hundred and fifty subjects who were aged ≥15years were sampled using systematic sampling technique. Each recruited subject was given information regarding the research objectives in English or the local language (Hausa or Berom) as appropriate. Pregnant women and ill subjects were excluded. Written informed consent was obtained from the subjects before enrolment into the study. The subjects were assured of

confidentiality of the data. Permission and co-operation for the study was obtained from the community leader of Zawan and management of Our Lady's of Apostles Hospital, Zawan. The study was approved by the Ethical Committee of the Jos University Teaching Hospital, Jos, Nigeria. Data on sociodemograhic information were collected with questionnaire. Waist circumference was measured in centimeters (cm) with a dressmaker tape as the horizontal level at the mid-point between the iliac crest and the lower costal margin with minimal clothes. Hip circumference was recorded in centimeters (cm) as the horizontal level of maximum circumference around the buttocks using a dressmaker tape. Waist to hip ratio (WHR) was calculated as waist circumference divided by the hip circumference.

Blood samples (without regard to time of last meal) were collected from subjects for the estimation of blood glucose concentration using the glucose oxidase method of Trinder [15].

Each subject's blood sample (two millitres) was stored in a labeled fluoride oxalate tube, and transported to the Chemical Pathology Laboratory of Jos University Teaching Hospital for plasma glucose estimation.

Statistical Analysis

Data entry and analysis were done with Epi Info 3.2.2 (CDC, Atlanta Georgia, USA). The frequencies of categorical variables and means of continuous variables were determined. Linear regression analysis was carried out to determine the relationship blood glucose levels with waist circumference, hip circumference and waist-hip ratio. All P-values less than 0.05 were considered significant.

RESULTS

Seven hundred and fifty subjects were recruited for the study by the investigators. The sex, age, and occupational distribution of the study subjects is shown in table 1. The study population consisted of 385(51.3%) males and 365(48.7%) females (male: female= 1.05:1). The mean age of the study population was 39.42±16.17years. The mean ages of the males and female were 35.23±14.09years and 43.83±17.04years respectively (t=7.55, p<0.001).

Most of the subjects were unemployed 331(44.1%) while most of the employed subjects were civil servants 181(24.1%).

Table 1: Sex, Age and Occupational Distribution of the Subjects

Characteristic	Total (n)	Percentage (%)
Sex		
Male	385	51.3
Female	365	48.7
Age group		
15-24	151	20.1
25-34	176	23.5
35-44	138	18.4
45-54	150	20.0
55-64	72	9.6
65-74	31	4.1
75-84	32	4.3
Occupation		
Unemployed	331	44.1
Civil servant	181	24.1
Farmer	82	10.9
Skilled worker	72	9.6
Business	38	5.1
Petty trader	33	4.4
Unskilled worker	13	1.7

The mean (±SD) Random Plasma glucose level (RPGL) in the study subjects was 5.68(±2.16) mmol/L [males 5.69(±2.42)mmol/L and females 5.67(±1.86) mmol/L, t=0.11, P=0.91]

The relationship of RPGL (mmol/L) to waist circumference (cm) of the study subjects is as shown in figure 1. The waist circumference range in the subjects was 52-115cm with a median of 83cm. There was a positive relationship of RPGL with waist circumference of study subjects(r=0.1, P=0.004).
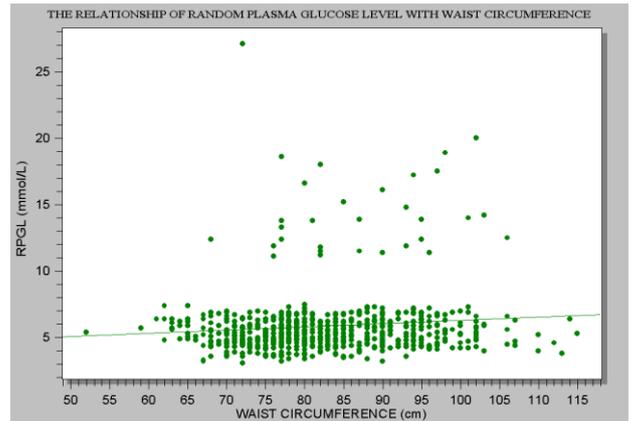

Figure 1: The relationship of random plasma glucose level with waist circumference

The relationship of RPGL (mmol/L) and hip circumference (cm) of the study subjects is as shown in figure 2. The hip circumference range in the subjects was 60-130cm with a median of 93cm. There was no relationship of RPGL and hip circumference in the study subjects(r=0.0 P=0.13).
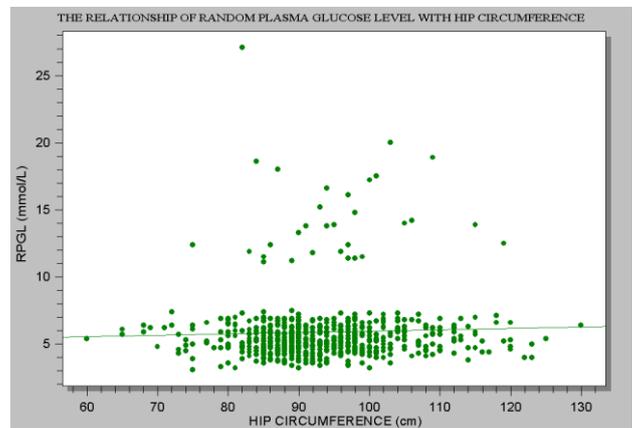

Figure 2: The relationship of random plasma glucose level with hip circumference

The relationship of RPGL (mmol/L) by WHR in the study subjects is as shown in figure 3. The waist-hip ratio range in the subjects was 0.59-0.99 with a median of 0.89. There was positive relationship of RPGL with WHR of study subjects(r=0.1, P=0.002).
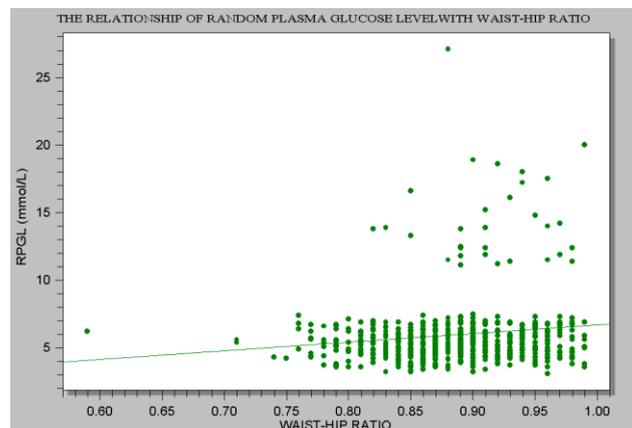

Figure 3: The relationship of random plasma glucose level with waist-hip ratio

DISCUSSION

There were positive relationship of blood glucose levels with waist circumference and waist-hip ratio in this study. These results were in agreement with similar studies [16-19]. These findings strengthen the current use of anthropometric measurements as predictors for the presence of diabetes mellitus in different populations in the world. The simplicity in the measurement of waist circumference with a dressmaker tape makes it an easy tool for obtaining risk information of diabetes mellitus among the rural populace as seen in this study. The results of our study are not surprising since several studies have supported the use of waist circumference and the waist to hip ratio rather than body mass index as important independent predictors of diabetes mellitus [16-20]. However, waist to hip ratio requires calculation and this makes it complicated in practice especially in rural setting. There was no relationship of blood glucose levels with hip circumference in this study in contrast to a similar study [11]. In the Horn study, hip circumference was negatively associated with glucose levels [11]. There are limited studies to allow for proper comparison and conclusion on the relationship of blood glucose levels with hip circumference; however, hip circumference contributes to the waist-hip ratio used in the studies of the ratio's relationship with glucose level [16-19].

Simple random sampling of a defined population would have been ideal for this study but this was not possible because of the large size of the population used. However, a systematic sampling technique was employed for this study.

CONCLUSION

We establish a positive relationship of blood glucose levels with waist circumference and waist-hip ratio among the rural adults in the north central Nigeria. These would serve as better predictors of diabetes mellitus than hip circumference among rural adults.

Conflict of interest: None

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