Journal of Medicine and Medical Sciences Vol. 8(4) pp.042-047, June 2017
DOI: http:/dx.doi.org/10.14303/jmms.2017.035
Available online http://www.interesjournals.org/JMMS

Full Length Research Paper

Waist-hip ratio, body mass index, physical activity and the risk of diabetes mellitus in Gombe State, Northeast Nigeria

Sule J Bathna[1], Jacob A Dunga[2], Nura H Alkali[2], Datonya Alasiya[3], Jafiada J Musa[2], Yerima Suleiman[4], Ojobi Joseph[5]

[1]Federal Teaching Hospital Gombe, Nigeria
[2]Abubakar Tafawa Balewa Teaching Hospital Bauchi, Nigeria
[3]Federal Medical Center Makurdi, Benue Nigeria
[4]University of Port Harcourt Teaching Hospital, Nigeria
[5]Federal Medical Center Yola, Adamawa state, Nigeria
*Corresponding author's E-mail: jacobdunga@yahoo.com

Abstract

Background: Obesity as measured by waist-hip ratio and body mass index, both increase the risk of diabetes mellitus (DM). Few studies have examined this relationship among Nigerians. Materials and Methods: In this community-based study conducted in Gombe Town of Gombe State, Northeast Nigeria, we looked at hip-waist ratio, body mass index, family history of DM, and levels of physical activity in relation to the risk of DM amongst apparently healthy adults. We employed a two-stage cluster sampling scheme based on existing administrative divisions through random sampling. Results: The crude prevalence rate of DM was 3.9% (5.7% in males, 2.8% in females; *p* value = 0.005), which was higher than rates previously reported in population surveys from Nigeria. Body mass index, hip-waist ratio, low physical activity and a positive family history of DM all conferred significant risks of DM in our study subjects. Conclusion: The prevalence of diabetes mellitus is higher in some parts of Nigeria than reported previously. Obesity as measured by hip-waist ratio and BMI are significant contributors to the risk of DM among Nigerians.

Keywords: Diabetes Mellitus, Hip-Waist Ratio, Obesity, Nigeria

INTRODUCTION

The prevalence of diabetes and its risk factors is increasing worldwide. It appears to be an epidemic affecting an increasing proportion of populations in many parts of the world (King and Zimmet 1988). The global prevalence of Diabetes mellitus is estimated to rise from 135 million in 1995 to 300 million by 2025 (5.4% of the world population) with a 27% increase in developed countries and a 48% increase in developing countries (19). The World Health Organization (WHO) estimates that the number of cases of diabetes in developing countries is likely to increase more than two folds within three decades, 115 million in 2000 to 284 million in 2030. It also estimates that 1 in 20 deaths worldwide are attributable to diabetes (World Health Organization 2003).

In Africa, diabetes was considered rare in the last century, population based reports of diabetes mellitus in Africa are few; nevertheless, information on the prevalence of DM among blacks in Africa is growing. The WHO estimates the prevalence of DM to be in the range of 1-2% (World Health Organization 2003).

However survey of urban communities using the WHO criteria revealed a different trend with a higher prevalence of diabetes in adult Africans (King and Zimmet, 1988), (World Health Organization 2003). Similarly, prevalence of diabetes mellitus in urban Africans is considerably

higher than in their rural counterparts. Urbanization and change to modern life styles have been implicated (Ohwovoriole et al., 1988). In Nigeria, estimation of prevalence of diabetes mellitus is difficult because of paucity of population surveys on diabetes, however available evidence suggests that there is a rising prevalence of diabetes mellitus particularly type 2 DM in its urban residents, based on previous studies an estimated prevalence is 0.43% to 2.4% (National Expert Committee on Non Communicable Diseases (NCD) in Nigeria. 1997), (Erasmus et al., 1989).

DM is becoming a major health problem in Nigeria with a prevalence of 2.2%. (National Expert Committee on Non Communicable Diseases (NCD) in Nigeria. 1997). As malnutrition and communicable diseases come under control, with resultant increase in life expectancy, and with progressive urbanization and industrialization, non-communicable diseases (NCD) like DM and hypertension would begin to emerge as major public health problems (World Health Organization 2003).

Few Nigerian diabetics are aware of the devastating effects of DM and very few have access to facilities for self-monitoring of blood glucose (SMBG), an important part of modern diabetic management (Ohwovoriole et al., 1988).

Urban population studies on the prevalence of DM have scarcely been undertaken except few done in southern part of Nigeria (Ohwovoriole et al., 1988), (Olatunbosun et al., 1988) Limited studies on the prevalence of DM in urban areas have been carried out also. (Erasmus et al., 1989) this may not be representative of the overall prevalence of DM in all parts of the country. Geographical variation and diet might have effect on the DM in this part of the country.

MATERIALS AND METHODS

This study was carried out in Gombe state north eastern Nigeria, It is an urban town with rapid industrialization and influx of people from all over the state. It has a population of over 2m million people based on 2006 census. This cross-sectional survey was carried out in jekadafari ward in jekadafari district of Gombe local government with a current population of 268,000 (NPC census 2006). With a two-stage cluster sampling scheme based on existing administrative division, Jekadafari ward was randomly selected.

Population is made up of mainly unskilled laborers, farmers, petty traders, teachers, civil servants, businessmen and few fishermen. The young adults are mostly unemployed but some are students. The area is basically residential. The diet of most of the inhabitants of this area consists of carbohydrate meals with beans and animal proteins. During sampling the outcome variable was considered as the presence of DM based on the diagnostic criteria while the exposure variables were considered as genetics, diet and sedentary life style. Possible cofounders to the study are drugs, presence of retroviral infection, pancreatic disease and chronic liver disease

The study had a sample size of 1600 based on prevalence of 3.1% with a power of 85% and precision of 5%.

This study is a Cross-sectional Survey, involving Male and female from 16 years and above residents of Jekadafari ward. Subject were excluded from this study if he/she did not give consent, Individuals <16 years of age, pregnant women or presence of chronic disease condition such as chronic renal failure, chronic liver disease, chronic lung diseases etc.

Data was analyzed using the SPSS 21 statistical programme. Means (±SD) were used to describe continuous variables and proportions were used for categorical data. Two-tailed student's t-test was used for comparisons of group means. When comparing groups of subjects, the chi-squared (X^2) test was applied to determine the significance of the differences observed.

RESULTS

Of the sample size of 1600 enlisted during the household census, 298 people did not turn up during the survey; therefore, the analysis was based on 1302 subjects giving a response rate of 81.4%. Of the 298 non-responders 174 (58.4%) were males and 124 (41.6%) females. This could have been due to the fact that females are more likely to participate in a survey of this nature than males. Of the 1302 responders, 571 (43.9%) were males and 731(56.1%) were females (Figure 1).

Socio-demographic and clinical characteristics of study subjects

The mean (SD) ages of males and females were 35.31 (14.96) and 37.68(14.44) years respectively. The female were much older ($p<0.05$).

Physical activity

The distribution of subjects by the level of physical activity of is shown in Table 1. Males appeared more active than females, ($p<0.005$). Overall, there are more inactive subjects in females than the male subjects, ($p<0.05$).

Parental history of diabetes mellitus

One hundred and thirteen 8.7% of the subjects had parental history of diabetes and of these, 42.5% had

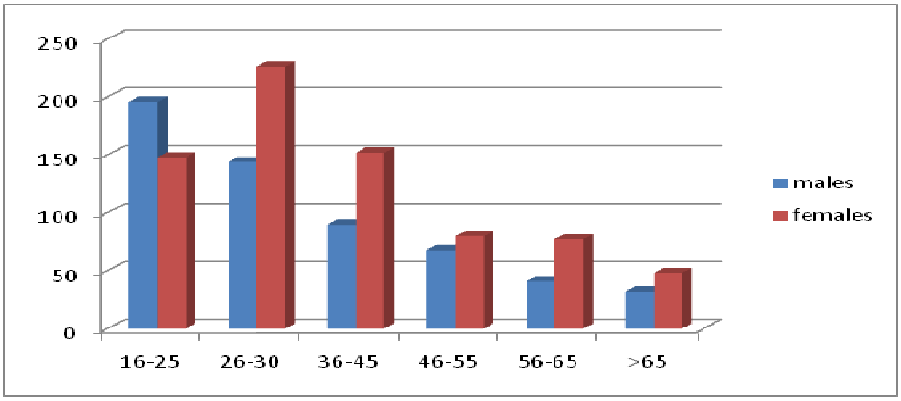

Figure.1: Age and sex distribution of study participants (responders)

Table 1: Level of physical activity of subjects by sex

	Number of subjects (%)		
Level of activity	**Males**	**Females**	**Total (%)**
Very active	107(18.7)	200(27.4)	307(23.6)
Moderately active	339(59.4)	245(33.5)	584(44.8)
Not active	125(21.9)	286(39.1)	411(31.6)
Total	**571(100)**	**731(100)**	**1302(100)**

Table 2: Distribution of BMI by sex of study subjects

	Number of subjects		
BMI (kg/m^2)	**Males**	**Females**	**Total (%)**
<18.5	19	7	26 (2.0)
18.5-24.9	467	595	1062 (81.6)
25-29.9	70	102	172 (13.2)
≥30	15	27	42 (3.2)
Total	**571**	**731**	**1302 (100)**

diabetic father, 17.2% had diabetic mother and 39.8% subjects had history of diabetes in both parents. Four hundred and five 31.1% had no family history of DM, majority (60.2%) are not aware if any of the parents have DM.

Body mass index (BMI)

The distribution of BMI by sex of subjects is shown in Table 2. More than three quarter of the subjects, (81.6%) had normal BMI, 13.2% were overweight, 3.2% were obese and 2.0% were underweight. Overall, the mean (SD) BMI was 24.09(3.31) kg/m^2. The mean (SD) BMI for males and females were 24.06(2.64) kg/m^2 and 24.13(3.00) respectively. There was no statistically significant difference between the BMI of the males and females, t=0.484, p>0.05.

Waist circumference (WC)

Five hundred and thirty nine (93.7%) of male subjects had WC of less than 102cm while 688 (94.1%) of female

Table 3: Distribution of WHR by sex of study subjects

Sex	Risk Frequency		
	Low risk (%)	Moderate risk (%)	High risk (%)
Males	531(93.0)	28(4.9)	12(2.1)
Females	662 (90.6)	51(7.0)	18(2.4)
Total(%)	1193(91.6)	79(6.1)	30(2.3)

subjects had WC less than 88cm (102). The mean (SD) of WC for males and females in the study were 78.73(10.31) and 66.25(10.63) respectively.

Waist-Hip-Ratio (WHR)

WHR were divided into three; based on risk factors for development of co-morbidities (102). In the high-risk group for males and females were subjects with WHR of >1.0 and >0.85 respectively, while in the low risk groups were subjects with WHR of <0.96 and <0.81 for males and females respectively as shown in Table 3. The mean (SD) WHR for males and females were 0.83(0.08) and 0.72(0.06) respectively.

DISCUSSION AND CONCLUSION

Screening for diabetes mellitus (DM) by measuring casual blood glucose levels is an accepted method for obtaining a crude estimate of the prevalence of diabetes in a population and it is less expensive than the standard WHO method (fasting and 2 hours post 75g glucose load). (World Health Organization 2003), (NIDDM in urban Africans in Cape Town, South Africa. Diabetes care, 1993) Application of the standard criteria for the confirmation of DM. (World Health Organization 2003) is desirable but often impracticable under field conditions especially in areas with very scarce resources. The finding from this study therefore, provides a crude estimate of the prevalence rates of DM in adults in Gombe.

The prevalence rates of DM was found to be 3.9% (M 5.7% and F 2.8%) this findings is higher than the rates previously reported from other population surveys in Nigeria. Strict comparisons of the prevalence rates of DM from this study with those of the Nigerian studies are rather difficult to make because of differences in criteria for diagnosis employed and the age range of the subjects in various studies (Ohwovoriole et al., 1988), (Erasmus et al., 1989).

The high prevalence of DM in adults in this study may be due to the fact that the prevalence of DM in adults may be higher in northern Nigeria than in the southern counter parts. Most of the previously reported surveys were from the southern parts of the country. Another reason for the higher prevalence may be due to the fact that the prevalence of DM in urban adults (Type 2 DM) may be increasing in Nigeria, an observation already confirmed in other developing countries.

Prevalence rates from population based reports of DM in Africa vary from 0% in rural Togo. (NIDDM in urban Africans in Cape Town, South Africa. Diabetes care, 1993) to 10.4% in Mauritian creoles (Fisch et al., 1987). Comparisons of the prevalence rate of DM from this study (3.9%) with rates from other studies in Africa are also difficult to make because of the variations in the diagnostic criteria employed in the various reports. However, the prevalence rate of 3.9% observed in this study is higher than those reported from Tanzania (1.6% and 1.1%). (King and Zimmet 1988), (NIDDM in urban Africans in Cape Town, South Africa. Diabetes care, 1993) and Mali (1.0%). (Fisch et al., 1987) But considerably lower than the rates of 8.0% and 10.4% (Shaten et al., 1993) in urban South Africa and Mauritian Creoles respectively.

The prevalence rate in this study is also considerably lower than the rates reported in Caucasoid communities. (Mengesha et al., 1999) ethnic minorities in industrialized countries. and Asian immigrants in Africa. (Fisch et al., 1987) probably due to the youthfulness of the study participants and the fact that the northern part of Nigeria may be relatively backward in terms of westernization.

The crude prevalence of DM in males and females in this study were 5.1% and 2.9% respectively. Some surveys have reported higher rates in females (Ohwovoriole et al., 1988), (Erasmus et al., 1989) while others have reported the contrary. (World Health Organization 2003). As in this study. Others reported a roughly equal sex-distribution. (Johnson 1971) The slight male preponderance among the diabetic subjects in this study (M:F 2:1) differs from the ratios in other Nigerian studies (NIDDM in urban Africans in Cape Town, South Africa. Diabetes care, 1993), (National Expert Committee on Non Communicable Diseases (NCD) in Nigeria. 1997) which reported slight female preponderance.

Only three (6%) of the detected diabetic subjects (2 males and 1 female) were previously diagnosed to be

diabetics, the remaining forty-seven (94%) detected diabetic subjects were previously undiagnosed before the survey and they were all asymptomatic. This confirms the observation that DM particularly type 2 DM may be asymptomatic, in which case the diagnosis is often made on glucose test during medical examinations or survey studies (NIDDM in urban Africans in Cape Town, South Africa. Diabetes care, 1993), (National Expert Committee on Non Communicable Diseases (NCD) in Nigeria. 1997). In most reported population surveys in Africa, over 60% of the discovered diabetics were previously undiagnosed, majority of whom are usually asymptomatic. (Ohwovoriole et al., 1988), (Erasmus et al., 1989) this observation suggests the need for increasing routine screening for diabetes in the population.

Risk factors associated with diabetes mellitus

The prevalence rate of diabetes mellitus (DM) in the study population was determined in relation to the presence of BMI, WHR, WC, physical inactivity, and social class these were significantly associated with diabetes mellitus.

It has been documented that diabetes prevalence is increasing worldwide, especially in transitional populations from traditional to modern lifestyles. (Campbell 1963), (Mohan et al., 2006) and while prevalence and incidence of type 2 diabetes are highest among adults, youths are now increasingly affected (Mohan et al., 2006), (Tseng et al., 2006) This could have been the case in this study probably due to the fact that the youths were increasingly being affected by the epidemiological transition. The other reason could be that, those that developed the disease earlier never reached any more decades after diagnosis but died from complications of the disease and /or poverty in that the disease could not be controlled.

Diabetes appears to be uncommon in the age group 16-25 years. This may support the observation that type 1 DM appears uncommon in Africa, the majority of diabetes being type 2 DM. (World Health Organization 2003) 96% of the detected diabetics were over 30years of age, being similar to other observations. (Fabiyi et al., 2002), (Olatunbosun et al., 1988). WHO reported over 50% of their detected diabetic subjects being over 30years of age, while in Tanzania 0.2% of their detected diabetic subjects are below 30 years of age (Johnson 1971).

There is an increase in diabetes rates across the group with high BMI, identification of obesity as an independent risk factor for Type 2 DM is consistent with findings in many other studies (Johnson 1971). Only two (4%) of the detected diabetics had BMI <20kg/m^2 which contrasts with the findings of about 20% of the detected diabetics with BMI >20kg/m^2.

The rise in prevalence of DM across WHR groups and the identification of high WHR as an independent risk factor for Type 2 DM is consistent with the findings from other studies that identified high WHR as a risk factor for Type 2 DM (Shaten et al., 1993).

Lack of physical activity appeared to be a risk factor for DM in this study. This confirms the several cross-sectional and prospective studies which suggested lack of physical activity as a risk factor for DM in adults (Shaten et al., 1993).

Type 2 DM is known to show a strong family aggregation (Omar et al., 1983). Nineteen (38%) of the detected diabetic subjects had parental history of diabetes. This has also been supported by findings in some studies which shows family history of DM in 37% and 19% respectively in South Africa and Ethiopian diabetics. (Omar et al., 1983), (Mengesha et al., 1999). However in some similar studies it was shown that hereditary does not play a role in African diabetics, family history of diabetes in only 4% and 2.4% among Zulu and Nigerian diabetics respectively has also been reported. (NIDDM in urban Africans in Cape Town, South Africa. Diabetes care, 1993), (Omar et al., 1983) such discrepancies could be due to the fact that most people were unwilling to give family history but with the awareness of the disease and improvement in health care facilities, most people may be changing their attitude in volunteering information to family history of diabetes which could have accounted for the contrast of the findings from this study with other previous reports.

Variations in genetic susceptibility to type 2 DM has been suggested.[2] however, the influence of heredity on the prevalence of DM in this study population is not conclusive as only parental history of DM was recorded.

Failure to use the strict standard WHO criteria for diagnosis of DM (fasting and 2 hours post glucose load of 75g) limited strict comparisons of rates with studies outside Africa. Parental history of DM alone without the consideration of other first-degree relatives may not be enough to determine genetic influence on DM.

CONCLUSIONS AND RECOMMENDATIONS

The overall prevalence rate of diabetes mellitus observed in this study is higher than that previously reported in surveys from other parts of Nigeria. It seems that the prevalence of diabetes may be higher in northern part of Nigeria and probably, overall prevalence of diabetes mellitus may actually be rising in Nigeria, a situation observed in some other developing countries.

The predominant form of DM in the study population is type 2 DM and most are undiagnosed before the survey, which confirms the observation that high blood glucose may go undetected and thus untreated for considerable length of time indicating the need for more active screening of subjects for DM in Nigeria. WHR, BMI, WC,

Hereditary, physical activity, and social class are still a recognizable risk for type 2 DM in this environment.

REFERENCES

Campbell GD (1963). Some observations upon 4000 Africans and Asiatic Diabetes collected in Durban between 1958 and 1962. East Afr Med J:5,272.--24

Erasmus RT, Fakeye T, Olukoya O (1989). Prevalence of diabetes mellitus in Nigerian population. Trans Royal Soc. Trop. Med. Hyg.; 83: 417-418.--8

Fabiyi AK, Kolawole BA, Adefehinti O, Ikem RT (2002). The impact of knowledge, attitude, practice and beliefs of type 2 Nigerian diabetic patients on drug compliance, Diabetes international ;12:15-17.—11.

Fisch A, Pichard E, Prazuck T, Leblanc H, Sidebe Y, Brucker G (1987).

Prevalence and risk factors of diabetes mellitus in rural region of Mali: A practical approach. Diabetologia, , 30: 859-62. --15

Johnson TO (1971). Comparative study of screening methods for diabetes mellitus in the elderly Nigerian subjects. West Afr. Med J; 201: 243-6.--23

King H, Zimmet P (1988). Trends in the prevalence and incidence of diabetes: NIDDM. World Health Statistics Quarterly; 41: 190-96.--1

Knowler WG, Bennett PH, Hamman RF, Miller M (1978). Diabetes incidence and prevalence in Pima Indians; a 19-fold greater incidence than in Rochester, Minnesota. American J. epidemiology; 108: 497-505.--17

Mengesha B, Abdulkadir J, Oli K, Lugi Y (1999). Study of family history among parents and siblings of Ethiopian diabetics: a preliminary report. Journal of Tropical Medicine and Hygiene.; 93: 39- 41.—33.

Mohan V, Deepa M, Deepa R, Shanthirani CS, Farooq S, Ganesan A, Datta M (2006). Secular trends in prevalence of diabetes and impaired glucose tolerance in urban South India: The Chennai Urban Rural Epidemiology Study (CURES-17). Diabetologia; 49:1175–78.--27

National Expert Committee on Non Communicable Diseases (NCD) in Nigeria (1997). Report of a national survey, Fed Mins. Of health and Human services, Lagos:64-90.--6

NIDDM in urban Africans in Cape Town, South Africa (1993). Diabetes care,; 16: 601-7.--5

Ohwovoriole AE, Kuti JA, Kabiawu SIO (1988). Casual blood glucose levels and prevalence of undiagnosed diabetes mellitus in metropolitan Nigerians. Diabetes Res. Clinic. Practice,; 4:153-158.--7

Olatunbosun ST, Ojo PO, Fineberge NS, Bella AF (1988). Prevalence of diabetes mellitus and impaired glucose intolerance in a group of urban adults in Nigeria. 1: J Natl. Med. Assoc. May; 90(5): 293-301.--12

Omar M, Asmal AC (1983). Family histories of diabetes mellitus in young African and Indian diabetics. BMJ:286; 1786.--32

Shaten J, Smith GD, Kuller LH, Neaton JD (1993). Risk factors for the development of type 2 diabetes among men enrolled in the usual care group of the multiple risk factor intervention trial. Diabetes care,; 16: 1331-39.--31

Tseng CH, Tseng CP, Chong CK, Huang TP, Song YM, Chou CW, Lai SM, Tai TY, Cheng JC (2006). Increasing incidence of diagnosed type 2 diabetes in Taiwan: analysis of data from a national cohort. Diabetologia; 49:1755–60.--28

World Health Organization. The burden of diabetes on the world. WHO, Geneva 2003.--2