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Type 2 diabetes in adult Nigerians: a study of its prevalence and risk factors in Port Harcourt, Nigeria

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Abstract

Objectives: This study aimed to assess the prevalence rates of type 2 diabetes and to determine potential associated risk factors of the disease in Port Harcourt, Nigeria. *Research design and methods:* Five hundred and two (502) subjects aged above 40 years, obtained by a two-stage cluster sampling technique participated in this survey. Casual (random) plasma glucose estimations were done for all subjects after relevant personal data were obtained. Subjects with casual plasma glucose (CPG) ≥ 7.0 mmol/l had oral glucose tolerance tests (OGTT) done. Fasting and 2 h post glucose load blood samples were analyzed for plasma glucose levels. *Results:* Thirty-four (34) subjects had diabetes, giving a crude prevalence rate of 6.8% (CI = 4.6–9.0%), and standardized rate of 7.9%. The crude prevalence rates were 7.7 and 5.7% for males and females, respectively. Of the 34 diabetic subjects seen, 14 (41.2%) of them were not previously known to have diabetes; 83.7% of these were asymptomatic. Body mass index (BMI) ≥ 25 kg/m^2 and WHR ≥ 0.85, family history of diabetes, physical inactivity, heavy consumption of alcohol, older age as well as high social status and Hausa–Fulani or Ibibio origin were associated with significantly higher prevalence of type 2 diabetes. *Conclusion:* The prevalence of type 2 diabetes in Port Harcourt is relatively high. Changing lifestyle associated with industrialization may explain this. A significant proportion of the diabetic subjects are asymptomatic and undiagnosed. The risk factors as shown in our study clearly emphasize the point that type 2 diabetes is to a large extent a preventable disease.

Keywords: Type 2 diabetes in adult Nigerians; Plasma glucose; Body mass index

1. Introduction

Although there is a paucity of data on the prevalence of diabetes in Nigeria and other African countries, available data suggest that diabetes is emerging as a major health problem in Africa, including Nigeria [1]. The prevalence of diabetes in Port Harcourt is unknown [2,3] but

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studies show that diabetes is a considerable cause of morbidity and mortality in Port Harcourt [2–4]. In the University of Port Harcourt Teaching Hospital (UPTH) diabetes accounted for approximately 14% of all new cases seen in the Medical Clinics in 1994, and over 18% of all the Medical outpatient consultations in the same year [5].

Port Harcourt, the capital of the oil rich Rivers State of Nigeria is a cosmopolitan city with a projected population of over half a million people [6].

The city has undergone rapid transformation in recent times as a result of the boost in petroleum and other industries, and increasing influx of people from all over the world. Lifestyle is becoming increasingly westernized. It became pertinent, therefore, to study the prevalence of and assess risk factors for type 2 diabetes in Port Harcourt.

2. Materials and methods

2.1. Study population

Port Harcourt is located in the Niger Delta region of Nigeria. It is the center of the petroleum industry in Nigeria. The ethnic groups in Port Harcourt include Ikwerre, Ijaw, Ogoni and other Nigerian tribes such as Ibo, Yoruba and Hausa–Fulani. Expatriates from different parts of the world also live in Port Harcourt, which has many municipalities. This survey was carried out in the old township area of Port Harcourt. This area was chosen because it is well planned, which made sampling and logistics for the study easier. Secondly a fair representation of different strata of the society live in this area.

2.2. Sampling procedures

The study area was divided into 11 clusters of approximately 100 housing units each, using the standard map of the area. Three clusters were randomly selected. All housing units in the three selected clusters were enlisted for the study. Seven hundred and forty-eight subjects living in the chosen units who fulfilled the inclusion criteria were selected for the survey. Every selected subject was given a handbill designed for the survey, explaining the purpose, benefits, date and venue of the study. Radio announcements were made to remind the selected subjects to come for the study. The sampling procedure lasted 1 week (1st–7th September 2000).

Inclusion criteria:

1) Age, 40 years and above.
2) Resident in the study area—old Port Harcourt Township.
3) Selected by the random sampling procedure explained above.
4) Willing to participate and comply with the instructions of the study e.g. overnight fasting where necessary.
5) Informed consent.

Exclusion criteria:

1) History of use of drugs that could affect glucose metabolism e.g. steroids, B-blockers, thiazide diuretics.
2) Pregnant women.

2.3. Study procedure

This study was done between 08:00 and 15:00 h daily in September and October of the year 2000. On arrival at the study venue, each subject was allowed to rest for about 10 min; a questionnaire designed for the study was administered. Socio-demographic data and history of personal habits such as smoking, alcohol consumption and physical activity were obtained.

Physical activity was assessed from the occupation of the individual. People who engaged in manual labor, such as farming or professional sports were classified as physically active, while those who engaged in trade, housework or nursing were classified as moderately active physically. Physically inactive people included those who did sedentary jobs, e.g. office workers, or the unemployed. Those who engaged in sedentary jobs were classified as moderately active physically if they engaged in leisure sports. Alcohol consumption was categorized as moderate or heavy based on the

criteria of the Royal College of Physicians of London [7]. Alcohol intake of 21 units/week or more was regarded as heavy drinking, while less than 21 units/week was regarded as moderate drinking [7]. Social classification was done according to the classification of Abengowe et al. in Nigerians [8].

Physical examination was carried out by the authors. The weight of the subject was measured to the nearest kilogram with a Hanson type bathroom weighing scale. The height was measured to the nearest centimeter. The body mass index (BMI) was calculated and recorded. Classification by BMI was done according to the recommendations of the WHO expert committee for the classification of overweight [9].

The waist and hip circumferences were measured with a flexible tape to the nearest 0.5 cm wearing minimal clothing; the waist/hip ratio (WHR) was then calculated and recorded.

Venous blood (2.5 ml) was collected into fluoride-oxalate and transported to the chemical pathology laboratory of U.P.T.H within 2 h for the determination of casual plasma glucose (CPG) by the glucose oxidase method. Subjects who had CPG levels ≥ 7.0 mmol/l were subjected to a 75 g oral glucose tolerance test (OGTT) as soon as possible during the study period, with sampling at 0 and 2 h after glucose load. Subjects reported for OGTT between 08:00 and 09:00 h after overnight fasting. Repeat OGTT was not done.

2.4. Criteria for data interpretation

Diabetes was defined according to WHO criteria of 1999 [10]. Individuals who were previously known to have diabetes based on history and laboratory data were also classified as having diabetes without OGTT.

2.5. Statistical analysis

The data obtained were coded and entered into IBM compatible personal computers for analysis using EPI-INFO 6 statistical package as software. The data are presented as mean $\pm$ S.D. Comparison was done by Student's t-test for continuous variables and χ^2-test for discrete variables. All diabetes risk factors, presented in bivariate mode in Table 3, were entered into a multivariate logistic regression model, with diabetes (0 = no, 1 = yes) as the dependent variable. BMI, WHR and age are continuous variables and the others are categorical. The analysis was done using SPSS version10.

2.6. Precision

The coefficient of variation for the glucose estimations was 6.4% at 5.6 mmol/l and 2.1% at 18.3 mmol/l.

2.7. Ethical consideration

This study was conducted with adherence to ethical standards. Informed consent was used in the recruitment of participants. Approval for this study was obtained from the Ethics Committee of UPTH. Confidentiality was maintained in accordance with standard medical practice.

3. Results

Five hundred and two of the 748 subjects selected for this study, participated in the survey, giving a response rate of 67.1%. Non-responders were not followed-up in this study. The data of subjects studied are given below:

a) Ethnic group distribution: Twenty-two (22) ethnic nationalities were represented in the sample. The Ijaws comprised 47.4%, the Ibos 18.9%, the Yorubas 7.8%, the Hausa Fulanis 6.6%, the Ikwerres 4.4% and the other tribes 14.9% of the population.
b) Age and sex distribution: The subjects were aged 40–90 years. The male to female ratio was 1.2:1. Males were significantly older than females ($t = 7.41$, $P < 0.001$). The mean age of the sample population was 48.9 ± 9.2 years (see Table 1). The distribution of the sample population was not statistically different from that of Port Harcourt city ($\chi^2 = 0.39$, $P > 0.5$).

Table 1
Prevalence rates and variables in the population

Variable	Males (n = 273)	Females (n = 229)	*P* value	Sample population
Age (years) mean ± S.D.	50.2 ± 8.9	47.5 ± 9.2	< 0.001	48 ± 9.2
BMI (kg/m^2) mean ± S.D.	24.1 ± 3.7	27.7 ± 5.7	< 0.001	25.7 ± 5.1
WHR mean ± S.D.	0.91 ± 0.055	0.87 ± 0.060	< 0.001	
Crude prevalence of DM (%)	(n = 21) 7.7 (CI 4.6–10.8)	(n = 13) 5.7 (CI 2.7–8.7)	0.1	(n = 34) 6.8 (CI 4.6–9.0)
Standardized prevalence (%)	9.1	6.3		7.9

3.1. Family history of diabetes

Family history of diabetes was obtained in 38 subjects (7.6%); 21 of these (55.3%) had diabetic fathers, while 17 (44.7%) of them had mothers with diabetes. 72 subjects (14.3%) had relations who had diabetes (brothers, sisters, child, aunt, uncle, and grandparents).

3.2. Anthropometry

The mean BMI was 25.7 ± 5.1 kg/m^2. Females had significantly higher BMI than males ($t = 8.54$, $P < 0.001$), while the WHR was significantly higher in males than females ($t = 7.12$, $P < 0.001$). 50.2% of the subjects had BMI ≥ 25 kg/m^2 while 42.6% had WHR ≥ 0.90 (see Table 1).

3.3. Plasma glucose

The plasma glucose profiles of the subjects are summarized in Fig. 1 and Table 2.

49 (9.8%) of the subjects had CPG ≥ 7.0 mmol/l; nine of these were previously known to have diabetes and so were classified as having diabetes without OGTT. Two of the 40 remaining subjects had classical symptoms of diabetes in addition to CPG of 12.0 and 12.8, respectively, and so were also categorized as having diabetes without OGTT. Thus 38 subjects had OGTT. 12 of the 38 subjects who had OGTT were diagnosed to have diabetes. Seven of these had fasting and 2 h post glucose load plasma glucose levels in the diabetes range (≥ 7.0 and ≥ 11.1 mmol/l, respectively). Two subjects were diagnosed with diabetes by fasting plasma glucose levels alone, while three people had 2 h post glucose load plasma glucose levels in the diabetes range. In all 14 people were found to have diabetes by abnormal blood glucose levels including two symptomatic subjects who had high CPG and 12 subjects who had OGTT. 11 people showed impaired glucose tolerance.

3.4. Prevalence of diabetes

Out of 502 subjects seen, 20 were previously diagnosed to have diabetes, 14 subjects were diagnosed with diabetes during this study. 34 subjects were, therefore, found to have diabetes, giving a crude prevalence rate of 6.8% (95% CI = 4.6–9.0%). The rates obtained were standardized to the Nigerian population of 1991 (see Table 1). The male to female prevalence ratio was 1.4:1. The difference between males and females was not statistically significant (χ^2 1.69, $P > 0.1$). The prevalence of undiscovered diabetes was 2.8% while that of IGT was 2.2%.

3.5. Risk factors for diabetes

Subjects with diabetes were compared with non-diabetic individuals excluding those with IGT, giving a total of 457 normal and 34 diabetic subjects.

1) Obesity: BMI was significantly higher in the diabetic subjects than in the normal subjects ($t = 3.01$, $P < 0.01$). See Tables 2 and 3. WHR was significantly higher in the diabetic group ($t = 6.19$, $P < 0.001$), see Tables 2 and 3.
2) Physical inactivity: In this study, physical inactivity appeared to be an important factor influencing the prevalence of diabetes in people previously known to have diabetes, however, this effect was not sustained when all

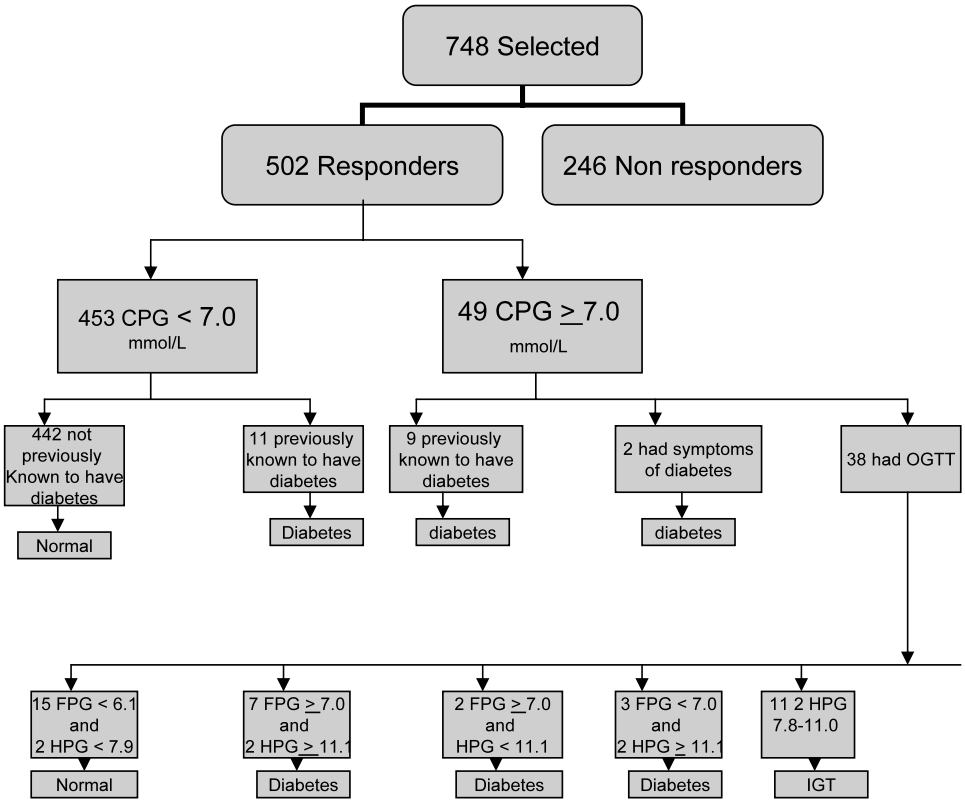

Fig. 1. Plasma glucose profile of the subjects.

Table 2
Differences between normal and diabetic subjects

Variable	Normal	Diabetic	*P* value
CPG (mmol/l)	4.6±1.2	8.8±0.9	<0.0001
BMI (kg/m^2)	25.6±4.99	28.3±6.20	<0.01
WHR	0.88±0.058	0.95±0.061	<0.001
Age (years)	48.6±9.2	53.6±8.5	<0.05
FPG (mmol/l)	4.8±0.96	8.9±2.65	<0.0001
2HPG (mmol/l)	6.2±0.98	14.5±3.11	<0.0001

CPG, casual plasma glucose; BMI, body mass index; WHR, waist/hip ratio; FPG, fasting plasma glucose; 2HPG, 2 h post-glucose load plasma glucose level.

the diabetic subjects were analyzed together. See Table 3.

3) Family history of diabetes: Diabetes was significantly more prevalent in people with a family history of diabetes compared with those without a family history. Table 3 shows this relationship.
4) Alcohol: Subjects who drank more than 21 units of alcohol per week were more likely to have diabetes than those who drank moderately. See Table 3.
5) Age: The diabetic subjects were significantly older than the subjects with normal glucose tolerance ($t = 2.164$; $P < 0.05$). Diabetes was more frequent in people aged 50 years and above. See Tables 2 and 3.
6) Smoking and social class: Smoking showed no influence on the prevalence of diabetes in this study (Table 3). Subjects in the highest socio-economic class showed significantly higher prevalence of type 2 diabetes when compared with the others (see Table 3).
7) Ethnicity: Diabetes was more prevalent in the Ibibio and Hausa–Fulani subjects than the other ethnic groups (see Table 3).

Table 3
Risk factors for diabetes

Risk factor	Normal	Diabetic	*P*-value
BMI (kg/m^2)			
<25	235	10	
≥ 25	222	24	<0.05
WHR			
<0.85	106	1	
≥ 0.85	351	33	<0.05
Physical inactivity (known diabetic subjects)			
Active	278	7	
Not active	177	13	<0.05
Physical inactivity (all diabetic subjects)			
Active	278	15	
Not active	177	19	>0.05
Family history			
Present	28	10	
Absent	429	24	<0.001
Alcohol intake			
<21 units/week	122	7	
≥ 21 units/week	54	9	<0.05
Age (years)			
<50	278	11	
≥ 50	179	23	<0.01
Smoking			
Yes (previous+current)	57	7	>0.1
No	395	27	
Social class			
1	29	8	
2–5	428	26	<0.001
Ethnic group			
Ibibio–Hausa–Fulani	41	8	
Others	416	26	<0.01

Multivariate analysis of these risk factors is shown in Table 4.

Table 4
Multivariate logistic regression analysis of risk factors for diabetes

Risk factor	*P* value	Odds ratio	95% CI
WHR	0.000	1.170	1.085–1.263
Family history	0.000	9.453	3.499–35.539
Age	0.025	1.053	1.007–1.102
BMI	0.086	1.075	0.990–1.167
Alcohol intake	0.912	1.050	0.438–2.522
Physical inactivity	0.987	1.008	0.416–2.443
Smoking	0.248	1.933	0.632–5.912
Social class	0.855	0.917	0.360–2.332
Ethnic group	0.077	2.504	0.906–6.919

4. Discussion

The crude and standardized prevalence rates of type 2 diabetes in this study was 6.8 and 7.9%, respectively. This is close to the crude rate of 7.2% reported for the Lagos mainland by the National non-communicable disease survey [11]. Although the National standardized rate is 2.2% in Nigeria, the crude prevalence rate is 7.4% in those aged 45 years and above who live in urban areas. However, it is noteworthy that other cities in Nigeria have lower rates than that in Port Harcourt. For instance, Ibadan, an urban center had prevalence rates of 1.5% in the National survey [11] and 0.8% in another study [12]. Jos, another urban center had a prevalence rate of 3.1% [13]. Although these studies included younger age groups, the wide difference observed may not be explained by age alone. Lagos and Port Harcourt are among the most industrialized cities in Nigeria. This may explain the similarity in prevalence rates observed in the two areas. Modernization influenced by upsurge in petroleum exploration could explain to some extent, the high prevalence rate obtained in this study. The effect of change in lifestyle on diabetes has been noted in Mauritius where the prevalence of type 2 diabetes is as high as 10.4% in Creoles [14].

The prevalence of undiscovered diabetes in this study was 2.8%. Ohwvoriole et al. [15] reported in 1988 that the prevalence of undiscovered diabetes was 1.7% amongst Nigerians in Lagos Metropolis. The influence of time and modernization may explain the difference between these two studies. Mclarty et al. [16] reported that only 13.5% of the 53 diabetic subjects in a survey in Tanzania were previously known to have diabetes, 74% of the newly diagnosed subjects were asymptomatic. This compares with the finding in this study where 83.7% of those newly diagnosed to have diabetes were asymptomatic. However, as much as 58.8% of the diabetic population in this study were previously known to have diabetes. The difference

observed may be related to the literacy rates in the two populations. While Mclarty's population was a rural one, this study was done in a Cosmopolitan city. Olatunbosun [12] and Puepet [13] also found very high levels of undiagnosed and asymptomatic diabetes in Nigeria. The finding of this study indicates that for every three known type 2 diabetic individuals in Port Harcourt, there are two others who are not known. This calls for intervention.

Some proven and hypothesized risk factors were examined to evaluate their associations with type 2 diabetes in this study population. The findings of this study accords with what has been known about obesity and diabetes. Obesity is by far the strongest modifiable risk factor for type 2 diabetes [17,18]. Subjects with BMI ≥ 25 kg/m^2 and WHR ≥ 0.85 were at significantly higher risk of having type 2 diabetes. Other epidemiological studies have demonstrated this effect of obesity on diabetes [19]. WHR emerged as a strong independent risk factor for diabetes while BMI did not. Abdominal obesity measured by WHR has been implicated as carrying more risk for type 2 diabetes than peripheral fat distribution [9,10]. Although the cut off for WHR in males is 0.90, we have used 0.85 for both males and females for ease of arithmetic. We believe this will not change the outcome since the normal and diabetic subjects were treated equally.

Multivariate analysis showed family history of diabetes as a strong independent risk factor for type 2 diabetes in this population. It is well accepted that the lifetime risk of any offspring developing diabetes is about 40% if one parent has diabetes and 70% if both parents have diabetes [20,21]. Family history of diabetes is more frequently obtained from diabetic subjects than from non-diabetic individuals. Omar and Asmal [22] and Mengesha et al. [23] have highlighted the importance of family history of diabetes in South Africa and Ethiopia, respectively. The National survey in Nigeria also reported that subjects with diabetic parents were at increased risk of having diabetes [11]. While these support the effect of heredity on the prevalence of diabetes, they also raise the issue of ascertainment bias, since individuals with diabetes are more likely to be aware of history of diabetes in their parents than non-diabetic subjects.

Heavy consumption of alcohol has been positively associated with diabetes [11]. This may be due to hepatic and/or pancreatic damage, which is known to complicate alcoholism [7]. Adi [24], Oli and Nwokolo [25] in Enugu have reported association between liver disease and diabetes in Nigeria. Moderate drinking reduces the risk of diabetes by improving insulin sensitivity [17,26], this may explain the lack of association between diabetes and drinking when both moderate and heavy drinkers were analyzed together against abstainers.

Advancing age was another identified independent risk factor for diabetes, which was more prevalent in subjects aged 50 years and above. Johnson [27] and McLarty et al. [28] found that the peak incidence of diabetes in Nigeria and Tanzania, respectively, was after 45–50 years of age. It is well known that the prevalence of diabetes increases with age [19]. In Nigeria, the risk of diabetes increases 3–4-folds after the age of 44 years [11]. The worsening of insulin resistance with age and increasing longevity of diabetic patients due to improved care, all contribute to the rising prevalence of type 2 diabetes with age [14,19].

Physical inactivity is a well-known risk factor for type 2 diabetes. The risk of diabetes is reduced by 50% among men who take moderately vigorous exercise [26]. Helmrich et al. [29] showed in a prospective study that physical activity is inversely related to the prevalence of diabetes. This study found an association between physical inactivity and diabetes in people who were previously known to have diabetes; however, this association was not sustained when all the diabetic subjects were analyzed together. This lack of association may be a reflection of the non-standardized indices used for measuring physical activity. Occupation is not a good indicator of physical activity as measurement of energy expenditure in kilocalories or metabolic equivalents (METS), but it was not feasible to use the latter in this study because most of the subjects did not engage in leisure sports.

The finding of higher prevalence rates in the Hausa–Fulani, and Ibibio ethnic groups is inter-

esting. The reason for this, which remains unapparent, would require further epidemiological studies to elucidate.

People in the highest social class had a significantly higher prevalence of type 2 diabetes than those in the lower classes. This finding agrees with the observation by Indian Doctors in 400 BC that diabetes was a disease of the rich. Zimmet also noted that diabetes was more common in the upper-class families in the developing Nations of the world [19]. However, the non-communicable disease survey in Nigeria reported a crude prevalence of 4.6% in the lower social class compared with 2.5% in the highest social class.

5. Conclusion

The prevalence of type 2 diabetes in this study population is fairly high. 40% of the subjects with diabetes are undiagnosed, over 80% of these are asymptomatic. Some of the identified risk factors for type 2 diabetes are modifiable, making type 2 diabetes a potentially preventable disease. It would be prudent, therefore, to recommend screening of subjects at risk and lifestyle modification to reduce the prevalence of type 2 diabetes in Port Harcourt.

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