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Determinants and Prevalence of Type 2 Diabetes Mellitus in Abuja, North Central Nigeria
Déterminants Et Prévalence Du Diabète Sucré De Type 2 À Abuja, Centre-Nord Du Nigeria.

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ABSTRACT

Background: *The surge in the global prevalence of diabetes Mellitus is driven by modifiable factors such as obesity, a sedentary lifestyle, and poor dietary habits. Non-modifiable factors include family history and advancing age. Epidemiologic transition which encourages an atherogenic diet helps to drive this trend. The surge, even though a global phenomenon, may continue mostly in low-income countries, Nigeria included. This study examined the current prevalence of diabetes and drivers in Abuja, the Nigerian capital city.*

Methods: *Leveraging the World Diabetes Day exercises for the years 2018, 2022, and 2023, consenting participants were recruited from three locations, mainly suburbs, across the city for this cross-sectional study. A structured questionnaire adapted from the WHO STEPS tool was used. Results: 385 participants with a mean age of 48.7 + 12.18 years were involved. The prevalence of diabetes mellitus was 5.2%. Determinants were poor dietary habits ($p<0.05$) and the use of beta-blockers and thiazide diuretics ($p<0.05$) as antihypertensive agents. Conclusions: Diabetes prevalence was 5.2% with driving factors such as poor dietary habits, the use of beta-blockers, and thiazide diuretics as antihypertensive drugs being prominent. Appropriate dietary counseling and proper selection of antihypertensives may help prevent diabetes mellitus in Abuja.*

Keywords: *Prevalence, Diabetes mellitus, determinants, Abuja, Nigeria*

ABSTRAIT

Contexte: *L'augmentation mondiale du diabète sucré s'explique par des facteurs modifiables (obésité, sédentarité, mauvaises habitudes alimentaires) et non modifiables (antécédents familiaux, vieillissement). La transition épidémiologique et une alimentation athérogène accentuent cette tendance, surtout dans les pays à faible revenu comme le Nigeria. Cette étude a évalué la prévalence actuelle du diabète à Abuja, la capitale nigériane.*

Méthodes: *S'appuyant sur la Journée mondiale du diabète de 2018, 2022 et 2023, des participants consentants ont été recrutés dans trois sites suburbains pour cette étude transversale. Un questionnaire structuré, basé sur l'outil WHO STEPS, a été utilisé. Résultats :385 participants, avec un âge moyen de 48,7 ± 12,18 ans, ont été inclus. La prévalence du diabète sucré était de 5,2 %. Les déterminants identifiés étaient de mauvaises habitudes alimentaires ($p < 0,05$) et l'utilisation de bêta-bloquants ainsi que de diurétiques thiazidiques comme agents antihypertenseurs ($p < 0,05$). Conclusions: La prévalence du diabète était de 5,2 %, principalement déterminée par de mauvaises habitudes alimentaires et l'usage de bêta-bloquants et diurétiques thiazidiques. Un conseil diététique et une meilleure sélection des antihypertenseurs pourraient aider à prévenir le diabète à Abuja.*

Mots-clés: *Prévalence, Diabète sucré, Déterminants, Abuja, Nigeria*

INTRODUCTION

Diabetes mellitus, DM, is a chronic metabolic disease characterized by elevated blood glucose levels due to abnormalities in insulin action and beta cell function (1). In the 2019 study of global estimates of disease burden, DM was the eighth leading cause of morbidity and mortality combined (2). Currently, over half a billion people are living with DM worldwide, with a humongous health-related expenditure that is expected to rise with the increasing number of cases (3-7). Fact-checks on the global picture from the international diabetes federation, IDF, shows that about 537 million adults in the age range of 20-79 years are currently living with DM globally, representing 1 in every 10 adults (8).

Also, the total number of people living with DM is predicted to rise to 643 million (1 in every 9 adults) by the year 2030 and 784 million (1 in every 8 adults) by the year 2045. Four in every five people with DM (81%) live in low- and middle-income countries (8). DM caused 6.7 million deaths in 2021, that is, 1 in every 5 seconds. An estimated 44% of adults living with DM (240 million people) are undiagnosed, with almost 90% of them living in low-and middle-income countries (8).

Available literature suggests that in Sub-Saharan Africa with Nigeria in focus, the major risk factors driving the prevalence of DM such as urbanization, obesity, sedentary lifestyle, and advancing age among others, are not different from those in other parts of the world (5,6), especially with the epidemiologic transition which is encouraging more atherogenic diet (9).

Thus, the surge in the prevalence of DM is a global phenomenon, although most of the expected increase will occur in the low-income countries zone where Nigeria belongs (8).

Interestingly, cigarette smoking has been shown to increase DM risk, conferring a 1.5 times risk and as much as 25% chance after five years of smoking (10,11). Beyond increasing the risk for DM, cigarette smoking increases the risk for DM-related long-term complications which are mainly cardiovascular (12). Hypertension frequently coexists with DM, partly explained by the common soil hypothesis (13). The treatment of hypertension using certain drugs has been shown to increase the risk of not only DM but also metabolic syndrome (14).

A positive family history of DM has been shown to confer a 2 to 6-fold risk of developing DM, thus establishing the existing association between a family history of DM, (particularly with first-degree relatives) and a high risk for developing DM (14-16).

A sedentary lifestyle is a risk factor for DM as shown in many studies (17-20), whereas even light to moderate-grade activities are associated with a substantial reduction in DM risk (18). DM is a major risk factor for atherosclerotic cardiovascular diseases (21), worsening the morbidity profile.

Therefore, DM-prevention and management approaches include strategizing against the risk factors and complications, as well as deploying established interventions that reduce the disease burden.

With limited infrastructures for diabetes care, many developing countries may be ill-equipped to manage this epidemic, underscoring the urgent need for primary prevention particularly through the promotion of a healthy lifestyle.

Abuja, the capital city of Nigeria, displays much of the Western lifestyle and has a rapidly increasing obesity rate from poor lifestyle practices such as prolonged consumption of calorie-dense atherogenic diets (22). With the widespread prevailing high risk for DM, it is emergent, therefore, to assess the prevalence and determinants of DM in Abuja whose population has increased dramatically over the last few years. This may provide updated representative data on the prevalence of DM in this area which has limited DM-related data. A knowledge of the determinants of DM may help plan prevention strategies.

METHODS

Consenting adults, 18 years and above who were willing to receive target free health assessment during world diabetes day, November 14th, were recruited for this study.

Un-consenting, too ill to participate, Gestational diabetes mellitus patients were excluded.

Sample size/ study sites/ recruitment of subjects

The target sample size of 385 participants was determined using a sample size calculator, based on the current population of the FCT (23). This sample size ensured sufficient statistical power, with a margin of error of ±5%, a 95% confidence level, and a 50% response distribution (24).

Recruitment was conducted during World Diabetes Day events (November 14th) in 2018, 2022, and 2023. Participants were recruited from three locations: the Asokoro District Hospital car park area, the Chief's Palace at Kpaduma-3 (Asokoro Extension), and the Karu Mechanic Workshop in Abuja. Details of recruitment are provided in Table 1.

Table 1: Distribution of participants recruited per year per location.

Year	Asokoro District Hospital Area	Kpaduma-3 village	Karu mechanic workshop	Total (n)	Percentage %
2018	53	88	62	203	52.72
2022	41	52	29	122	31.70
2023	-	36	24	60	15.58
Total	94	176	115	385	100.00
Percentage	24.40	45.70	29.90	100.00	

STUDY DESIGN

In this cross-sectional community-based study, a structured questionnaire designed from the modified WHO STEPS tool (25) for surveillance of chronic non-communicable disease risk factors was administered by trained research assistants. A pre-testing of the questionnaire was done earlier on fifty participants who were not part of the study. Participants were informed of the aim of the study during the world diabetes day exercise, and their consent was obtained before the questionnaire was administered. Contents of the questionnaire include socio-demographic information such as age, gender, marital status and occupation, history of alcohol and cigarette consumption, physical activity level, dietary habits, family history of DM and history of hypertension as well as drugs used in treating hypertension for those on antihypertensive agents. Anthropometric data including height in meters, and weight in kilograms from which body mass index (BMI) was calculated using the formula: Weight (kg)/ Height Weight(kg)Height/(m2) were obtained. The height and weight of each participant were measured using a validated stadiometer (Techmel and Techmel USA TT 120). The height was measured with the participant standing upright looking straight forward; with back straight; heels against the scale; without shoes, caps, or scarves, and approximated to the nearest 0.01m. Weight was taken with the participant standing erect, wearing light clothing, and barefooted. Zero-mark calibration of the weighing scale was ensured before each measurement and weight was approximated to the nearest 0.01 kilogram. Alcohol consumption was defined as the weekly intake of beer, wine, and hard liquor (like spirits, brandy, and whisky) converted into grams of alcohol (26). Information on cigarette smoking was obtained. Participants were classed based on smoking status into three groups: nonsmokers, current smokers, and past smokers (27). The family history of diabetes was considered positive either in the presence of at least one diabetic parent or sibling (first-degree) or if diabetes occurred in the respondent's cousin, uncle, or aunt (second-degree). Information on the dietary practice was obtained. Dietary fiber intake was assessed by dietary history and inquiring about the participants' intake of the best sources of dietary fiber such as beans and peas, navy beans, black beans, green leafy vegetables, fruits, whole grains, and nuts (28). Leisure-time physical activity was assessed by considering both the intensity and the duration of physical activity (29). Similarly, leisure-time sedentary behaviors including time spent reading, sitting when talking to friends or listening to music, watching television, and driving or riding in a car; were also considered (29). Blood Pressure, (BP), was measured using an automated blood pressure monitor (Omron M2 Basic HEM-7120-E) with the appropriate cuff size that covers two-thirds of the arm. The participants were seated, with back and arm supported, with legs uncrossed, and both feet flat on the floor. BP was taken on the bare, upper-left arm at the cardiac level after a resting period of at least 5 minutes with no talking, mobile phone usage, or reading. BP was then classified based on the JNC 7 report and 2017 American Heart Association/American College of Cardiology guidelines for comparison. (30). Glucose level was assessed using an Accu-Chek glucometer.

Definition of Terms

BMI: Participants were categorized into four BMI groups: underweight (<18.5), normal weight (18.5–24.9), overweight (25.0–29.9), and obesity (≥30.0) (31). Hypertension: Normotensive was defined as blood pressure <139/80 mmHg, and hypertensive as ≥140/90 mmHg (28). Diabetes Mellitus (DM): Diagnosis was based on fasting blood glucose levels ≥126 mg/dL (7.0 mmol/L) or random blood glucose levels meeting diagnostic criteria (32). Alcohol Consumption: Categorized into four groups: none, light, moderate, and heavy, based on recommendations from the Royal College of Physicians of London (26). Smoking: Participants were classified as: Current smokers: Smoked ≥100 cigarettes in their lifetime and reported smoking daily or occasionally at the time of the study. Past smokers: Previously smoked ≥1 cigarette daily for at least one year but were not smoking at the time of the study. Never smokers: No history of smoking (27). Exercise: Categorized into three levels: none, 1–2 times per week, and >3 times per week (29). Additional data were collected on the frequency of fast food, soft drinks, and ice cream consumption (28).

Ethical Consideration

Ethical approval for this study was obtained from the Asokoro District Hospital Ethical Committee

(Reference Number: FCTA/HHSS/HMB/ADH/042/22).

Data Collection and Statistical Methods

Data was initially entered into an Excel spreadsheet, before exporting to SPSS for analysis. Data include demographic variables such as age, gender, marital status and occupation, history of alcohol and cigarette consumption, physical activity level, dietary habits, family history of DM, and history of hypertension. Anthropometric data including height and weight. Waist circumference was used as a measure of truncal obesity: >80 cm in women and >94 cm in men. A biochemical variable was blood glucose. Data was checked for completeness and analyzed using the International Business Machine Corporation Statistical Package for the Social Sciences (IBM SPSS version 25). Continuous variables were expressed as mean (±SD) All categorical data were expressed as frequencies and proportions and presented in a table or graph. The chi-square test was used to establish an association between qualitative variables. Regression analysis was used to assess the association of risk factors with DM. Adjusted odds ratio was calculated. A 95% confidence interval was used for this study and a p-value of < 0.05 was considered statistically significant.

RESULTS

There were three hundred and eighty-five participants in this study, mostly females, 231 (60%). Participants' ages were distributed as follows: most were aged 45 to 64 (47%), followed by those aged 18 to 44 (36%), with the smallest group 65 years and over (17%). Forty-seven percent of the participants were within the middle age group with a mean age of 48.7 +12.18 years. The marital status of participants shows that the majority are married, comprising 71% of the group. Additionally, 12% have never married, 8% are divorced, 6% are widowed, and 3% are separated.

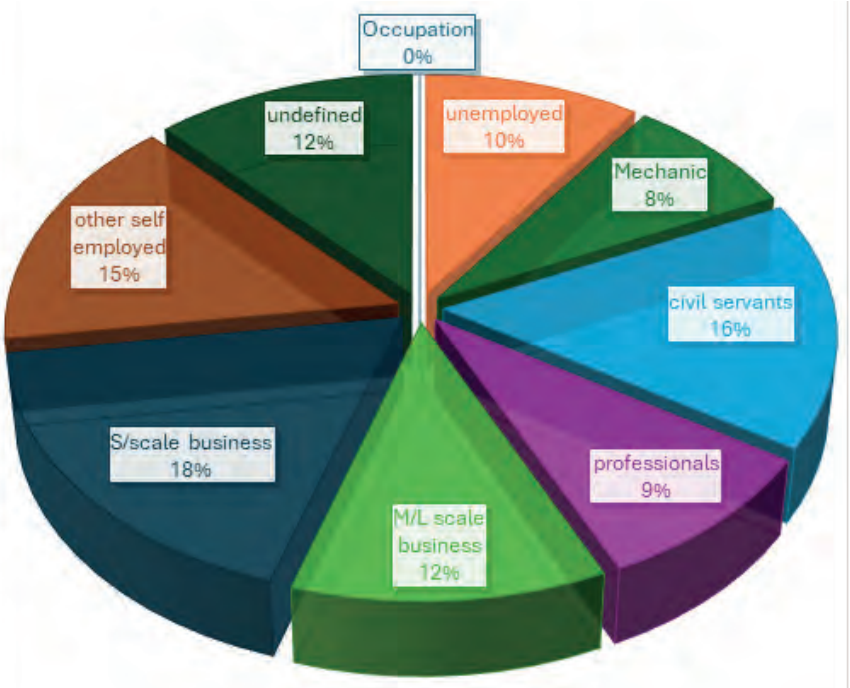
Table 2: Table of means of quantitative variables

Variables	Mean	± SD
Age (years)	48.7	12.18
Height (m)	1.61	0.09
weight (Kg)	77.96	13.88
BMI Kg/m2	30.1	6.01
SBP mmHg	136	18.61
DBP mmHg	80.7	11.21
WC (cm)	98.41	12.61
HC (cm)	99.8	11.91
WHR	0.98	0.12
FBG (mmol/l)	7.84	5.06
RBG (mmol/l)	6.33	1.64

The subjects were mainly obese and normotensive.

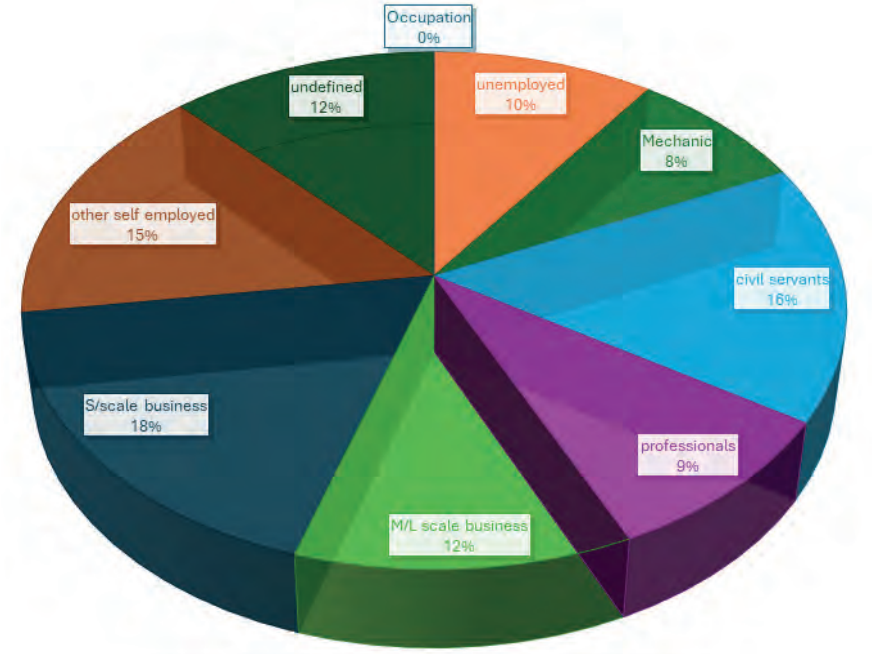
BMI is body mass index, SBP: is systolic blood pressure, DBP is diastolic blood pressure, WHR is waist-to-hip ratio, WC: is waist circumference, HC is hip circumference, FBG: fasting blood glucose concentration, and RBG is random blood glucose concentration.

Figure 1a. Distribution of occupation of participants



The prevalence of diabetes mellitus was 5.2% with prevalent risk factors being physical inactivity 57.9%, low fruits and vegetables 21.56%, regular consumption of sugar-sweetened drinks, fast foods, and ice cream, 37.4%, 22.86% and 20.52% respectively. Others were DM in first-degree relatives (22.34%) and overweight/obese (44.16%). Most of the subjects in the 45 – 64 age group were mostly males, small-scale business owners, and self-employed married people.

Figure 1b. Distribution of occupation of participants



The subjects were mainly obese and normotensive.

BMI is body mass index, SBP: is systolic blood pressure, DBP is diastolic blood pressure, WHR is the waist-to-hip ratio, WC: is waist circumference, HC is hip circumference, FBG: fasting blood glucose concentration, RBG is random blood glucose concentration

Figure 1c. Distribution of marital status of participants

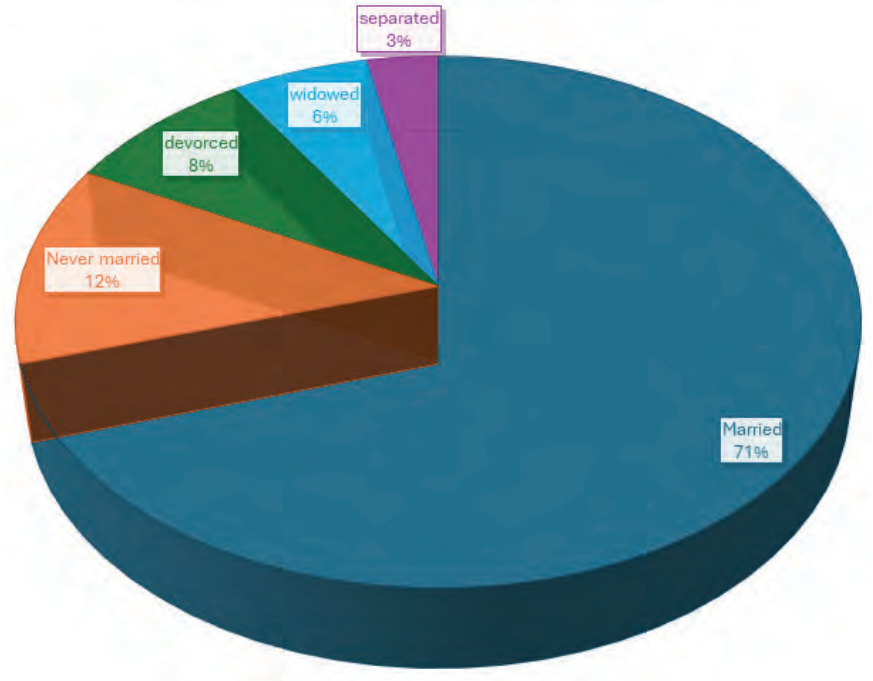
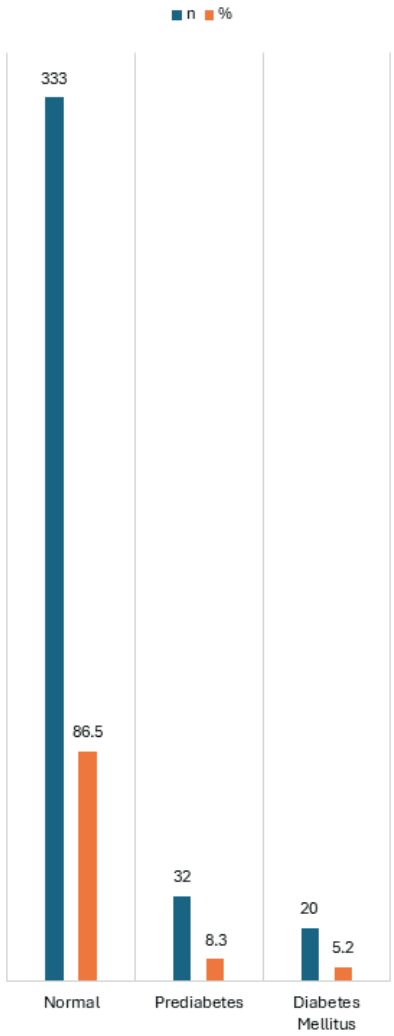


Figure 2: Glycaemic status of study participants



There were significant statistical relationships with poor diet, depicted majorly by low consumption of fruits and vegetables, and regular consumption of fast foods and ice cream, p=0.005, 0.001, and 0.012 respectively. The use of beta-blockers and thiazide diuretics to treat hypertension showed a significant association with diabetes mellitus, p=0.001. The relationships with sex, sugar-sweetened drinks, alcohol, and family history of diabetes mellitus were weak, p=0.071, 0.098, 0.096, and 0.074 respectively.

Table 3: Prevalences of the risk factors for diabetes mellitus amongst study participants

Variable	N=385	(%)	Variable	N=385	(%)
Physical Activity Levels of Study Participants			**Cigarette smoking**		
Inactive	223	57.9	Never smoked	342	88.83
At most 2x a week	114	29.6	past smoker	36	9.35
At least 3x a week	48	12.5	current smoker	7	1.82
Dietary Habits of Study Participants			**Body Mass Index (BMI)**		
Low intake of Fruits and Vegetables	83	21.56	Underweight	68	17.66
Regular intake of sugar-sweetened drinks	144	37.4	Normal weight	147	38.18
Regular consumption of fast food	88	22.86	Overweight	94	24.42
Regular consumption of Ice cream	79	20.52	Obese	76	19.74
Family history of diabetes mellitus			**Hypertension status**		
Not Known	288	74.8	Hypertensive	120	31.17
Yes in First degree	86	22.34	Previously known	96	24.94
Yes in second degree	11	2.86	Newly diagnosed	30	7.79
Alcohol consumption			Non-hypertensive	259	67.27
No	256	66.49	**Antihypertensive used**	**101(120)**	**80.16**
Light (< 83g/week)	115	29.87	ACE-I	55	54.45
Moderate (84-167g/week)	14	3.64	ARB	6	5.94
Heavy	0	0	Beta Blocker	15	14.85
Cigarette smoking			Calcium channel blocker	71	70.29
Never smoked	342	88.83	Methyl dopa	15	14.85
past smoker	36	9.35	Thiazide Diuretics	30	29.7
current smoker	7	1.82			

ACE-I: Angiotensin-converting enzyme inhibitor, ARB: Angiotensin receptor blocker.

Table 4: Table of bivariate analysis of variables as risk factors

Variables	Diabetes	Non-diabetes	Total	Chi-Sq	df	p-value
1. Sex/Diabetes Mellitus						
Male	8(5.16%)	147(94.84%)	155(100%)			
Female	12(5.2%)	218(94.8%)	230(100%)	3.572	2	0.071
Total	20 (5.2%)	365(94.8%)	385(100%)			
2. Age/Diabetes Mellitus						
18-44	3(2.14%)	137(98.85%)	140(100%)			
45-64	12(6.67%)	168(93.33%)	180(100%)	2.925	2	0.141
>65	5(7.670%)	60(92.30%)	65(100%)			
Total	20(5.20%)	365(94.80%)	385(100%)			
3. PA/Diabetes Mellitus						
Inactive	4(1.79%)	219(98.21%)	223(100%)			
At most 2x/wk	10(8.77%)	104(91.23%)	114(100%)	0.065	3	0.984
At least 3x/wk	6(12.50%)	42(87.50%)	48(100%)			
Total	20(5.20%)	365(94.80%)	385(100%)			

Variables	Diabetes	Non-diabetes	Total	Chi-Sq	df	p-value
4. DH/Diabetes Mellitus						
Low Fruits						
Yes	9(10.84%)	74(89.16%)	83(100%)	18.49	1	*0.005
No	11(3.64%)	291(96.36%)	302(100%)			
Total	20(5.2%)	365(94.80%)	385(100%)			
SSD						
Yes	11(7.64)	133(92.36%)	144(100%)	2.738	1	0.098
No	9(3.73%)	232(96.24%)	241(100%)			
Total	20(5.2%)	365(94.8%)	385(100%)			
Fast foods						
Yes	10(11.36%)	78(88.64%)	88(100%)	16.86	1	*0.001
No	10(3.37%)	287(96.63%)	297(100%)			
Total	20(5.2%)	365(94.8%)	385(100%)			
Ice cream						
Yes	8(10.13%)	71(89.87%)	79(100%)	12.185	1	*0.012
No	12(3.92%)	294(96.08%)	306(100%)			
Total	20(5.2%)	365(94.8%)	385(100%)			
5. FH/Diabetes Mellitus						
Not known	11(3.82%)	277(96.18%)	288(100%)			
First degree	8(9.30%)	78(90.70%)	86(100%)	5.197	2	0.074
second degree	1(9.10%)	10(90.9%)	11(100%)			
Total	20(5.2%)	365(94.8%)	385(100%)			
6. BMI/Diabetes Mellitus						
Underweight	4(5.88%)	64(94.12%)	68(100%)			
Normal	9(6.12%)	138(93.88%)	147(100%)			
Overweight	3(3.20%)	91(96.80%)	94(100%)	2.357	3	0.798
Obese	4(5.26%)	72(94.74%)	76(100%)			
Total	20(5.20%)	365(94.80%)	385(100%)			
7. Alcohol/Diabetes Mellitus						
No	9(3.52%)	247(96.48%)	256(100%)			
Light	9(7.83%)	106(92.17%)	115(100%)			
Moderate	2(14.30%)	12(85.70%)	14(100%)	4.691	3	0.096
Heavy	0(0.00%)	0(0.00%)	0(0.00%)			
Total	20(5.2%)	365(94.8%)	385(100%)			
8. Smoking/Diabetes Mellitus						
Never	17(5.0%)	325(95.0%)	342(100%)			
past	2(5.56%)	34(94.44%)	36(100%)	1.517	2	0.468
current	1(14.3%)	6(85.7%)	7(100%)			
Total	20(5.2%)	365(94.8%)	385(100%)			
9. Hypertension/Diabetes Mellitus						
Hypertensive	7(5.56%)	119(94.44%)	126(100%)			
Nomo-tensive	13(5.02%)	246(94.98%)	259(100%)	0.007	1	0.933
Total	20(5.2%)	365(94.8%)	385(100%)			

Variables	Diabetes	Non-diabetes	Total	Chi-Sq	df	p-value
10. Antihypertensives used(combinations)						
ACE-I			55	0.213	1	0.634
ARB			6	0.608	1	0.435
Beta Blocker			15	21.366	1	*0.000
CCB			71	0.336	1	0.562
Methyl dopa			15	0.543	1	0.321
Thiazide Diuretics			30	15.721	1	*0.000

FH: Family history, CCB: Calcium channel blocker.

DISCUSSION

The Prevalence of DM in this study was 5.2%, which is higher than the 3.8% pooled prevalence previously reported in 2018 from the north-central zone where Abuja is situated (33). This may have revealed a trend that supports a rising DM prevalence with Abuja in focus. This situation parallels an Abuja rising rate of obesity, a major driver of DM (22). Diabetes Mellitus is experiencing a global surge in its prevalence with a consequent increase in DM-related morbidity, mortality, and of course expenditures (2-7). An overall prevalence of DM in Nigeria from a 2018 meta-analysis was estimated to be 5.77%, (33) representing a 2.6-fold increase from the 1992 non-communicable disease estimates of 2.2% (34). The same 2018 meta-analysis reported a prevalence of 3.8% for the north-central zone, where Abuja is situated. Earlier studies conducted from 2008 through 2014 involving the northcentral zone of Nigeria showed prevalences ranging from 4% to 4.1%, 4.61% to 8.3% (35-38). This wide variation may be related to differences in methodology and the study populations.

The study by Anzaku et al in Jos was on women with Gestational diabetes mellitus (37), a population that was excluded in our study. The other studies above, used an oral glucose tolerance test, OGTT, the gold standard for the diagnosis of DM (35,36). Etukumana et al used fasting blood glucose (38) while our study used fasting and random blood glucose levels for diagnosis. Our diagnostic method differs from the IDF standard of OGTT use. Although OGTT is the gold standard for the diagnosis of DM (39), fasting and random blood glucose assessments are not only handy and cheap methods, but they are also easy to use where OGTT may not be feasible, as in our study where on-the-spot sampling was done during outreach activities. The risk factors of interest are shown in Table 3. The most prevalent among them was decreased physical activity.

This is consistent with findings from a previous Nigerian study (33). The finding from our study may be due to prevalent urban habitation in Abuja, where most communities are proximal to urban locations. Urban habitation is known to be associated with decreased energy expenditure, which is an independent risk factor for metabolic syndrome, a driver for dysglycaemia, DM inclusive (40,41). A sequela of this decreased energy expenditure is the tendency to gain weight and thus rising obesity, a pattern which has been reported by an earlier study among Abuja residents (23). In our study, on bivariate analysis, physical inactivity was however not statistically significant (p=0.984) as a DM risk factor, table 4. As shown, more of the subjects who had DM had lower levels of physical activity, suggesting an inverse relationship which even though not statistically significant is consistent with findings from previous studies (19,20). This pattern may be partly explained by possible variations in biological mechanisms, impacting the beneficial effects of physical activity on insulin sensitivity (17).

Among the other risk factors of interest in our study were unhealthy dietary habits which include low intake of fruits and vegetables, regular consumption of sugar-sweetened drinks, (SSD), and regular consumption of fast foods and ice cream. An unhealthy diet consisting mainly of high-fat, calorie-dense food is readily available and served at the many fast-food outlets dotted all over the city of Abuja. The busy nature of people's schedules encourages inhabitants to regularly patronize these outlets where they consume calory-dense and atherogenic meals, contributing to obesity and DM (23). Strong associations existed between DM and low consumption of fruits/vegetables, (p=0.005), regular consumption of fast foods, (p=0.001), and regular consumption of ice cream, p=0.012 as shown in table 4. While regular consumption of SSD has been shown to be associated with a significant risk of developing DM (42), in this study, that association was weak p=0.098.

This may be partly due to sample size as well as unmet thresholds of quantity and duration of exposure, although those factors were not assessed in this study.

There were more female participants in this study, a pattern consistent with that in previous similar studies suggesting better female health-seeking behavior (43). There was no association between age and DM in this study, even though aging is a known risk factor for DM (44,45). This is unexpected since insulin resistance tends to worsen with advancing age (46). This, coupled with decreased physical activity among the aged, increases the risk of type 2 DM. The lack of association with age in this study may be partly explained by the fact that most of the participants were in the age ranges of 45-64 years (46.75%) and 18-44 years (36.36%), representing the middle-age and young-age groups respectively. Considering smoking, 1.82% and 9.35% of our study participants were respectively current and previous cigarette smokers. This was less than that reported by an earlier review from Nigeria (47).

Although there was no statistical significance, p=0.468, in the association between smoking and DM in this study, smoking has been previously shown to be a standing-alone risk factor for DM (10-12,48) The lack of association may be related to sample size, duration of exposure and quantity exposed to. Interestingly, available literature postulates that smoking may cause DM through mechanisms such as oxidative stress, chronic inflammation, and endothelial dysfunction which are factors that are strongly associated with insulin resistance (48,49).

On alcohol consumption, most of the participants in this study were either non-, light, or moderate drinkers. No participant was found to be a heavy drinker. Our study did not establish a significant association between alcohol consumption and DM, likely because the participants were not heavy drinkers. Chronic and heavy consumption of alcohol is a DM risk factor, while moderate use is thought to improve insulin sensitivity (50). Dysglycaemia (especially diabetes mellitus), and hypertension, are two common non-communicable diseases that are closely related (51). Mechanisms for dysglycaemia in patients with hypertension may include the atherogenic effect of hypertension-related insulin resistance and β-cell failure, suggesting that dysglycaemia may partly be a consequence of vascular impairment (52).

Even though we did not find a statistically significant relationship in this study, p=0.933, probably because of the sample size, we however did observe a significant relationship between treatment of hypertension and DM among participants who used beta blocker, p=0.000 and thiazide diuretic, p=0.000 as antihypertensive agents. Similar associations have been reported previously (53). These drugs are thought to worsen insulin resistance (54,55).

In our study, the association between DM and a family history of DM was weak, p=0.074. It is observed that close to three quatres of the study population either lacked knowledge of their family history or were not living with DM themselves. This may partly explain the lack of association. In a recent study in Abuja, Onyegbutulem et al (51) corroborating previous studies (56,57), reported that a family history of DM is a significant predictor of DM. This was explained by the roles played by possible genetic predisposition and environmental antecedents, with expression of the common soil hypothesis (13).

High BMI, even though known to be associated with DM, was not significant in this study. Among the participants who were found to have DM, 65% were underweight or of normal weight. Most, 75.6% of the participants, came from the periphery of the city, where they are mostly subsistent farmers, mechanics, artisans, and middle- and low-class inhabitants with a possible higher level of physical activity which is known to carry a lower risk for fat accumulation, truncal obesity and DM.

CONCLUSION

In this study, the prevalence of DM was 5.2%. Determinants include dietary factors such as low consumption of fruits and vegetables, and regular consumption of calorie-dense fast foods and ice cream. The use of beta-blockers and thiazide diuretics as antihypertensive drugs was associated with DM. Weak determinants include female gender, regular consumption of sugar-sweetened drinks, family history of DM, and alcohol consumption. Proper diet and meticulous selection of antihypertensive medications should be considered. Discouraging high consumption of sugar-sweetened drinks and alcohol may help prevent diabetes mellitus in Abuja.

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