

PREVALENCE AND PREDICTORS OF PREDIABETES AMONG ADMINISTRATIVE STAFF OF A TERTIARY HEALTH CENTRE, SOUTH-WESTERN NIGERIA

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ABSTRACT

Introduction: Prediabetes is a condition in which individuals have blood glucose levels higher than normal but not high enough to be classified as diabetes mellitus. Inadequate moderate-intensity physical activity, amidst other risk factors, is a well-documented risk factor for prediabetes. Hospital administrative staff can be particularly vulnerable to prediabetes because of the greater number of hours spent in a sitting or sedentary position during administrative duties. The aim of this study was to find the prevalence of prediabetes and to determine its predictors among administrative staff of a tertiary health centre in southwestern Nigeria.

Methods: This was a descriptive cross-sectional study carried out among 300 administrative staff of the University College Hospital, Ibadan over a period of three months. Data was collected using a semi-structured questionnaire that was adapted from the generic WHO-STEPs instrument approach to surveillance of chronic non-communicable diseases risk factors. Data was analyzed using the Statistical Package for Social Sciences (SPSS) version 17. Descriptive analyses were performed to estimate the prevalence of prediabetes while the independent predictors of prediabetes were investigated using multinomial logistic regression model. The level of statistical significance was set at $p < 0.05$.

Results: The mean age of participants was 51.2 ± 5.3 years. There were 164 (54.7%) males and 136 (45.3%) females that participated in the study. The prevalence of prediabetes was 22.3%. Based on the final multivariable multinomial model, the independent predictors of prediabetes included; male sex (OR= 1.24; 95% CI= 1.082 - 2.460), positive family history of diabetes mellitus (OR= 1.57; 95% CI= 1.088 - 2.611), alcohol intake (OR= 1.13; 95% CI= 0.688 - 1.543) and inadequate moderate-intensity physical activity (OR= 1.49; 95% CI= 1.027 - 2.936).

Conclusion: There was a high prevalence of prediabetes among the administrative staff of University College Hospital, Ibadan. Regular screening of hospital employees for prediabetes is highly recommended. Work-place exercise should be advocated to improve moderate-intensity physical activity among hospital employees.

Keywords: Prediabetes, Administrative staff, Hospital employees, University College Hospital.

INTRODUCTION

Prediabetes, an intermediate stage between normal glucose tolerance (NGT) and overt type 2 diabetes mellitus, is a condition in which individuals have blood glucose levels higher than normal but not high enough to be classified as diabetes mellitus.^{1,2} As such, it represents two groups of individuals, those with impaired glucose tolerance (IGT) and/or those with impaired fasting glucose (IFG).^{1,3} According to the American Diabetes Association,⁴ prediabetes is diagnosed as a fasting blood glucose of 100 to 125 mg/dl (5.6 to 6.9 mmol/L) known as IFG; a blood glucose of 140 to 199 mg/dl (7.8 to 11.0 mmol/L)

two hours after an oral glucose tolerance test (OGTT) known as IGT or HbA1c level of 5.7% to 6.4%. Prediabetes is largely asymptomatic and it is therefore mostly detected on routine screening in apparently healthy individuals.^{3,5} Three tests are used for the screening of prediabetes; a fasting blood glucose (FBG) level, a two-hour OGTT and measuring of HbA1c levels. Though, the OGTT is a specific indicator of diabetes risk and is considered to be the gold standard for detection of prediabetes.³

According to the Centers for Disease Control and Prevention (CDC),¹ prediabetes has been noted to have a higher prevalence figures than diabetes mellitus among populations. For instance, prediabetes was called “America’s largest healthcare epidemic” in year 2011 as approximately 79 million adults in the United States had prediabetes.¹ This number was more than three times the number of adults (approximately 26 million) with frank diabetes mellitus in the United States that same year.¹ Few studies have shown a high prevalence of prediabetes among hospital employees in a similar fashion as noted in the general population. In a study to determine the prevalence of prediabetes in healthcare professionals, Rongies et. al⁶ found 15.7% of their study participants had prediabetes. In another survey among medical staff of a hospital in Kuwait, AlRandi et. al⁷ found that out of the 51 participants with high Finnish diabetes risk assessment scores, 26 (51.0%) had prediabetes.

Inadequate moderate-intensity physical activity, amidst other risk factors, is a well-documented risk factor for prediabetes.⁸⁻¹⁰ The World Health Organization (WHO) had recommended that; adults aged 18–64 years should do at least 150 minutes of moderate-intensity physical activity throughout the week.² Arguably, hospital administrative staff can be particularly vulnerable to chronic medical conditions like diabetes mellitus because of the greater number of hours spent in a sitting or sedentary position during administrative duties while making out time for exercises might be extremely difficult. Uninterrupted sitting at workplaces for lengthy hours has also been linked with high postprandial glucose and insulin levels which may lead to prediabetes.¹¹

Studies have shown that hospital employees, despite their proximity to healthcare system, have a low level of health seeking behaviour including regular screening for chronic medical conditions like diabetes mellitus.¹²⁻¹⁵ A huge knowledge gap exists as there is no local study on the prevalence and predictors of prediabetes among hospital administrative staff in Nigeria. The specific objectives of this study were to find the prevalence and predictors of prediabetes and to determine its predictors among administrative staff of a tertiary health centre in southwestern Nigeria. The findings of this study will be important for implementing routine screening for prediabetes among hospital employees and for informing public health policy decisions on lifestyle interventions to prevent the progression of prediabetes to type 2 diabetes mellitus.

MATERIALS AND METHODS

Study setting

The study was carried out at the Metabolic Research Ward of the University College Hospital (UCH), Ibadan, Nigeria. The study population was administrative members of staff of UCH, Ibadan. The hospital has a total staff population of 5,697 persons within the varying departments of the hospital. The administrative members of staff in UCH Ibadan are a total number of 2,065.

Sample size determination

The sample size was estimated using the Leslie Kish formula ($N = Z^2pq/d^2$) for prevalence studies.¹⁶ Where N = Desired sample size, Z = The standard normal deviate set at 1.96 which correspond to 95% confidence level. An estimated sample size of 300 participants was determined based on a precision of 0.05 and a prevalence of 20.2% from a study of prevalence of prediabetes and its associated risk factors in eastern Uganda.¹⁷ A systematic sampling of one in seven staff was used to recruit participants from the sample frame (list of the 2,065 administrative members of staff UCH Ibadan) until estimated sample size of 300 participants was reached.

Study Design

This was a descriptive cross-sectional study carried out within a period of three months between February to April, 2015. Inclusion criteria include: (i) age of participant between 40 and 60 years⁴ (ii) not diagnosed with diabetes mellitus or not currently on medications for diabetes mellitus. Exclusion criteria include: (i) non-consenting staff (ii) pregnant women.

Data collection

The study involved the administration of a semi-structured questionnaire which was adapted and modified from the generic WHO STEPwise approach to chronic disease risk factor surveillance.¹⁸ The WHO STEPs instrument was developed by the WHO and it provides an entry point for chronic disease surveillance activities in low and middle income countries making it suitable for this study. It is called STEPwise approach because data are collected in 3 steps; step 1 uses a questionnaire to collect demographic and lifestyle data; step 2 involves measurements of height, weight, blood pressure, waist and hip circumference; and step 3 is laboratory investigations as collection of venous blood sample for FPG and OGTT estimation. The WHO STEPs instrument is validated and had been used in some local studies on chronic disease surveillance in Nigeria.¹⁹⁻²² The questionnaire was in English language and self-administered.

Step 1: Demographic and lifestyle data were obtained using the WHO STEPs instrument. A proxy for social classification of respondents was used by categorizing this study participants into junior and senior staff cadres using the grade level 6 and above as senior staff and grade level 5 and below as junior staff according to the Nigeria Federal Civil Service gazette.²³ Alcohol consumption was categorized into non-drinkers or previous drinkers and current drinkers depending on whether the respondents had never taken alcohol in their lifetime, drank alcohol in the past but had not used alcohol in the previous 12 months preceding this study or currently used alcohol in the previous 30 days preceding this study respectively. Cigarette smoking status was categorized as non-smokers or previous smokers and current smokers depending on whether the subjects had never used cigarette in their lifetime, took cigarette in the past but had not smoked in the last 12 months preceding this study and currently smoked cigarette within the last one year preceding this study respectively. Questions on physical activity sought information on participants' undertaking of moderate-intensity activities (e.g. brisk walking, carrying light loads, riding a bicycle, light recreational activities etc.). Physical activity was categorized as adequate or inadequate physical activity whether participant met the WHO recommendations of 150 minutes of moderate-intensity activities per week or did not respectively. Food frequency was assessed using recall of foods eaten in the seven days preceding this survey. The responses of participants to the dietary intake pattern were summarized into two broad categories as healthy diet and Western diet.¹⁷ The healthy dietary pattern was characterized by a frequent consumption (1 – 2 times/day) of food items that had a high fibre contents and low fat contents such as fruits, vegetables, legumes, whole grains, fruits, salad, fish and other seafood. In contrast, the Western dietary pattern was characterized by a frequent consumption (1 – 2 times/day) of food items that had low fibre contents and high fat contents such as processed meat, red meat, butter, high-fat dairy products, refined grains and eggs.

Step 2: Height was measured in metres using a stadiometer, with the participant standing upright. Weight was measured in kilograms using a calibrated Seca® weighing scale, with the participant lightly clothed. Body Mass Index (BMI) was then calculated as weight divided by the square of height. Using an inelastic measuring tape, waist circumference was measured in centimeters at the level midway between the lowest rib margin and the iliac crest while the hip circumference was measured in centimeters at the widest level over the greater trochanters. Waist-to-hip ratio (WHR) was calculated as waist circumference divided by hip circumference. Two blood pressure measurements were taken (5 to 30 minutes apart), with

the participant seated, using a mercury sphygmomanometer and the mean of these two measurements was calculated as their blood pressure. Participants were classified as high/uncontrolled blood pressure if their systolic BP was ≥ 140 mmHg, or if their diastolic BP was ≥ 90 mmHg or if they were on anti-hypertensive drugs.

Step 3: The fasting blood glucose was determined after an overnight fast of 8 – 10 hours by collection of 2mls of venous blood sample following which participants were given a glucose drink containing 75g of anhydrous glucose. Another 2mls of venous sample was taken for an OGTT estimation, two hours after the ingestion of a glucose drink. Estimation of blood glucose was done by glucose oxidase method. Prediabetes was defined using the ADA criteria.⁴

Data management

The questionnaires were cross-checked after each interview and coded serially. The SPSS (version 17) was used for data entry and analysis. Categorical variables were summarized using frequency and percentages while mean and standard deviations were computed for quantitative variables. Descriptive analyses were performed to estimate the prevalence of prediabetes while the independent predictors of prediabetes were investigated using multinomial logistic regression model. The level of statistical significance was set at 5% ($p < 0.05$).

Ethical consideration

Ethical approval for the study was obtained from the UI/UCH Institutional Review Committee and a written informed consent was obtained from each participant.

RESULTS

Demographic and lifestyle data of the participants

The demographic and lifestyle data characteristics of the participants are shown in Table 1. The mean age of participants was 51.2 ± 5.3 years. There were 164 (54.7%) males and 136 (45.3%) females that participated in the study. Majority of the participants in this study were Muslims (180, 60.0%); were married (286, 95.3%); belonged to the Yoruba ethnic group (287, 95.6%) and had tertiary education (255, 85%). More of the study participants (211, 70.3%) belonged to the senior civil servant cadre while 89 (29.7%) respondents belonged to the junior civil servant cadre. The majority of participants (224, 74.7%) had a positive family history of diabetes mellitus. The majority of participants (251, 83.7%) had never smoked cigarettes while less than half of the participants, (130, 43.3%) never consumed alcohol. The majority of participants

Table 1: Demographic and lifestyle data of participants (N=300)

| Variable | Frequency (n) | Percentages (%) |
|-----------------------------------|---------------|-----------------|
| Age (years) | | |
| 40-50 | 102 | 34.0 |
| 51-60 | 198 | 66.0 |
| Sex | | |
| Male | 164 | 54.7 |
| Female | 136 | 45.3 |
| Religion | | |
| Christianity | 119 | 39.7 |
| Islam | 181 | 60.3 |
| Marital Status | | |
| Married | 286 | 95.3 |
| Separated/Divorced/Widowed | 14 | 4.7 |
| Tribe | | |
| Yoruba | 287 | 95.6 |
| Igbo | 13 | 4.4 |
| Education | | |
| Secondary | 45 | 15.0 |
| Tertiary | 255 | 85.0 |
| Cadre | | |
| Senior cadre | 211 | 70.3 |
| Junior cadre | 89 | 29.7 |
| Family History of Diabetes | | |
| Yes | 224 | 74.7 |
| No | 76 | 25.3 |
| Cigarette Smoking Status | | |
| Non-smoker | 251 | 83.7 |
| Previous/Current smoker | 49 | 16.3 |
| Alcohol Intake Status | | |
| Non-drinker | 130 | 43.3 |
| Previous/Current drinkers | 170 | 56.7 |
| Dietary Pattern | | |
| Healthy | 215 | 71.7 |
| Western | 85 | 28.3 |
| Moderate Physical Activity | | |
| Adequate | 147 | 49.0 |
| Inadequate | 153 | 51.0 |

(215, 71.7%) had a healthy dietary intake pattern while (85, 28.3%) participants had a Western dietary intake pattern. A little above half (153, 51.0%) of the participants had an inadequate moderate-intensity physical activity while (147, 49.0%) participants had an adequate moderate-intensity physical activity.

Biochemical and anthropometric profile of the participants

The biochemical and anthropometric profile of the participants in this study are shown in Table 2. A greater proportion of the participants, 186 (62.0%), were

overweight while 59 (19.7%) participants had normal body mass index and 51 (18.3%) participants had obesity. A total of 127 (42.3%) participants had an increased metabolic risk on waist circumference measurements and 106 (35.3%) participants had a substantial metabolic risk on waist-hip ratio measurements. A high number of participants, 238 (79.3%) had a normal/controlled blood pressure measurement while 62 (20.7%) participants had a high/uncontrolled blood pressure measurement. Following fasting plasma glucose test, the majority of participants in this study, 243 (81.0%), had normoglycemia while

46 (15.3%) and 11 (3.7%) participants had an impaired fasting glucose (IFG) and diabetes respectively using ADA criteria. Following the 2 hours' post-glucose load, 248 (82.7%) participants had normoglycemia while 41 (13.7%) and 11 (3.7%) participants had an impaired glucose tolerance (IGT) and diabetes respectively using ADA criteria. Figure 1 is a pie chart that summarizes the three categories of glycemic profile of the study participants following both the FPG and OGTT, using the American Diabetes Association (ADA) criteria. Majority of the participants in this study, 222 (74.0%), had normoglycemia while 67 (22.3%) participants had prediabetes and 11 (3.7%) participants had diabetes mellitus.

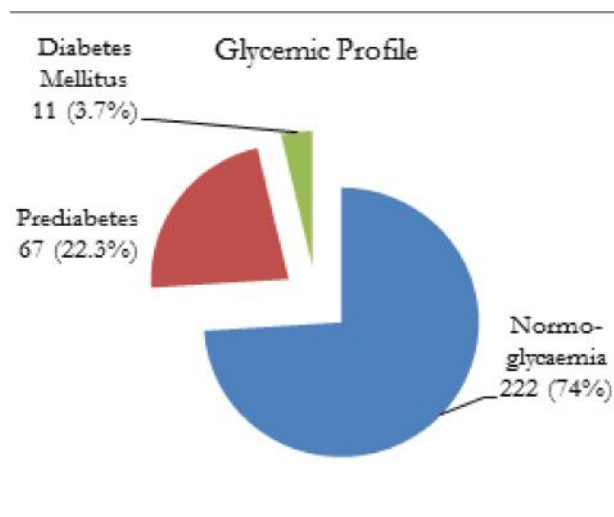


Figure 1: Glycemic profile of participants (N=300)

Association between varying factors and prediabetes among participants

Table 3 shows a bivariate analysis of the association between various characteristics of the participants in this study and the presence of prediabetes. It was noted

Table 2: Biochemical and anthropometric of participants (N=300)

| Parameter | Description | Frequency (%) |
|---|---|---------------|
| Body Mass Index (kg/m²) | | |
| 18.5 – 24.99 | Normal | 59 (19.7) |
| 25.0 – 29.99 | Overweight | 186 (62.0) |
| 30.0 – 34.99 | Obesity (Grade I) | 51 (17.0) |
| 35.0 – 39.99 | Obesity (Grade II) | 1 (0.3) |
| > 40.0 | Obesity (Grade III) | 3 (1.0) |
| Waist Circumference | | |
| | Normal | 173 (57.7) |
| | Increased metabolic risk ^u | 127 (42.3) |
| Waist-Hip ratio | | |
| | Normal | 194 (64.7) |
| | Substantial metabolic risk [#] | 106 (35.3) |
| Blood Pressure (mmHg) | | |
| | Normal/Controlled ^s | 238 (79.3) |
| | High/Uncontrolled ^{ss} | 62 (20.7) |
| Fasting Blood Sugar (mg/dl)* | | |
| < 100 | Normoglycemia | 243 (81.0) |
| 100 - 125 | Impaired Fasting Glucose (IFG) | 46 (15.3) |
| > 126 | Diabetes Mellitus | 11 (3.7) |
| Oral Glucose Tolerance Test (mg/dl)* | | |
| < 140 | Normoglycemia | 248 (82.7) |
| 140 - 199 | Impaired Glucose Tolerance (IGT) | 41 (13.6) |
| > 200 | Diabetes Mellitus | 11 (3.7) |

*American Diabetes Association (ADA) criteria

^uIncreased metabolic risk (waist circumference ≥ 94 cm for males or ≥ 80 mm for females)

[#]Substantial metabolic risk (waist hip ratio ≥ 0.90 for males or ≥ 0.85 for females)

^sNormal/Controlled (Systolic Blood Pressure < 140 mmHg/ Diastolic Blood Pressure < 90 mmHg)

^{ss}High/Uncontrolled (Systolic Blood Pressure ≥ 140 mmHg/ Diastolic Blood Pressure ≥ 90 mmHg)

Table 3: Association between varying factors and prediabetes among participants (N=300)

| Variable | Normoglycemia n (%); n= 222 | Prediabetes n (%); n= 67 | Diabetes n (%); n=11 | χ^2 | p-value |
|-----------------------------------|--------------------------------|-----------------------------|-------------------------|----------|---------|
| Sex | | | | | |
| Male | 103 (62.8) | 58 (35.4) | 3 (1.8) | 36.97 | 0.001* |
| Female | 119 (87.5) | 9 (6.6) | 8 (5.9) | | |
| Cadre | | | | | |
| Senior | 159 (75.4) | 43 (20.4) | 9 (4.2) | 2.094 | 0.001* |
| Junior | 63 (70.8) | 24 (27.0) | 2 (2.2) | | |
| Family History of Diabetes | | | | | |
| Yes | 156 (69.6) | 65 (29.1) | 3 (1.3) | 32.84# | 0.003* |
| No | 66 (86.9) | 2 (2.6) | 8 (10.5) | | |
| Smoking Status | | | | | |
| Never smoked cigarette | 186 (74.1) | 55 (21.9) | 10 (4.0) | 0.546# | 0.761 |
| Smokes cigarette | 36 (73.5) | 12 (24.5) | 1 (2.0) | | |
| Alcohol Intake | | | | | |
| Never took alcohol | 109 (83.8) | 11 (8.5) | 10 (7.7) | 32.99# | 0.000* |
| Takes alcohol | 113 (66.5) | 56 (33.0) | 1 (0.5) | | |
| Blood Pressure | | | | | |
| Normal/Controlled | 204 (85.7) | 25 (10.5) | 9 (3.8) | 2.025 | 0.363 |
| High/Uncontrolled | 18 (29.0) | 42 (67.7) | 2 (3.3) | | |
| Dietary Pattern | | | | | |
| Healthy | 183 (85.1) | 24 (11.2) | 8 (3.7) | 55.99 | 0.000* |
| Western | 54 (63.5) | 28 (33.0) | 3 (3.5) | | |
| Moderate Activity | | | | | |
| Adequate | 110 (74.8) | 33 (22.5) | 4 (2.7) | 8.161 | 0.017* |
| Inadequate | 112 (73.2) | 34 (22.2) | 7 (4.6) | | |
| Body Mass Index | | | | | |
| Normal | 56 (94.9) | 3 (5.1) | 0 (0) | 62.96# | 0.039* |
| Overweight | 137 (73.7) | 49 (26.3) | 0 (0) | | |
| Obesity | 29 (52.7) | 15 (27.3) | 11 (20.0) | | |
| Waist-Hip Ratio | | | | | |
| Normal | 124 (71.7) | 41 (23.7) | 8 (4.6) | 21.47 | 0.104 |
| Metabolic risk | 98 (77.2) | 26 (20.5) | 3 (2.3) | | |

* Statistical significance ($p < 0.05$); # Fisher's exact test quoted.

that a significantly higher proportion of male participants ($\chi^2 = 36.97$, $p = 0.001$); participants within the junior civil service cadre ($\chi^2 = 2.094$, $p = 0.001$); participants with a positive family history of diabetes ($\chi^2 = 32.84$, $p = 0.003$); participants that consumed alcoholic beverages ($\chi^2 = 32.99$, $p = 0.000$); participants with Western dietary intake pattern ($\chi^2 = 55.99$, $p = 0.000$) and participants that did not engage in moderate-intensity physical activities ($\chi^2 = 8.161$, $p = 0.017$) had prediabetes as compared to their respective counterparts with prediabetes within the aforementioned categories.

Multivariate logistic regression model for predictors of prediabetes among participants

Table 4 shows a multivariate logistic regression model of the independent predictors of prediabetes among the participants. Male respondents were 1.24 times more likely to have prediabetes as compared to female respondents (OR = 1.24; 95% CI = 1.082 - 2.460; $p = 0.07$). Participants with a positive family history of diabetes were 1.57 times more likely to have prediabetes as compared to participants without a family history of diabetes (OR = 1.57; 95% CI = 1.088 - 2.611; $p = 0.023$). Participants who consumed alcohol were 1.13

Table 4: Multivariate logistic regression model for predictors of prediabetes among all participants (N=300)

| Variable | Odd's Ratio (OR) | 95% CI for OR | p-value |
|-----------------------------------|------------------|---------------|---------|
| Sex | | | 0.007* |
| Male | 1.24 | 1.082 - 2.460 | |
| Female | 1.00 | Referent | |
| Cadre | | | 0.156 |
| Senior | 1.39 | 1.013 – 2.433 | |
| Junior | 1.00 | Referent | |
| Family History of Diabetes | | | 0.023* |
| Yes | 1.57 | 1.088 – 2.611 | |
| No | 1.00 | Referent | |
| Smoking status | | | 0.112 |
| Never smoked cigarette | 2.01 | 1.235 – 4.372 | |
| Smokes cigarette | 1.00 | Referent | |
| Alcohol intake | | | 0.039* |
| Never took alcohol | 1.00 | Referent | |
| Takes alcohol | 1.13 | 1.038 – 1.543 | |
| Blood Pressure | | | 0.141 |
| Normal/Controlled | 1.00 | Referent | |
| High/Uncontrolled | 1.62 | 1.038 – 3.173 | |
| Dietary pattern | | | 0.204 |
| Western | 1.26 | 0.925 – 4.103 | |
| Healthy | 1.00 | Referent | |
| Moderate activity | | | 0.001* |
| Yes | 1.00 | Referent | |
| No | 1.49 | 1.027 – 2.936 | |
| Body Mass Index | | | 0.416 |
| Normal | 1.00 | Referent | |
| Overweight | 1.29 | 1.141 – 3.188 | |
| Obesity | 1.43 | 1.213 – 2.071 | |
| Waist-Hip ratio | | | 0.131 |
| Normal | 1.00 | Referent | |
| Metabolic risk | 1.26 | 1.107 – 2.413 | |

95% CI for OR: 95% Confidence Interval for Odd's ratio

*Statistically significant ($p < 0.05$)

times more likely to have prediabetes as compared to participants who never consumed alcohol (OR= 1.13; 95% CI= 0.688 – 1.543; $p = 0.039$). Participants who do not engage in moderate-intensity physical activities were 1.49 times more likely to have prediabetes as compared to participants who engage in moderate-intensity physical activities (OR= 1.49; 95% CI= 1.027 – 2.936; $p = 0.001$).

DISCUSSION

Before developing overt diabetes, most individuals spend years in an intermediate condition called prediabetes. The efficacy of diabetes prevention in people with prediabetes is well known, and there is strong evidence that progression to type 2 diabetes can be delayed or prevented.^{1,2,4} This had made screening for prediabetes to identify individuals that are at risk of type 2 diabetes mellitus highly imperative.

The result from this study showed that there was a high prevalence of prediabetes among the participants and the independent predictors were male sex, positive family history of diabetes mellitus, alcohol intake and inadequate moderate-intensity physical activity.

Prevalence of prediabetes among the study participants

The prevalence of prediabetes among respondents in this study was higher than the 15.7% prevalence of prediabetes recorded by Rongies *et al*⁶ among their study participants. This difference in prevalence might be due to the racial difference in the prevalence of prediabetes in the general population between Poland and Nigeria.^{24,25} In the study conducted in eastern Uganda by Mayega *et al*,¹⁷ the 20.2% prevalence figure for prediabetes reported in that study was similar to the prevalence of prediabetes in this study. Another

study that recorded a similar prevalence to our study was that conducted by Mustapha *et al*⁶ in Malaysia which found a 22.1% prevalence of prediabetes among their study population. In Nigeria, Ogbu *et al*⁷ and Uche *et al*⁷ in their respective studies reported slightly higher prevalence figures of prediabetes among hypertensive patients as 25% and 33.1% respectively. These higher prevalence figures might be because the study participants in the two aforementioned studies had hypertension which is a significant risk factor for prediabetes among them.

However, the prevalence of prediabetes in this study was higher than the prevalence figures of some studies such as; 3.3% prevalence figure reported by Ojewale *et al*⁵ in Ibadan, 3.5% prevalence figure reported in the DIASCAN study²⁸ and 4.9% prevalence figure reported by Shuqian *et al*²⁹ in China. After taking a closer look at these aforementioned studies, it was noted that the WHO diagnostic criteria were used for blood glucose reference in those studies rather than the ADA diagnostic criteria that was used in this study. The WHO diagnostic criteria for prediabetes and diabetes mellitus differs from the ADA diagnostic criteria because the upper limit of the range of a normal fasting blood glucose is defined differently by each.^{4,30} The WHO opted to keep the upper limit of the range of a normal fasting blood glucose at 110 mg/dl for fear of causing too many people to be diagnosed as having impaired fasting glucose, whereas the ADA put the upper limit of the range of a normal fasting blood glucose at 100 mg/dl to allow for an early diagnosis and prompt management of prediabetes. It is noteworthy to mention that, the ADA criteria was adopted for our study because studies have shown that a fasting plasma glucose level of 100 mg/dl and higher is correlated to higher occurrence of complications from diabetes mellitus in at-risk individuals.^{31–34} During this research, respondents that were incidentally discovered to have diabetes mellitus were promptly referred to the Staff Clinic of the University College Hospital, Ibadan for further evaluation and management.

Predictors of prediabetes among the study participants

Several studies had documented various non-modifiable and modifiable risk factors associated with prediabetes and these include ageing, gender, race/ethnicity, genetics and family history of diabetes mellitus, obesity, physical inactivity, excessive alcohol ingestion and tobacco use among others.^{8,35–38} It was therefore not surprising that these risk factors were also associated with prediabetes in this study. Male sex was an independent predictors of prediabetes in this study in

a similar way as reported by Ogbu *et al*⁷ in their study where they found that a significantly higher proportion of males had prediabetes. Conversely, Ejike *et al*⁴ and Ekpenyong *et al*⁹ in their respective studies found a higher female population with prediabetes in their surveys. The high family history of diabetes mellitus and its significant association with prediabetes among the participants in this study may be a reflection of the rising prevalence of diabetes mellitus in Nigeria that had been documented in some local literatures.^{27,40–42}

Inadequate moderate-intensity physical activity is a known risk factor for prediabetes and was significantly associated with prediabetes in this study. A greater proportion of participants of this study might spend below the recommended level of moderate-intensity physical activity as stipulated by the WHO² because of the greater number of hours spent in a sitting or sedentary position during their administrative duties with little leisure times for exercises. Since hospital administrative staff spend most of their workday at their workplace, offering physical activity programs at work may be an efficient strategy to increase physical activity among them. Workplace physical activity programs had been widely advocated for workers to improve physical activities especially during work hours. This is specifically important because the imbalance between physical activity and energy intake at work contribute promote a sedentary lifestyle that leads to insulin resistance and prediabetes.

Limitations of the study

1. The likely presence of other chronic medical conditions and comorbidities like hypertension, dyslipidemia, obesity etc. among participants in this study was not an exclusion criterion and this could be a confounder which might have had an influence on the findings of this study.
2. This study was a cross-sectional survey carried out among hospital administrative staff of UCH, Ibadan and so its findings might not be representative of hospital administrative staff in other healthcare facilities in Nigeria.

CONCLUSION

The screening exercise conducted in this concluded study revealed a high prevalence of prediabetes among the administrative staff of University College Hospital, Ibadan. Regular screening of hospital employees for prediabetes and advocacy for work-place gymnasia to improve physical activities among healthcare workers are highly recommended. Employers of labour should be continuously encouraged to develop plans or policy for workplace physical activity by setting up work-place indoor gyms or consider joining a

corporate membership scheme with a gymnasium at discounted fees for employees to help employees become more physically active.

AUTHORS' CONTRIBUTIONS

The conceptualization and study design were done by all authors. The data analysis and writing of the manuscript was done by SOM.

REFERENCES

- Centers for Disease Control and Prevention. National diabetes fact sheet: national estimates and general information on diabetes and prediabetes in the United States, 2011. <http://www.cdc.gov/diabetes/pubs/references11.htm>.
- Rynders CA**, Weltman JY, Jiang B. Effects of exercise intensity on postprandial improvement in glucose disposal and insulin sensitivity in prediabetic adults. *J Clin Endocrinol Metab*. 2014; 99: 220–228.
- Ogbu I**, Azodo E, Chinwuba A. Prevalence of Pre-Diabetes And Unreported Diabetes Mellitus In Population Aged 45 Years And Above. *IJMDEV* 2012; 17: 1–6.
- American Diabetes Association. Standards of medical care in diabetes-2011. *Diabetes Care* 2011; 34: 11–61.
- Ojewale LY**, Adejumo PO. Type 2 diabetes mellitus and impaired fasting blood glucose in urban South Western Nigeria. *Int J Diabetes Metab* 2012; 21: 9–12.
- Rongies W**, Wolska M, StrzaÅka-Goc K. The prevalence of prediabetes in healthcare professionals assessed based on glycated hemoglobin levels. *J Diabetes Metab*. 2016; 07: 2–5.
- AlRandi M**, Hussain AH, Al-Nesef A. Identifying employees at high risk of diabetes among the medical staff of Jaber Al-Ahmed Armed Forces Hospital in Kuwait and screening them for diabetes. *J Bahrain Med Soc*. 2014; 25: 101–104.
- Riddell M**, Fowles J. How to treat prediabetes with exercise effectively. *Diabetes* 2010; 1: 10–20.
- Geiss LS**, James C, Gregg EW. Diabetes risk reduction behaviors among U.S. adults with prediabetes. *Am J Prev Med*. 2010; 38: 403–409.
- Bell LM**, Watts K, Siafarikas A. Exercise alone reduces insulin resistance in obese children independently of changes in body composition. *J Clin Endocrinol Metab*. 2007; 92: 4230–4235.
- Dunstan DW**, Kingwell BA, Larsen R. Breaking up prolonged sitting reduces postprandial glucose and insulin responses. *Diabetes Care* 2012; 35: 976–983.
- Shazia B**, Javed Y, Nourin J. Understanding health seeking behavior of health care professionals in tertiary care hospitals in Pakistan. *J Ayub Med Coll Abbottabad* 2016; 28(3) 545–549.
- Lindo J**, LaGrenade J, McCaw-Binns A. Health status and health maintenance practices among doctors and nurses at two hospitals in Jamaica. *West Indian Med J* 2009; 58: 539–545.
- Agaba**, Ocheke A, Akanbi M. Health seeking behavior of physicians at the Jos University Teaching Hospital. *Niger Med J* 2017; 52: 90–94.
- Fawibe AE**, Odeigah LO, Akande TM. Self-reported medical care seeking behaviour of doctors in Nigeria. *Alexandria J Med* 2016.
- Araoye OM**. Subject selection. Research methodology with statistics for health and social sciences. Nathadex publishers, Ilorin, Nigeria. 2003; p.115-129.
- Mayega R**, Guwatudde D, Makumbi F. Diabetes and pre-diabetes among persons aged 35 to 60 years in eastern uganda/ : prevalence and associated factors. *Abnorm Glucose Regul East Uganda* 2013; 8: 1–11.
- World Health Organization. The WHO STEPwise approach to chronic disease risk factor surveillance (STEPS) Instrument (Core and Expanded) 2009. www.who.int/chp/steps.
- Sowemimo I**, Ajayi I, Akpa O. Prevalence of hypertension and associated factors among residents of Ibadan-North Local Government Area Of Oyo State, Nigeria. *J Hypertens* 2015; 4: 87–92.
- Okpechi IG**, Chukwuonye II, Tiffin N. Blood pressure gradients and cardiovascular risk factors in urban and rural populations in Abia State South Eastern Nigeria using the WHO STEPwise approach. *PLoS One* 2013;8: 1–8.
- Yahaya GL**, Roberts AA, Inem VA. Spouses of patients with diabetes mellitus type 2 at increased risk of high blood glucose levels. *Open J Prev Med*. 2013; 3: 58–63.
- Sabir A**, Ohwovoriole A, Isezuo S. Type 2 diabetes mellitus and its risk factors among the rural Fulanis of Northern Nigeria. *Ann Afr Med*. 2013; 12: 217–222.
- Federal Republic of Nigeria Official Gazette 2007; 24(94): B194-B195., <http://ispub.com/IJLHE/6/2/3421#>.
- Ejike CE**, Uka NK, Nwachukwu SO. Diabetes and pre-diabetes in adult Nigerians: Prevalence, and correlations of blood glucose concentrations with measures of obesity. *Afr J Biochem Res*. 2015; 9: 55–60.
- Polakowska M**, Piotrowski W. Incidence of diabetes in the Polish population: Results of the Multicenter Polish Population Health Status Study – WOBASZ. *Pol Arch Med Wewn*. 2011; 121 156–163.

26. **Mustafa N**, Kamarudin NA, Ismail AA. Prevalence of abnormal glucose tolerance and risk factors in urban and rural Malaysia. *Diabetes Care* 2011; 34: 1362–1364.
27. **Uche G**, Iloh P, Uchenna NR. Risk factors of pre-diabetes among adult Nigerians with essential hypertension in a resource-constrained setting of a primary care clinic in eastern Nigeria. *Am J Heal Res.* 2013; 1: 56–64.
28. **Leiter L**, Barr A, Lubin S. Diabetes Screening in Canada (DIASCAN) Study. *Diabetes Care* 2011; 24: 1038–1042.
29. **Liu S**, Wang W, Zhang J. Prevalence of diabetes and impaired fasting glucose in Chinese adults, China National Nutrition and Health Survey, 2002. *Prev Chronic Dis.* 2011; 8:1–9.
30. **Schneider H**, Shaw J, Zimmet P. Guidelines for the detection of diabetes mellitus - diagnostic criteria and rationale for screening. *Clin Biochem Rev.* 2010; 24: 77–80.
31. **Waugh N**, Scotland G, McNamee P, *et al.* Screening for type 2 diabetes: literature review and economic modelling. *Health Technol Assess* 2007; 11(17) 1-7.
32. **Knowler WC**, Barrett-Connor E, Fowler SE. Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. *N Engl J Med* 2002; 346: 393–403.
33. **Matfin G**, Pratley RE. Advances in the treatment of prediabetes. *Ther Adv Endocrinol Metab.* 2010; 1: 5–14.
34. **Abraham TM**, Fox CS. Implications of rising prediabetes prevalence. *Diabetes Care* 2014; 36: 2139–2141.
35. **Nwatu CB**, Ofoegbu EN, Unachukwu CN. Prevalence of prediabetes and associated risk factors in a rural Nigerian community. *Int J Diabetes Dev C.* 2015; 4: 6–11.
36. **Wagner R**, Thorand B, Osterhoff MA. Family history of diabetes is associated with higher risk for prediabetes: a multicentre analysis from the German Center for Diabetes Research. *Diabetologia* 2013; 56: 2176–2180.
37. **Riddell M**, Burr J. Evidence-based risk assessment and recommendations for physical activity clearance/:diabetes mellitus and related comorbidities. *Am Physiol Nutr Metab* 2011; 189: 165–178.
38. **Stewart K**. Evaluating the Effects of a Diet and Exercise Program in People With Type 2 Diabetes or Prediabetes/ : (The SHAPE3 Study). *Clin Trial* 2013; 4: 1–8.
39. **Ekpenyong CE**, Akpan UP, Ibu JO. Gender and age specific prevalence and associated risk factors of type 2 diabetes mellitus in Uyo Metropolis, South Eastern Nigeria. *Diabetol Croat.* 2012; 17–28.
40. **Nwafor A**, Owhoji A. Prevalence of diabetes mellitus among nigerians in port harcourt correlates with socio-economic status. *J Appl Sci Env Mgt.* 2011; 5: 75–77.
41. **Alebiosu OC**, FAMILONI OB, Ogunsemi OO. Community based diabetes risk assessment in Ogun state, Nigeria (World Diabetes Foundation project 08-321). *Indian J Endocrinol Metab* 2013; 17: 653–658.
42. **Chineye S**, Oputa R. Diabetes mellitus: a global epidemic with potential solutions. *Afr J Diabetes Med* 2012; 20: 33–35.