DOI: https://doi.org/10.53350/pjmhs020241811.4

ORIGINAL ARTICLE

Association between Socio-demography/Behavioural Characteristics and Pre-diabetes: A hospital-based comparative study of adult patients

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ABSTRACT

Background: Pre-diabetes is a condition in which blood glucose levels in humans are higher than normal but not yet in the diabetic range. This condition is not routinely screened for in primary careclinics by health care providers.
Aim: To evaluate the association between socio- demographic/behavioural characteristics and pre-diabetes.
Method: It is a cross-sectional, comparative study of 100 participants, selected via a systematic random sampling using pre-tested interviewer administered questionnaire. Participants were recruited by consecutive continuous selection and matched for age and sex. Data was analysed using SPSS Version 23.
Results: The result revealed pre-diabetes prevalence of 10.3%. Education (***P*=0.004**), occupation (***P*=0.005**) and social class (***P*=0.001**) had significant association with pre-diabetes. Also, smoking (***P*=0.007**), use of snuff (***P*=0.003**) and physical activity (***P*=0.001**) had significant association with pre-diabetes. Education, occupation and social class status, smoking, use of snuff and physical activity were independently associated with pre-diabetes.
Conclusion: The above characteristics were independently associated with pre-diabetes. Clinicians should have high index of suspicion of abnormal glucose level in persons with these factors and institute measures for early detection and interventions, to delay progression to overt diabetes mellitus.
Keywords: Socio-demography, Behavioural characteristics, Pre-diabetes

INTRODUCTION

Pre-diabetes is a condition in which blood glucose levels in humans are higher than normal but not yet in the diabetic range[1]. There is an increasing prevalence of pre-diabetes worldwide, with over 5 million people suffering from the disease in Africa. The number is expected to skyrocket to 15 million by 2025[2]. In Nigeria the prevalence varies from 0.65% in rural Mangu village to 11% in urban Lagos.[3]Risk factors for pre-diabetes include old age, overweight, obesity, positive family history of diabetes, prior gestational diabetes, cultural issues, and urbanization/migration. The strongest of these are overweight and obesity[4].

Early diagnosis and treatment of diabetes which improve health outcomes are facilitated by detection of pre-diabetes[4]. In resource poor settings like ours, biochemical detection would not be likely done on a general scale, therefore, clinicians rely on anthropometric, socio-demographic and behavioural risk factors which could lead to a high index of suspicion for screening, diagnosis and subsequent counselling and treatment.

Since lifestyle changes can slow down or even prevent progression of pre-diabetes to diabetes and other health related complications, screening for pre-diabetes in primary care clinics will be important. Identifying patient with pre-diabetes can have important implications for the intensity of treatment and resultant reduction in cardiovascular morbidity and mortality[5].

Literatures on pre-diabetes in our setting and elsewhere in Nigeria are scarce, hence, this study aimed to identify the socio-demographic and behavioural characteristics of adults, comparing pre-diabetics and non-diabetics. There is a general assumption that the risk factors for pre-diabetes are the same as those for diabetes. However, it is unclear if the strength of association of the risk factors are the same for both pre-diabetes and diabetes.[6]In a study by Okwechime et al (2015) among adults 18 years and above, being insufficiently active or inactive, being overweight or obese, hypertensive or hypercholesteronemic and arthritic were more associated with pre-diabetes.[6]In a number of cross-sectional studies, age had been found to have a significant association with pre-diabetes and diabetes. In an Iranian urban population study by Rahmanian et al, statistically significant difference in age between pre-diabetes and normoglycemic subjects with the risk of pre-diabetes increasing with advancing age in both sexes[7]. In a Spanish study by Diaz-Redondo, in 2019, age was reported to be higher among subjects with pre-diabetes in both men and women[8]. While some studies reported higher prevalence of pre-diabetes among women, others deposited higher prevalence in men, while in others, the opinion on the prevalence did not vary[7,9.10]. Also, marital and educational status were said to be significantly associated with pre-diabetes in some studies while others reported no significant association[7,9,11].

Excessive alcohol ingestion and tobacco use are among other non-constitutional factors for Pre-diabetes and by extension diabetes[12]. Alcohol consumption and smoking were not statistically significant risk factors for pre-diabetes[10]. Risky alcohol consumption was found to be a risk factor for pre-diabetes in men.[8] There is an association between physical activity and pre-diabetes[13].

Gatimu et al (2016) reported that low physical activity had significantly higher prevalence of diabetes compared to high physical activity[14].

MATERIALS AND METHODS

Study Population: The study population was all the adult patients, aged 18 years and above, who presented for primary health care during the study period.
Eligibility Criteria: Included in this study were adult patients aged 18 years and above, pre-diabetics and normoglycemic subjects, who gave their written informed consent. Excluded from this study were pregnant women, diabetic patients, critically ill patients, co-morbid states that predispose to raised glycemic levels.
Study Design: It is a cross-sectional comparative study.
Sample Size Determination: This was determined using the formula for comparative study with quantitative outcomes[15].

$$n = r + 1 \quad \frac{}{r} \left[\frac{(SD)^2 (Z_\beta + Z_{\alpha/2})^2}{d^2} \right]$$

Received on 07-07-2024
Accepted on 28-10-2024

Where n=minimum sample size, r=ratio of controls (normoglycaemics) to cases (Pre-diabetics)
Here r=1 (because controls and cases were equal), SD = Degree of variability of observations offasting blood glucose (FBG) in the population (taken as 2.8),[16]d=Expected mean difference between FBG of case and control (normoglycaemics), taken as 1.7mmol/L.Z_{β} and $Z_{\alpha/2}$ are constants (0.84 and 1.96 respectively). Substituting values, n= 42.5 (approximately 43 participants per group). To increase the power of the study, n was approximated to minimum sample size of 50.

Sampling Technique: The study and its purpose were explained to the participants and written informed consent obtained from those who wished to participate. There was no hospital record of pre-diabetes attendance, hence consecutive methods were used to select participants[12]. The patients' phone numbers and addresses were taken in a separate booklet and no identifying articles in the questionnaires; this was to be able to reach them whenever the need arose and for confidentiality.

Study Instruments: This included structured interviewer-administered questionnaires on socio-demographic and behavioural characteristics. To ensure validity, the questionnaire was transcribed from English language to tribal language, then back-transcribed to English, and it made the same meaning. Calibrated Accu-Check Active glucometer and strips (by Roche Germany) was used, with accuracy level close to colorimeter technique[17].

Methods of Data Collection: The researcher worked with one assistant, who was trained in the standard procedures of the different measurements. The participants who had not eaten had their data taken. Those who had eaten or came beyond 10am, in batches of ten, were given different appointment dates which corresponded with their follow-up visit days and had their FBG tested after an overnight fasting of at least 8 hours. Those with pre-diabetes were matched for age and sex and was interviewer-administered to each of them.

Fasting Blood Glucose Test: The FBG alone was used (in preference to 2 hour post-load oral glucose tolerance test or HbA1c) because of its convenience and low cost[2]. Calibrated Accu-Check Active glucometer (made in Mannheim Germany), under standard procedure was employed. The little finger was pierced with a disposable lancet, using lancet gun and squeezed, a drop of blood was put on the glucometer strip, over the blood receptacle and the result of the FBG was indicated and recorded. The recruited participants were screened for glycemic levels and categorized as normal FBG levels =3.6-6.0mmol/L (65-109mg/dl), impaired fasting glucose at 6.1-6.9mmol/L (110-125mg/dl) and diabetes at ≥ 7.0mmol/L (126mg/dl).

Alcohol Screening Tool and Alcohol consumption[18,19]
Alcohol consumption was assessed based on whether, "never" consume alcohol and "ever" consume alcohol. The "ever" consume alcohol was further classified into low risk, moderate and high risk drinking, using the Alcohol Use Disorder Identification Test-Consumption (AUDIT-C) tool. The screening tool consists of validated questions for alcohol use (AUDIT-C). A score of < 5 indicated low risk drinking and score of ≥ 5 indicated high risk drinking. This status was analysed statistically.

Tobacco use Classification[19,20]
Smoking was classified as either Never used, former user (no use in past 30days), or current user (tobacco use in the last 30 days). For analysis, they were grouped either as “never smoked” or “ever smoked/current smoker”.

Physical Activity (PA) Assessment[21-23]
PA was assessed in leisure time, domestic and gardening, work-related, or transport- related.
The International Physical Activity- short form (IPAQ-SF)was used in the above regard.

The items were structured to provide separate scores in walking, moderate intensity and vigorous intensity activities. Computation for total scores required summation of the duration in minutes and frequency in days. Walking metabolic equivalent (MET) (mins/week) =3.3x walking mins x walking days, moderate MET (mins/week) =4.0 x moderate intensity activity mins x moderate intensity days, vigorous MET (mins/week) =8.0 x vigorous intensity activity mins x vigorous intensity days, total PA MET (mins/week) =sum of walking + moderate + vigorous MET (mins/week) scores. Classification of PA was done thus: vigorous intensity activity=minimum of 1,500 MET mins/week, moderate intensity activity=at least 600 MET mins/week, low intensity activity= <600 MET mins/week.

Data Analysis: Frequencies, percentages, means and standard deviations were calculated for descriptive statistics. Data generated were analysed using SPSS version 23. Outcome variable (dependent) was pre-diabetes. Independent variables were socio-demographic and behavioural characteristics. Chi-square tests were used to test the associations and logistic regression was used to find variables that had independent association with pre-diabetes. The level of statistical significance was set at $p < 0.05$ and confidence level at 95%.

RESULTS

A total number of 485 adults aged 18 years and above, were screened to get 50 cases of pre-diabetes. This gave a pre-diabetes prevalence of 10.3% in the study population.

Table I was the frequency distribution of the socio-demographics of the study participants. The majority were: young adult females, married, with tertiary education and unemployed, of lower social class and were Christians of Igbos ethnicity.

Table II was the measurement of relationship between socio-demographic characteristics (Age, Sex, Educational attainment and Occupation) and pre-diabetes. Only educational status (***P*=0.004**), occupational status (***P*=0.005**) and social class (***P*=0.001**), showed statistically significant association with pre-diabetes.

Figure 1 is the percentage distribution of physical activities and glycemic status of participants. Physical inactivity was seen more among the pre-diabetics while the normal people were more physically active.

Fig. 1: Percentage Distribution of Physical Activities and Glycemic Status of Participants

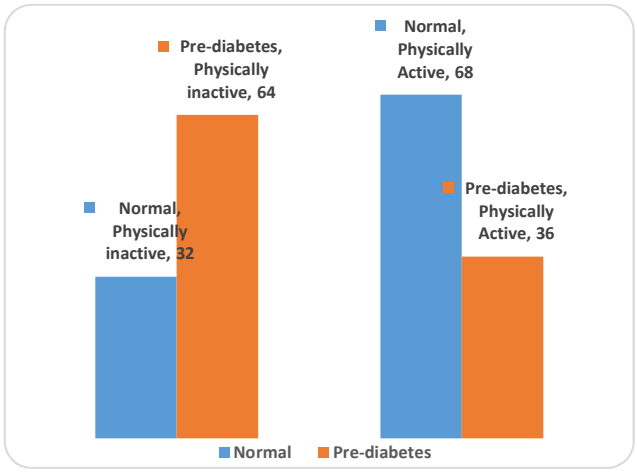

Table III was a measure of the relationship between socio-demographic characteristics and pre-diabetes (logistic regression). The probability of having pre-diabetes was about five times higher in those who were employed when compared with those who were unemployed (OR=5.29, 95% CI=1.53-18.25, *P*=0.008)); about five times higher among those that had above primary education than in those who had primary education and no formal education

(OR=4.76, 95% CI =1.38-16.39, *P*=0.01); about three times higher among those of higher social class when compared with those that were of lower social class (OR =2.93, 95% CI =1.09-7.85, *P*=0.03). These results indicated that only educational status, occupation and social class were independently associated with pre-diabetes.

Table IV showed the analysis of the relationship between pre-diabetes status and behavioural characteristics. Only smoking (***P*=0.007**), use of snuff (***P*=0.003**) and physical activity (***P*=0.001**) had statistically significant association with pre-diabetes.

Table V was the result of logistic regression of the effect of behavioural characteristics on pre-diabetes status. The p-value displayed was both for the regression coefficient (β) and the odds ratio (OR).

The probability of having pre-diabetes was about 7 times higher in those that ever smoked than in those who never smoked (OR=7.02, 95% CI=2.13-23.7; *P*=0.001); about five times higher among those who ever used snuff when compared with those who never used snuff (OR=4.91, 95% CI=1.33-18.08, *P*=0.017). The probability of not having pre-diabetes was about 22.3% lower among those who were physically inactive when compared with those who were physically active (OR=0.223, 95%CI=0.086-0.575, *P*=0.002). Hence, smoking, snuff use and physical activity were independently associated with pre-diabetes.

Table I: Frequency Distributions of the Socio-demographics of the Study Participants

Variable	Categories	Glycemic Status		Total/%
		Normal (%)	Pre-diabetes (%)	
Age (Years)	20-29	14(28)	14(28)	28
	30-39	9(18)	9(18)	18
	40-49	11(22)	11(22)	22
	50-59	9(18)	9(18)	18
	60-69	4(8)	4(8)	8
	70 and above	3(6)	3(6)	6
Sex	Male	23(46)	23(46)	46
	Female	27(54)	27(54)	54
Marital Status	Single	8(16)	13(26)	21
	Married	35(70)	34(68)	69
	Others	7(14)	3(6)	10
Educational Attainment	Non-Formal	2(4)	4(8)	6
	Primary	14(28)	7(14)	21
	Secondary	12(24)	7(14)	19
	Tertiary	22(44)	32(64)	54
Occupation	Senior Public Servant and its Equivalent	11(22)	11(22)	22
	Intermediate Grade Public Servant and its Equivalent	4(8)	6(12)	10
	Junior School Teachers and its Equivalent	10(20)	7(14)	17
	Petty Traders and its Equivalent	11(22)	8(16)	19
	Unemployed and its Equivalent	14(28)	18(36)	32
Social Class	Lower	30(60)	24(48)	54
	Middle	15(30)	25(50)	40
	Upper	5(10)	1(2)	6
Religion	Christianity	48(96)	47(94)	95
	Others	2(4)	3(6)	5
Ethnicity	Igbo	48(96)	47(94)	95
	Others	2(4)	3(6)	5
Family History of Diabetes	Yes	12(24)	17(34)	29
	No	38(76)	33(66)	71
Total		50(100)	50(100)	100

% - down the column among the glycemic status

Table II: Measure of Relationship between Socio-demographic Characteristics and Pre-diabetes.

Variable	Categories	Glycemic Status		Chi-square	p-value
		Normal	Pre-diabetes		
Age (Years)	20-29	14	14	0.405	0.995
	30-39	9	9		
	40-49	11	11		
	50-59	9	9		
	60-69	4	4		
	70 and above	3	3		
Sex	Male	23	23	0.360	0.548
	Female	27	27		
Marital Status	Single	8	13	2.805	0.249
	Married	35	34		
	Widow	7	3		
Educational Attainment	Non-Formal	2	4	6.168	0.004*
	Primary	14	7		
	Secondary	12	7		
	Tertiary	22	32		
Occupation	Senior Public Servant and its Equivalent	11	11	7.903	0.005*
	Intermediate Grade Public Servant and its Equivalent	4	6		
	Junior School Teachers and its Equivalent	10	7		
	Petty Traders and its Equivalent	11	8		
	Unemployed and its Equivalent	14	18		

Social Class	Lower Class	30	24	5.833	0.001*
	Middle Class	15	25		
	Upper Class	5	1		
Religion	Christianity	48	47	2.041	0.153
	Others	2	3		
Ethnicity	Igbo	48	47	1.001	0.603
	Others	2	3		
Family History of Diabetes	Yes	12	17	1.214	0.271
	No	38	33		

**P<0.05 indicates significance*

Table III: Measure of Effect of Socio-demographic Characteristics on Pre-Diabetes Status.

Parameter		Glycemic Status		B	OR	p-value	95% CI for OR	
		Normal	Pre-Diabetes				Lower	Upper
Age(Years)	<45	30	29	0.420	1.522	0.387	0.588	3.938
	≥45	20	21					
Sex	Male	23	23	-0.015	0.985	0.973	0.414	2.346
	Female	27	27					
Marital Status	Without Spouse	15	16	0.089	1.093	0.866	0.388	3.081
	With Spouse	35	34					
Occupation	Employed	36	32	1.666	5.289	0.008*	1.533	18.250
	Unemployed	14	18					
Education	At Most Primary	16	11	1.560	4.757	.013*	1.381	16.386
	Above Primary	34	39					
Social Class	Lower Class	30	24	1.074	2.928	0.033*	1.092	7.849
	Upper Class	20	26					
Ethnicity	Igbo	48	47	.156	1.169	0.860	0.208	6.567
	Others	2	3					
Family History of Diabetes	Yes	12	17	-0.725	0.484	0.164	0.175	1.343
	No	38	33					

**P<0.05 indicates significance, the second category serves as reference category for each variable*

Table IV): Relationship between Pre-diabetes and Behavioural Characteristics

Variable	Categories	Glycemic Status		Chi-Square	p-value
		Normal	Pre-diabetes		
Smoking	Ever Smoked	34	45	7.294	0.007*
	Never Smoked	16	5		
Snuff	Ever Used	34	46	9.000	0.003*
	Never Used	16	4		
Alcohol	Ever Consumed	29	25	0.644	0.422
	Never Consumed	21	25		
Health Risk/Harm Level	Low Risk	38	40	0.233	0.629
	High Risk	12	10		
Physical Activities	Physically inactive	16	32	10.256	0.001*
	Physically Active	34	18		

**P<0.05 indicates significance*

Table V: Measure of Effect of Behavioural Characteristics on Pre-Diabetic Status.

Parameter		Glycemic Status		B	OR	p-value	95% CI for OR	
		Normal	Pre-diabetes				Lower	Upper
Smoking	Ever Smoked	34	45	1.949	7.022	0.001*	2.128	23.168
	Never Smoked	16	5					
Snuff	Ever Used	34	46	1.591	4.909	0.017*	1.333	18.075
	Never Used	16	4					
Alcohol	Ever Consumed	29	25	-0.509	0.601	0.358	0.203	1.780
	Never Consumed	21	25					
Health Risk	Low Risk	38	40	0.966	2.628	0.161	0.681	10.149
	High Risk	12	10					
Physical Activities	Physically Inactive	16	32	-1.502	0.223	0.002*	0.086	0.575
	Physically Active	34	18					

**p<0.05 indicates significance, the second category serves as reference category for each variable, CI=Confidence interval*

DISCUSSION

This cross-sectional, hospital- based study, assessed the relationships between pre-diabetes and the socio-demographic and behavioural characteristics of the participants. The study compared the pre-diabetic participants with normal glycaemic ones. It also assessed and determined the factors that were independently associated with pre-diabetes status.

As shown in table I, pre-diabetes occurred most in the third decade (20-29 years) of life and mostly married females with no statistical significant association. This is not different from other research findings[7,9,11,21,24]. However, a community-based study in Ethiopia, reported pre-diabetes to be more prevalent after 60 years of age[25]. Females have more adiposity and less muscle mass, with better health seeking behaviour than the males, hence their dysglycemic status can be detected earlier than in males. In contrast, other findings reported more preponderant in males than in females[10,21].

Educational attainment and employment status were independently associated with pre-diabetes (tables II and III). Higher education might be with little or no time for physical activity, and higher income to afford eating of fast or refined food, thus predisposing them to dysglycemia[26,27]. It has been reported that higher education is associated with dysglycemia and was

attributed to lower physical activity[10,11]. Also, unemployment can lead to stress, which triggers the stress hormones that affect glucose metabolism[2,28]. Social class was also significantly and statistically associated with pre-diabetes with the risk increasing about 3-fold among the higher social class. This finding could be that higher social class is associated with unhealthy eating and sedentary lifestyle. This is in keeping with another study.[14]It is at variance with other studies[2,29].

Tobacco use was statistically and significantly associated with pre-diabetes (table IV). The probability of developing pre-diabetes was about 7 times higher among smokers and about 5 times higher among those who used snuff (table V). These findings could be as a result of the nicotine content in tobacco, whose effect can trigger the blood to making more triglycerides, which are fats linked to insulin resistance.[30]A study by Chiwanga et al, in Tanzania and Uganda had similar finding.[3]However, other studies had contrary views.[10,12]However, there was no statistically significant association between alcohol use and pre-diabetes, depicting that alcohol may not have effect on pre-diabetes. This could be that low to moderate consumption of alcohol lowers the risk of developing pre-diabetes especially in women, as participants majorly fell into low-risk alcohol use category for both pre-diabetics and normoglycemics. It has been reported that moderate alcohol consumption is associated with increased insulin sensitivity especially in healthy women.[31]Similar studies have documented the same finding[10,12,32].

Physical activity was statistically and significantly associated with pre-diabetes, showing that physical inactivity (or inadequate physical activity) was a risk factor for pre-diabetes, hence, was independently associated with pre-diabetes (fig 1, tables IV and V). The reason is probably because sedentary lifestyle is a risk factor for obesity, insulin resistance and pre-diabetes/diabetes. A study has shown that people who had prediabetes or diabetes were generally less active than those who were normoglycaemic[33]. Another study in Owerri, Nigeria also reported that inadequate physical activity was statistically significantly associated with pre-diabetes[12].

CONCLUSIONS

This study has shown that educational attainment, occupational status, social class, tobacco use and physical activity were independently associated with pre-diabetes. The presence of the sesocio-demographic and abnormal behavioural characteristics, should make the clinicians to have a high index of suspicion of possible abnormal glucose regulation and be prompted to screen such clients for risk factors of pre-diabetes, with a view to early detection of the condition, and prevent or delay development of overt diabetes and its deleterious complications.

Authors' contributions:

1. NO Okezie, CS Anyigor-Ogah: concept and design, definition of content, literature search, data analysis, manuscript preparation and editing
2. NC Oguejiofor: design, data acquisition, definition of content, manuscript review.
3. HI Amazue: literature search, statistical analysis, manuscript editing
4. Anyigor-Ogah: clinical studies, data acquisition, data analysis, manuscript preparation
5. AN Ekechi, HU Oboke: concept, literature search, clinical studies, manuscript preparation
6. UD Aghor: literature search, clinical studies, data acquisition, manuscript review
7. IM Idika: concept, literature search, clinical studies, manuscript preparation

Source of Funding: The authors received no form of financial support in this research

Conflict of interest: The authors declare that there was no conflict of interests encountered in the research

Ethical Considerations: An approval for the study was obtained from the Research and Ethics Committee of Alex Ekwueme Federal University Teaching Hospital, Abakaliki, with approval number: FETHA/RE/VOL.2/2018/078 and dated 31st July, 2018. This research work complied with the Helsinki declaration 2013 on human research. The nature and purpose of the study were explained to the respondents in the language they could understand. They were assured of the confidentiality. The respondents were told that participation was voluntary and they were free to withdraw their consent at any point, without any adverse consequences to them. They freely gave their consent. The costs of investigations as well as transportation for appointments were borne by the researcher.

Availability of data and materials: The sets of data generated and analyzed in this study are available from the corresponding author on reasonable request through the e-mail address of ogahstanly90@yahoo.com

Acknowledgement: We sincerely, thank the Research and Ethics Committee and members of the Department of Family Medicine, Alex Ekwueme Federal University Teaching Hospital, Abakaliki. Special appreciation goes to our colleagues and supervisors, for their kind support and continued advice throughout the duration of this research. The cooperation and willingness of the participants all through the

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This article may be cited as: Okezie NO, S C, Ogah A, Oguejiofor NC, Amazu IH, Aghor UD, Aghor UD, Ekechi NA, Oboke HU, Oga OA, Augustina: Association Between Socio-demography/Behavioural Characteristics and Pre-diabetes: A hospital-based comparative study of adult patients. Pak J Med Health Sci, 2024; 18(11): 11-16.