PJN
ISSN 1680-5194

PAKISTAN JOURNAL OF NUTRITION

ANSInet
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
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OPEN ACCESS Pakistan Journal of Nutrition

ISSN 1680-5194
DOI: 10.3923/pjn.2020.266.270

Research Article
Obesity and Hypertension among Nigerians with Impaired Fasting Glucose

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Abstract

Background and Objective: Obesity and hypertension are two important factors associated with the development of prediabetes and overt diabetes mellitus. The prevalence of obesity and hypertension among Nigerians with impaired fasting glucose (IFG), a prediabetic state, is not still fully established. This study therefore intends to determine the prevalence of obesity and hypertension among Nigerians with IFG. **Materials and Methods:** This was a retrospective study from the available in Special Investigation Clinic of Chemical Pathology Department of the Ekiti State University Teaching Hospital, Ado-Ekiti. Age, sex, systolic and diastolic blood pressure, height and weight were extracted from the record of individuals who presented with two previous IFG (5.6-6.9 mmol L^{-1}) as indication for oral glucose tolerance test (OGTT) over a period of 60 months. **Results:** A total of 608 subjects comprises of 208 males (34.21%) and 400 females (65.79%) who presented for OGTT on the basis of two previous IFG were recruited. One hundred and seventy six (28.95%) of the patients were found to be obese. Fifty-six (9.21%) had a combination of obesity and systolic BP ≥140 mmHg while 40 (6.58%) had a combination of obesity and diastolic BP ≥90 mmHg. **Conclusion:** Substantial number of patients with impaired fasting glucose (IFG) has hypertension and obesity.

Key words: Impaired fasting glucose, obesity, hypertension, overweight, pre-diabetes

Received: January 28, 2020 Accepted: April 19, 2020 Published: May 15, 2020

Citation: Adeniran Samuel Atiba, Dolapo Pius Oparinde, Joel Olufunmimiyi Akande, Temitope Adeola NIran-Atiba and Nurudeen O. Bello, 2020. Obesity and hypertension among Nigerians with impaired fasting glucose. Pak. J. Nutr., 19: 266-270.

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Despite the volume of knowledge on diabetes mellitus (DM), the occurrence of diabetes increases on daily basis[1]. Prior to the development of diabetes mellitus, are two important pre-diabetic states in the form of impaired fasting glucose (IFG) and impaired glucose tolerance (IGT). These two pre-diabetic states have been linked with some other clinical conditions like obesity, high blood pressure, hyperlipidemia and hyperinsulinemia[2-4]. A collection of these factors and others in the same individual has been described as Metabolic Syndrome (MS)[5]. The presence of Metabolic Syndrome is associated with an increased risk of cardiovascular morbidity and mortality[6].

In order to reduce the incidence of DM and other associated co-morbid states, emphasis has been focused on avenues to either prevent or delay the onset of DM. Therapeutic life style changes (dietary and life style modifications) have been advocated and found to be effective at delaying the onset of DM[7]. One other important preventive approach is to identify individuals at risk through the establishment of presence or absence of IFG and IGT or both[8].

Impaired fasting glucose is characterized by consistently elevated fasting plasma glucose level above the acceptable upper limit of normal but not high enough to be diagnosed as DM[9]. According to the American Diabetic Association (ADA), IFG is considered as fasting plasma glucose level from 5.6 mmol L^{-1} (100.8 mg L^{-1}) to 6.9 mmol L^{-1} (125 mg dL^{-1}). Impaired glucose tolerance (IGT) is defined as elevated 2 h plasma glucose concentration $\geq$5.6 mmol L^{-1} (100 mg dL^{-1}) and less than 11.1 mmol L^{-1} (200 mg dL^{-1}) after a 75 g glucose load on the standard oral glucose tolerance test (OGTT)[4].

It has been reported that about 70% of individuals with IFG or IGT or both will progress overtime, which may be as short as three years, to overt DM[10]. Moreover, it has been documented that there is an increased risk of cardiovascular pathology during progression of these pre-diabetes states to overt DM[11]. The presence of IFG or IGT or both has been identified as independent risk factor for the development of cardiovascular diseases.

For the purpose of this study, the emphasis is on IFG. The prevalence of IFG has been reported in different populations and this has been observed to vary from one region to another[12]. The sex distribution and association with co-morbid factors such as obesity and hypertension also vary widely[12]. However, there is paucity of data from Nigeria with regards to the prevalence of IFG and its associated co-morbid factors. The prevalence of IFG has been reported to be as low as 1.3% in a rural Bangladesh population to as high as 43.9% in Caucasians[13,14]. In the year 2000, the prevalence of IFG among United State adolescents was reported as 7.0% and this rose to 13.1% in 2006[15,16]. The prevalence of IFG among hypertensive individuals also varies widely; IFG among hypertensive patients in Karachi (Pakistan) was reported to be 8.7%, 14% in Enugu, South Eastern Nigeria and 31.3%in Greece[17-19].

To the best of our knowledge, report on the prevalence of obesity and hypertension among individuals with IFG has not been previously documented in Nigeria. This study therefore intends to determine the prevalence of obesity and hypertension among Nigerians with IFG. It is hoped that results obtained will further contribute to the general knowledge, early diagnosis and improved management of individual with obesity, hypertension and IFG.

MATERIALS AND METHODS

Experimental site: The study was carried out in Special Investigation Clinic of Chemical Pathology Department of the Ekiti State University Teaching Hospital, Ado-Ekiti, Ekiti State. This Teaching Hospital provides medical facilities to the people from major cities and several villages in the state.

Research procedure: It was a retrospective study; records of individuals with impaired fasting glucose were examined, recorded and analyzed. The record of all patients who presented for an oral glucose tolerance test (OGTT) based on two previous IFG results was used in this study. Required information about individual subjects was entered in a table. This table served as the primary source of data for statistical analysis.

Data collection: This study covered a period of 60 months, from January 2011 to December 2015. Age, sex, systolic and diastolic blood pressure, height and weight were extracted from the OGTT record book.

Parameters measured: Plasma glucose was analyzed in our laboratory routinely using standardized colourimetric method (glucose oxidase). Ready to use commercial kits manufactured by Randox Laboratories Limited, Crumlin, UK was used. Body Mass Index (BMI) was calculated using weight in kg and height in m^2 (kg/m^2) and then classified according to WHO classification for BMI; normal weight (BMI 18.50 -24.99), overweight (BMI 25.00-29.99) and obese groups (BMI $\geq$30.0).

Statistical analysis: All statistical analyses were performed using the Statistical Package for Social Sciences (SPSS) version 18.0 (SPSS Inc., Chicago, IL, USA).

RESULTS

In this study a total number of six hundred and eight (608) patients comprising of 208 males (34.21%) and 400 females (65.79%) presented for OGTT on the basis of two previous impaired fasting blood glucose (IFG) participated (Table 1). Total 176 (28.95%) of the patients were found to be obese; 192 (31.58%) were overweight while the remaining 240 (39.47%) had normal BMI. Out of the 176 in the obese group, 116 (65.91%) had mild obesity (BMI of 30.00-34.99), 48 (27.27%) had moderate obesity (BMI of 35.00-39.99) and the rest 12 (6.82%) had morbid obesity (BMI ≥40.00).

Out of the 608 patients, a total of 192 (31.58%) had systolic and diastolic blood pressure ≥140/90 mmHg. Out of the 240 individuals with normal BMI, 64 (26.67%) individuals [32 (13.33%) males and 32 (13.33%) females] had systolic and diastolic blood pressure ≥140/90 mmHg. In the overweight category, out of the 192 individuals 72 (37.5%) [40 (20.83%) males and 32 (16.67%) females] had systolic blood pressure ≥140 mmHg. Also, in this group 88 individuals (45.83%) [48 (25.00%) males and 40 (20.83%) females] had diastolic blood pressure ≥90 mmHg. Out of the 175 individuals in the obese group, a total of 56 (31.82%) [08(4.55%) males and 48 (27.27%) females] had systolic blood pressure >140 mmHg. Also, in the obese group, a total of 40 (22.86%) individuals [nil (0.00%) males and 40(22.73%) female] had diastolic blood pressure ≥90 mmHg (Table 2).

As shown in Table 3, out of the 608 patients, a total of 56 (9.21%) [8 (1.32%) males and 48 (7.90%) females] had a combination of obesity and systolic BP ≥140 mmHg. Also, a total of 40 (6.58%) had a combination of obesity and diastolic BP ≥90 mmHg, who were essentially of female gender. Those with only obesity without hypertension were 120 (19.74%) individuals [24 (3.95%) males and 96 (15.79%) females]. Those with hypertension without obesity were 64 individuals (10.53%) [32 (5.26%) males and 32 (5.26%) females].

The Fig. 1 further explains comparison between male and female with systolic and diastolic blood pressure. It shows that more subjects who were overweight and obese had systolic and diastolic high blood pressure. Obese females were more hypertensive than obese males.

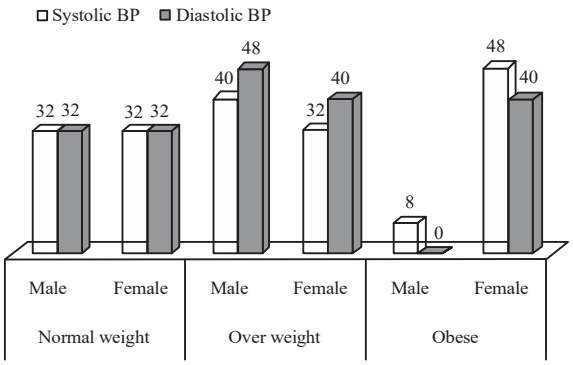

Fig. 1: Frequency of diastolic blood pressure ≥90 mmHg and systolic blood pressure ≥140 mmHg among individuals with IFG

Table 1: Classification of subjects according to BMI (kg/m²) (N = 608)

Obese (MBI ≥30.00)	176 (28.95%)	Mild obesity = 116 (65.91%) Moderate obesity = 48 (27.27%) Morbid obesity = 12 (6.82%)
Overweight (BMI of 25.00-29.99)	192 (31.58%)	
Normal BMI (BMI of 18.50-24.99)	240 (39.47%)	

Mild obesity: BMI (kg/m²) of 30-34.99, Moderate obesity: BMI (kg/m²) of 35-39.99, Morbid obesity: BMI (kg/m²) ≥40.00

Table 2: Grades of BMI (kg/m²) and percentage of subjects with hypertension

	No. of subjects with systolic hypertension (SBP ≥140 mmHg)	No. of subjects with diastolic hypertension (DBP ≥90 mmHg)
Normal BMI (n = 240)	64 (26.67%)	64 (26.67%)
	Male: 32 (13.33%)	Male: 32 (13.33%)
	Female: 32 (13.33)	Female: 32 (13.33)
Overweight (n = 192)	72 (37.5%)	88 (45.82%)
	Male: 40 (20.83%)	Male: 48 (25.00%)
	Female: 32 (16.67%)	Female: 40 (20.83%)
Obese (n = 176)	56 (31.82%)	40 (22.73%)
	Male: 08 (4.55%)	Male: 0 (0.0%)
	Female: 48 (27.27%)	Female: 40 (22.73)

Table 3: Subjects with combination of hypertension and/or obesity

Obesity and systolic hypertension (SBP ≥140 mmHg)	Obesity and diastolic hypertension (DBP ≥90 mmHg)	Obesity without hypertension	Hypertension without obesity
56 (9.21%)	40 (6.58%)	120 (19.74%)	64 (10.53%)
Male = 8 (1.32%)	Male = Nil (0.00%)	Male = 24(3.95%)	Male = 32 (5.26%)
Female = 48 (7.90%)	Female = 40 (6.58%)	Female = 96 (15.79%)	Female = 32 (5.26)

SBP: Systolic blood pressure, DBP: Diastolic blood pressure

DISCUSSION

In this study, the female population with IFG almost doubled that of the males (65.79% vs 34.21%). This indicates a high level of pre-diabetes in the female gender and it may be attributed to sedentary life-style coupled with the kitchen advantage (In African settings) of increased rounds of servings. Our findings also revealed that a total of 60.53% (31.58% overweight and 28.95% obese) individuals with IFG were in the category of overweight/obese. This figure is strongly in support of previous findings associating obesity with the development of IFG[3]. However, it is noteworthy that, out of the total population of women (400) with IFG, 68% of them (32% overweight, 36% obese) were in the category of overweight/obese as compared to the male population that were 46.16% overweight/obese (30.77% overweight, 15.39% obese). These figures indicate that prevalence of obesity in females with IFG was more than double as compared to the males, this may in-turn explain the double prevalence of IFG among females compared to the males[20].

Conversely, high blood pressure with IFG seems to be more predominant among males compared to their female counterparts. A higher percentage (38.46%)of males with IFG had diastolic and systolic blood pressure ($\geq$140/90 mmHg) compared to 28.0% females with IFG. Being Overweight rather than being obese tends to be a major predisposing factor for the development of high blood pressure in males with IFG. About 75% of overweight males had systolic blood pressure $\geq$140 mmHg while none of the thirty-two obese males with IFG had systolic pressure $\geq$140 mmHg. Although, there is no immediate explanation for this finding, however, increased social responsibilities placed on the male individuals may be a contributory factor.

This study tends to suggest that obesity/overweight are frequently associated factors in females with IFG while overweight with elevated blood pressure are important associated factors in males with IFG.

According to the previous studies, the presence of obesity/overweight has been linked to the development of insulin metabolic abnormalities giving rise to the pre-diabetic states, mainly IFG and IGT[21,22]. The pathophysiology of IFG and IGT in obese/overweight individuals were thought to be similar which implicated impaired insulin secretion rather than reduced insulin sensitivity for both[23]. Results of the present study support these findings especially in females because the presence of obesity in the study population does not translate to a concurrent increase in blood pressure which has been linked with hyperinsulinemia. However, previous study[24] has suggested a different pathophysiology for IFG which includes a reduced hepatic insulin sensitivity which may lead to hyperinsulinemia and a resultant increase in blood pressure as observed in males who were overweight in the present study. Therefore, the question is "does sex have a role in the pathogenesis of IFG"? Further study in this regard may be necessary to answer this question.

CONCLUSION

A number of patients with impaired fasting glucose (IFG) has hypertension and obesity. This further confirms association with impaired fasting glucose, hypertension and obesity.

ACKNOWLEDGMENT

We acknowledge and appreciate the contributions of the staff of the Department of Chemical Pathology of Ekiti State University Teaching Hospital, Ado-Ekiti.

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