Prevalence and Risk Factors of Impaired Fasting Glucose in Egyptian Adults, Menoufia Governorate

Aml Ahmed Salama (1)
Ahmed Mohammed Zahran (2)
Asma Shawqy Beddah (3)

(1) Aml Ahmed Salama , MD, Family Medicine Department , Faculty of Medicine, Menoufia University
(2) Ahmed Mohammed Zahran, MD, Internal Medicine Department, Faculty of Medicine, Menoufia University.
(3) Asma Shawqy Beddah , M.B.B.Ch. Resident of Family Medicine, Ministry of Health (MOH), Egypt.

Corresponding author:
Dr. Aml Ahmed Salama ,
Lecturer of family medicine,
Menoufia University,
Egypt
Email: aml_salama2002@yahoo.com

Abstract

Objective: The aim of this study was to assess the prevalence and risk factors associated with impaired fasting glucose (IFG) in adult individuals.

Background: Prediabetes is defined as blood glucose concentrations that are higher than normal but not of a magnitude which would correspond to a diagnosis of type 2 diabetes. Individuals with prediabetes have an increased high risk of developing type 2 diabetes and associated complications[1], and most type 2 diabetes patients have likely been in a state of hyperglycemia for several years prior to diagnosis [2].

Subject and method: Berket Elsabae district was randomly selected out of eight districts of Menoufia Governorate, of which two family health units were randomly selected. A randomized sample was selected from the attendants of these family health units for regular visits. 1,255 subjects were randomly selected for inclusion in the study.

Results: The prevalence of IFG was 7.9 % (n= 99), of these 52.5 % (n=52) were males and 47.5% (n=73) were females, (OR =0.721, CI =0.477-1.089, p=0.12). The main risk factors associated with IFG were age (>45 years: P value = 0.003), being married (OR = 1.73, CI = 0.928 - 3.22, P value =0.001), and rural resident (OR =0.71, CI =0.446-1.132, P value = 0.149). History of hypertension, hyperlipidemia and chronic viral hepatitis were significantly associated with higher percentage of isolated impaired fasting blood glucose. Body mass index and blood pressure values were positively correlated to levels of fasting blood glucose group of the studied groups.

Conclusion: Prediabetes with isolated impaired fasting blood glucose level was significantly related to patient education, history of hyperlipdemia, blood pressure and body mass index in the logistic regression model.

Key Words: Prevalence, Risk Factors, Impaired Fasting Glucose.

Introduction

Diabetes mellitus poses serious health concerns and economic burdens as incidence and prevalence rates continue to rise at alarming rates in the Arab and the entire World. Estimates indicate that 29.1 million people, or 9.3% of the US population, have diabetes mellitus, although the disease is undiagnosed in 8.1 million of those individuals. [3]. The prevalence of type II diabetes has increased dramatically in the Arabic-speaking countries over the last three decades; an estimated 9.1% of the populations from the Middle Eastern/North African region have type II diabetes (35.4 million of adults aged 20-79) in 2015, and 30 million with impaired glucose tolerance [4]. Egypt is in the world's top 10 in terms of the highest number of people with diabetes in 2015 (7.8 million) [4]. In 2003, the American Diabetes Association (ADA) [5] reported an intermediate metabolic stage in which blood glucose levels are higher than normal range but do not reach the diagnostic criteria for T2D, leading to the birth of the concepts of impaired fasting glucose (IFG) and impaired glucose tolerance (IGT) both known as pre-diabetes. The importance of this category of the disease, is that the patients are unaware of their pre-diabetes stage; during that time 20-30% of those patients develop complications of diabetes such as nephropathy, cardiomyopathy, retinopathy and neuropathy [6].

Some studies identified the same risk factors, that have been reported in studies of type 2 diabetes patients, to subjects with prediabetes [7 & 8]. Lifestyle-related risk factors and other factors, implicated in the progression of the prediabetic stage to type 2 diabetes, might also contribute to the appearance of prediabetes [8 ,9].

Materials and Methods

This was a case control study nested in a cross-sectional, descriptive, randomized, trial which enrolled a total of 1,255 subjects aged > 20 years of both genders. Berket Elsabae district was randomly selected out of eight districts of Menoufia governorate, of which two family health units were randomly selected. The randomized sample was selected from the attendants of these family health units for regular visits (as randomization was done through selection of each third attendant at the beginning of the working day, three days in each family health unit), for 6 months beginning from the first of July 2015 to the end of December 2015. The study was approved by the Ethical Committee of the Faculty of Medicine, Menoufia University. Informed consent was signed by all participants after simple and clear explanation of the research objectives and procedures.

The study sample size was calculated based on the lowest prevalence of IFG from the previous literature which was 2% [10] and the highest prevalence which was 35.8% by Chen et al., 2013 [11]; sample size was calculated using the Epi Info program (Atlanta, Georgia, USA) with 95% confidence interval (CI), depending on the total number of adult population in the selected rural area. They were physically examined by a trained team. Known diabetic patients were excluded.

The selected individuals were interviewed using questionnaire with the guide of the researcher. The questions were explained using easy language for the participants to understand, regarding their level of education and culture. The researcher was sure that patients understood each question. The items were read out verbally to the patients and the questionnaires were filled in with the patients' own words by the researcher.

The questionnaire covered history items : including age, sex, socioeconomic standard, which was assessed through their education, occupation, income, number of individuals per room, type of housing, material possessions, etc), They were graded into high, middle and low socioeconomic status [12]. Exercise (frequency of exercise was defined as performing an activity such as walking for ≥30 minutes every day, either <1 day/week, 1-4 days/week or ≥5 days/week, and classified as exercising every day and not every day. Smoking, history of diseases such as hypertension , hyper-lipidemia, heart disease and viral hepatitis, family history of diabetes and history of medication intake such as antihypertensive drugs, corticosteroids or oral contraceptive medication was recorded.

• **Validation of the questionnaire** was done through its submission to a panel of 4 experts to test its validity. The experts were professors of internal medicine, family medicine and two endocrinologists. The items were revised by the experts to determine whether the items were relevant for assessment.
• The experts were asked to evaluate individual items in relation to their relevance and appropriateness and rate items on a 4 point scale : score 4 for Adequate (simple, relevant and clear item), 3 for adequate, but needs minor modification, 2 for items that need major modification, 1 for not so adequate (can be omitted). Content validity index (CVI): percentage of total item was rated by experts as either 3 or 4.

The score of ≥ 80% is generally considered to have a good validity. CVI of the designed questionnaires was calculated. It was 85%.

Physical examination
Height in centimeters was measured bare footed with the patients standing straight. Weight in kilograms was recorded using portable weighing scale with patient bare footed standing straight with heels together while wearing light clothes. Body mass index (BMI) was calculated for each patient as formula: weight (kg) / [height (m)] 2. BMI was graded to

1. Normal body weight if BMI ranging from 18.5 to less than 25
2. Overweight if they had BMI of (25 to 29.9)
3. Obese if BMI was equal to or more than 30.

Blood pressure (BP) was measured using a suitable mercury sphygmomanometer after a 10 minutes rest with the patient in the sitting position and cubital fossa at heart level. BP was measured twice at 5 minute intervals. Hypertension was defined as a systolic blood pressure ≥140 mmHg and/or a diastolic blood pressure ≥90mmHg (JNC 7, 2008)[13]. The participants currently using antihypertensive medications were also classified as positive for hypertension even if they had normal blood pressure. Hypertension was identified according to the following criteria;

• Normotensive: < 120 mmHg (Systolic), and < 80 mmHg (Diastolic)
• Pre-hypertensive: ≥ 120 - < 140 mmHg (Systolic), and/or ≥ 80 - < 90 mmHg (Diastolic)
• hypertension: : > 140/90mmHg .

Laboratory analysis
Subjects were asked to fast 6 to 8 hours overnight (no caloric intake). The fasting venous blood sample was taken by the laboratory technician and fasting blood sugar level measured by RA 50 analyzer, wavelength 505, using spin-react reagent.

Two hour postprandial glucose level values were assessed after two hours of receiving an ordinary breakfast. Fasting blood glucose level values according to ADA, 2014 [14] were as follows:

• <100 mg/dl (non-diabetes)
• 100-<126 mg/dl (pre-diabetes IFG)
• ≥ 126 mg/dl (diabetes)

Two hour postprandial glucose level values for the non diabetics, pre-diabetics and diabetics were taken according to ADA, 2014[14] as follows:
• <140 mg/dl [(Non-diabetes)
• 140 - < 200 mg/dl (Pre- diabetics IGT)
• ≥ 200 mg/dl (Diabetics)

Diabetic cases (53 cases, with either diabetic FBG and 2hPP or one of them after repeating the test) were excluded and directed towards their proper management, after breaking the bad news regarding their diabetic state to them as they were unaware of that. The normoglycemic individuals (1012) constituted the control group for the isolated impaired fasting BG group (99 cases).

Statistical Analysis
Data were analyzed with the Statistical Package for the Social Sciences (SPSS) v.21 for Windows (IBM Inc. Chicago, IL), and the results were considered statistically significant when p<0.05. For quantitative data analysis, simple frequencies were used for data checking.

Quantitative data was expressed as mean and standard deviation (X ± SD) and analyzed by Student t- test for comparison of the two groups of normally distributed variables.

Qualitative data was expressed as number and percentage and analyzed by Chi-square test. t- test : is a test of significance for comparison between two quantitative variables with different variance. A logistic regression model was constructed in order to estimate odds ratios (Confidence Interval 95%) for the presence of IFG, adjusted by age groups, educational status, JNC-8 classification of hypertension, history of diseases as hypertension, hyper-lipidemia and chronic viral hepatitis.

Results

The total study sample was 1,255 subjects, 46.3% males and 53.7 % females. The mean age was 38.9±11.16 , 68.9% of the studied group were rural residents and 31.1 were urban residents (Table 1). Normoglycemic individuals constituted 80.6 % of the studied group (normal fasting and 2 hours post prandial), while the prevalence of isolated impaired fasting blood glucose was 7.9 % and undiagnosed diabetes in patients who were unaware of their glycemic status, constituted 4.2% of the studied group (2.8 % had both diabetic fasting and 2hpp, 0.6% had only diabetic 2hpp BG , 0.3% had only diabetic fasting BG and 0.5 % had diabetic 2hpp and impaired fasting BG). [Table 2] & Figure [1].

Age constituted statistical significant difference and risk factor between normal and IFG groups, with the highest prevalence among >45 years (p <0.001). Education of participants constituted statistically significant difference between the studied groups. Higher education grades seem to be protective as the highest percentage of normal group had university graduation (40.7%) versus 9.1% for the IFG group (p <0.001) in the normal fasting BG group. Sex, occupation, marital Status and residence didn't constitute statistical significant difference between the studied groups [Table 3].

History of hypertension, hyper-lipidemia and viral hepatitis were significantly higher among the IFBG group than the normal fasting blood glucose group (p value =0.003,OR= 2.305 , CI (1.323- 4.015) for hypertension, p value <0.001,OR= 1.079 , CI (2.67 - 8.51) for hyper-lipidemia and p value =0.004 , OR= 2.803 , CI (1.354 - 5.804) for chronic viral hepatitis), while history of heart and renal diseases didn't constitute significant difference among the studied groups. Regarding history of medications, consumption of anti-hypertensives and corticosteroids were significantly higher among the IFBG group than the normal fasting blood glucose group. Smoking constituted no statistical difference between the IFBG group and normal fasting blood glucose group (p value = 0.176 , OR= 0.731 and CI (0.462-1.153). Presence of relatives with diabetes in first and second grade constituted no statistical significant difference between IFBG and normal group [Table 4].

Table 1 : Demographic data of the studied group

Demographic character	No Total = 1255 cases	%
Sex		
Male	581	46.3
Female	674	53.7
Age		
Mean ± SD	38.9±11.16	
Patient education		
-Illiterate	4	0.3
-Basic education	151	12.1
-Secondary school	167	13.3
- Intermediate institute	463	36.9
-University graduation	470	37.4
Patient Occupation		
-No work or house wife	282	22.5
-Unskilled worker	50	4
-Skilled worker/farmer	98	7.8
-Trades /Free business	677	53.9
- Employment / retired	34	2.7
-Professional	114	9.1
Marital status		
-Not married	225	17.9
-Married	1030	82.1
Residence		
-Rural	865	68.9
-Urban	390	31.1
Socioeconomic		
-High	467	37.2
-Middle	486	38.7
-Low	302	24.1

Obese participants (BMI > 30) were significantly higher in the IFBG group than the normal group (69.4 % in IFBG group versus 45 % in normal group); IFBG while overweight were more among the normal FBG group. Comparing the mean of BMI among groups was significantly higher in IFBG (p =0.001) [Table 5] [Fig,2]. High blood pressure constituted 12.1 % of IFBG group versus 5.7 % in the normal fasting blood glucose group which constituted a statistical significant difference between them (p value = 0.002) [Table 5]. Comparing means of blood pressure parameters (systolic, diastolic and mean arterial pressure) they were significantly higher in the IFBG group (P value = 0.007, 0.002 and 0.001 respectively)[Table 5] &[Fig 3]

Pearson correlation showed statistical significant positive correlation of the fasting blood glucose values and body mass index, systolic, diastolic and mean blood pressure of the studied group [Table 6]&[Fig 4,5,6].

Logistic Regression Analysis model of risk factors associated with impaired fasting blood glucose showed risk factors (including age, higher patient education, , blood pressure, receiving of anti-hypertensive medication, BMI and presence of diseases as hypertension and chronic viral hepatitis) were associated with significantly higher odds of being in impaired fasting glucose group. Risk factors that had the strongest prediction of impaired fasting blood glucose were history of hyper-lipidemia (OR: 4.23, 95% CIs: 1.87-8.53), obese participants (OR: 2.91, 95% CIs: 1.21-2.21) and patient education (OR: 0.722, 95% CIs: 0.681-0.765) [Table 7].

Table 2 : Distribution of the Studied Group According to their Blood Glucose Level

Blood Glucose	No Total =1255	%	
Normal Fasting and Normal 2 HPP Blood Glucose Fasting BG <110md/dL 2hpp BG < 140 mg /dl	1012	80.6	
Isolated Impaired Fasting Blood Glucose : 110- 126 mg/dL	99	7.9	
Isolated Impaired 2hPP Blood Glucose : 140- 200 mg/dL	55	4.4	
Impaired Both fasting and 2 hPP BG 110- 126 mg/dL and 140- 200 mg/dL	36	2.9	
Diabetic cases Fasting > 126 mg /dL (repeated) and 2hPP > 200 mg /dL	35	2.8	Total Diabetic Cases 53 (4.2%)
Diabetic cases Fasting .. normal 2hPP>200 mg/dL	8	0.6	
Diabetic cases Fasting diabetic .. > 126 mg/dl 2hPP.....normal	4	0.3	
Diabetic cases Impaired Fasting 110-126 mg /dL Diabetic 2 hhpp > 200mg/dL	6	0.5	

Figure 1: Distribution of Cases according to their Blood Glucose Level

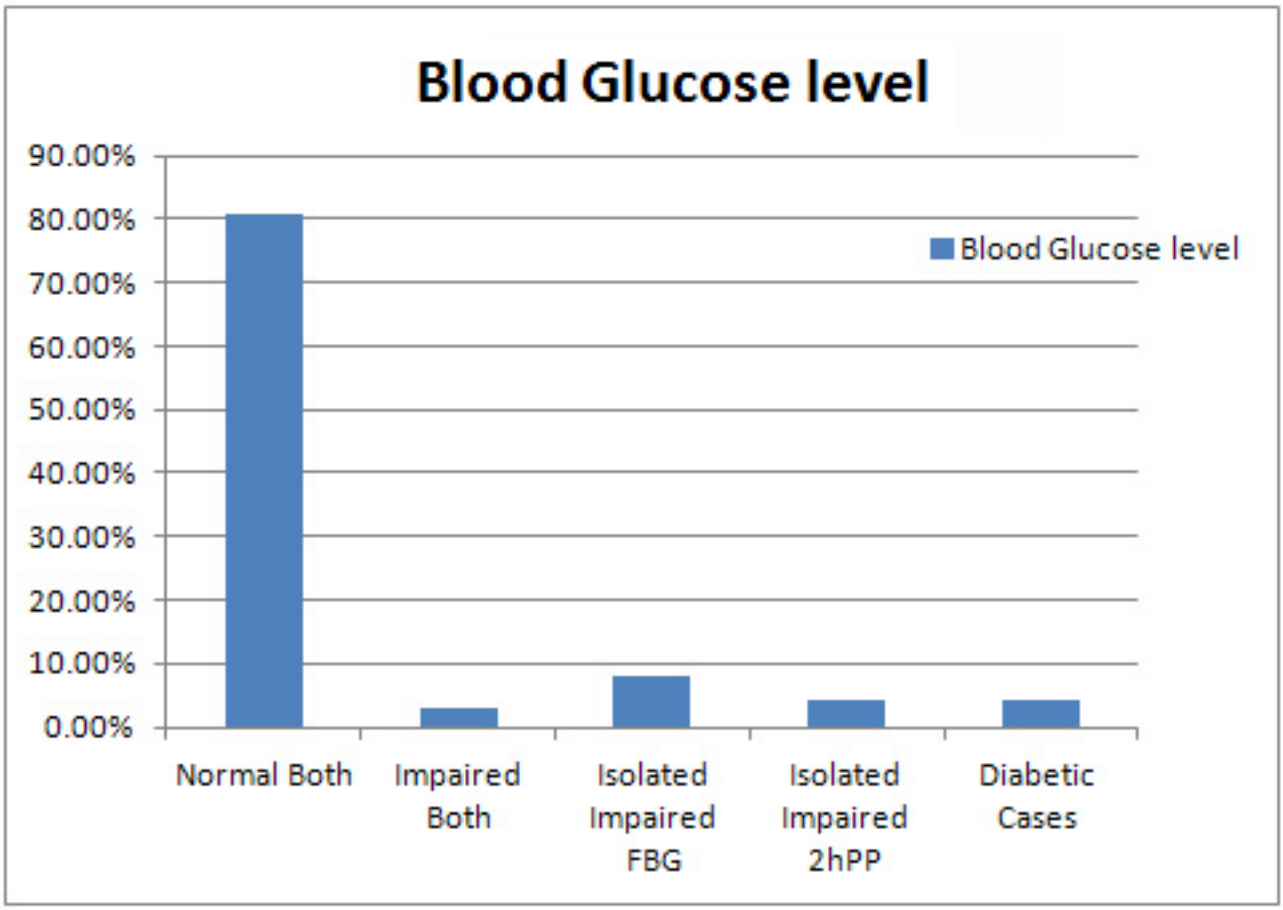

Table 3 : Comparison of Normal and Impaired Fasting Blood Glucose groups as Regards Their Demographic Characters

Demographic character	Normal Fasting BG (N= 1012) No (%)	Impaired Fasting Blood Glucose (N= 99) No (%)	Total (N= 1111) No (%)	X^2 P value	Odd's Ratio	CI 95 %
Sex						
-Male	449 (44.4)	52 (52.5)	501 (45.1)	2.42	0.721	(0.477-1.089)
-Female	563 (55.6)	47 (47.5)	610 (45.9)	0.12		
Age of patients Mean ± SD	38.04±11.94	42.49± 12.06	38.93±12.55	-3.537* <0.001	-----	--------
Age Group						
< 30 years	314 (31)	18 (18.2)	332 (29.9)	11.27		
30- 40 years	304 (30.1)	26 (26.3)	330 (29.7)		--------	----------
>45 years	394 (38.9)	55 (55.5)	449 (40.4)	0.003		
Education						
-Illiterate	15 (1.5)	17 (17.2)	32 (2.9)			
-Basic	80 (7.9)	45 (45.5)	125 (11.3)	62.44	--------	-------
-Secondary school	352 (34.9)	17 (17.2)	168 (15.2)	< 0.001		
- Intermediate	151 (15)	11 (11.1)	363 (32.8)			
-University	410 (40.7)	9 (9.1)	419 (37.9)			
Occupation						
-No work	228 (22.5)	21 (21.1)	249 (22.4)			
-Unskilled worker	35 (3.5)	5 (5.1)	40 (3.6)		--------	-------
-Skilled worker	84 (8.3)	7 (7.1)	91 (8.2)	4.83		
-Trade /business	540 (53.4)	50 (50.5)	590 (53.1)	0.436		
- Employer	26 (2.6)	6 (6.1)	32 (2.9)			
-Professional	99 (9.8)	10 (10.1)	109 (9.8)			
Marital status						
-Not married	195 (19.3)	12 (12.1)	207 (18.6)	3.039	1.73	0.928 - 3.228
-Married	817 (80.7)	87 (87.9)	904 (81.4)	0.081		
Socioeconomic						
-High	374 (37)	39 (39.4)	413 (37.2)	1.388		
-Middle	407 (40.2)	34 (34.3)	441 (39.7)	0.499	-----	----------
-Low	231 (22.8)	26 (26.3)	257 (23.1)			
Residence						
Rural	674 (66.6)	73 (73.7)	747 (67.2)	2.085	0.71	0.446 - 1.132
Urban	338 (33.4)	26 (26.3)	364 (32.8)	0.149		

Table 4 : Comparison of Normal and Impaired Fasting Blood Glucose Groups as Regards their History

History Parameters	Normal Fasting BG (N= 1012) No (%)	Impaired FBG (N= 99) No (%)	Total (N= 1111) No (%)	X^2 P value	Odd's Ratio	CI 95%
Hypertension						
Yes	89 (8.8)	18 (18.2)	107 (9.6)	9.131	2.305	1.323 - 4.015
No	923 (91.2)	81 (81.8)	1004 (90.4)	0.003		
Hyper-lipidemia						
Yes	48 (4.7)	19 (19.2)	67 (6.0)	33.222	4.77	2.67 – 8.51
No	964 (94.9)	80 (80.8)	1044 (94.0)	<0.001		
Heart Diseases						
Yes	38 (3.8)	4 (4)	42 (3.8)	0.12*	1.079	0.377 -3.089
No	974 (96.2)	95 (96)	1069 (94)	0.784		
Viral Hepatitis						
Yes	39 (3.9)	10 (10.1)	49 (4.4)	8.348	2.803	1.354 - 5.804
No	973 (96.1)	89 (89.9)	1962 (95.1)	0.004		
Medications						
No Drugs	808 (79.8)	63 (63.6)	871 (78.6)			
Antihypertensives	59 (5.8)	14 (14.1)	73 (6.6)	25.18	-----	-------
Corticosteroids	48 (4.7)	12 (12.1)	60 (5.4)	0.001		
Oral Contraceptives	69 (6.8)	6 (6.1)	75 (6.8)			
Others	28 (2.8)	4 (4.1)	28 (2.6)			
Daily exercising						
- Yes	373 (36.9)	34 (34.3)	407 (36.6)	0.246	0.896	0.581 – 1.383
-No	639 (63.1)	65 (65.7)	704 (63.4)	0.620		
Relative with Diabetes						
Yes in 1st Grade						
Yes in 2nd Grade	252 (24.9)	23 (23.2)	275 (24.8)			
No	31 (3.1)	0 (0)	31 (2.8)	3.413*	-----	----------
	729 (72.0)	76 (67.8)	805 (72.5)	0.182		
Smoking						
Yes	235 (23.2)	29 (29.3)	264 (23.8)	1.835	0.731	0.462 – 1.153
No	777 (76.8)	95 (70.7)	847 (76.2)	0.176		

Table 5 : Comparison of Normal and Impaired Fasting Blood Glucose groups as Regards their Body Mass Index and Blood Pressure

Parameters	Normal Fasting BG (N= 1012) No (%)	Impaired FBG (N= 99) No (%)	Total (N= 1111) No (%)	Test of Significant X^2	P value
BMI					
- Normal	130 (12.9)	8 (8.1)	139 (12.5)		
- Overweight	426 (42.1)	22 (22.2)	448 (40.3)	22.227	<0.001
- Obese	455 (45)	69 (69.7)	524 (47.2)		
Blood Pressure					
- Normal	894 (88.3)	75 (75.8)	969 (87.2)	12.817	0.002
- Pre hypertensive	60 (5.9)	12 (12.1)	72 (6.5)		
- Hypertensive	58 (5.7)	12 (12.1)	70 (6.3)		
	Mean ± SD	Mean ± SD	Mean ± SD	t test	
Body mass index	30.02 ±4.81	31.72±4.07	30.17±4.77	-3.406	0.001
Systolic BP	117.28±12.12	120.9 ±18.38	117.6±12.8	-2.691	0.007
Diastolic BP	69.01±9.76	72.32±11.23	69.31±9.93	-3.177	0.002
Mean Arterial Pressure	85.1 ±9.63	88.51 ±12.82	85.4±10.00	-3.257	0.001

Figure 2: Comparison of BMI (Mean ± SD) between groups

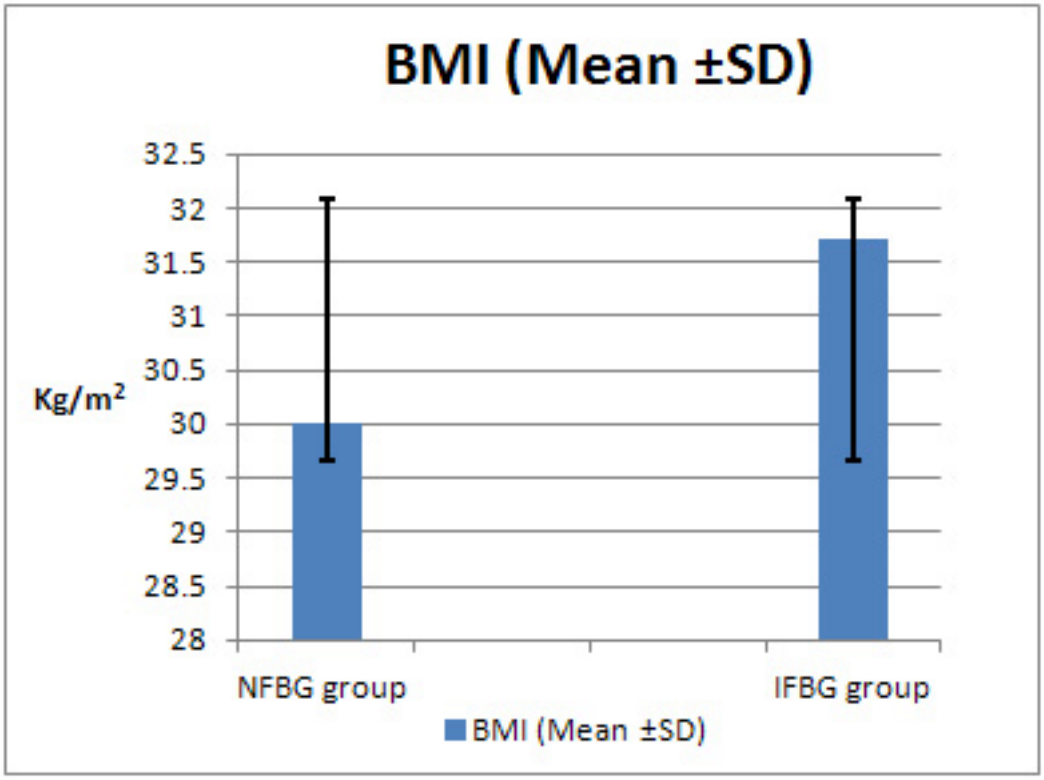

Figure 3: Comparison of Blood Pressure Parameters (Mean ± SD) between groups

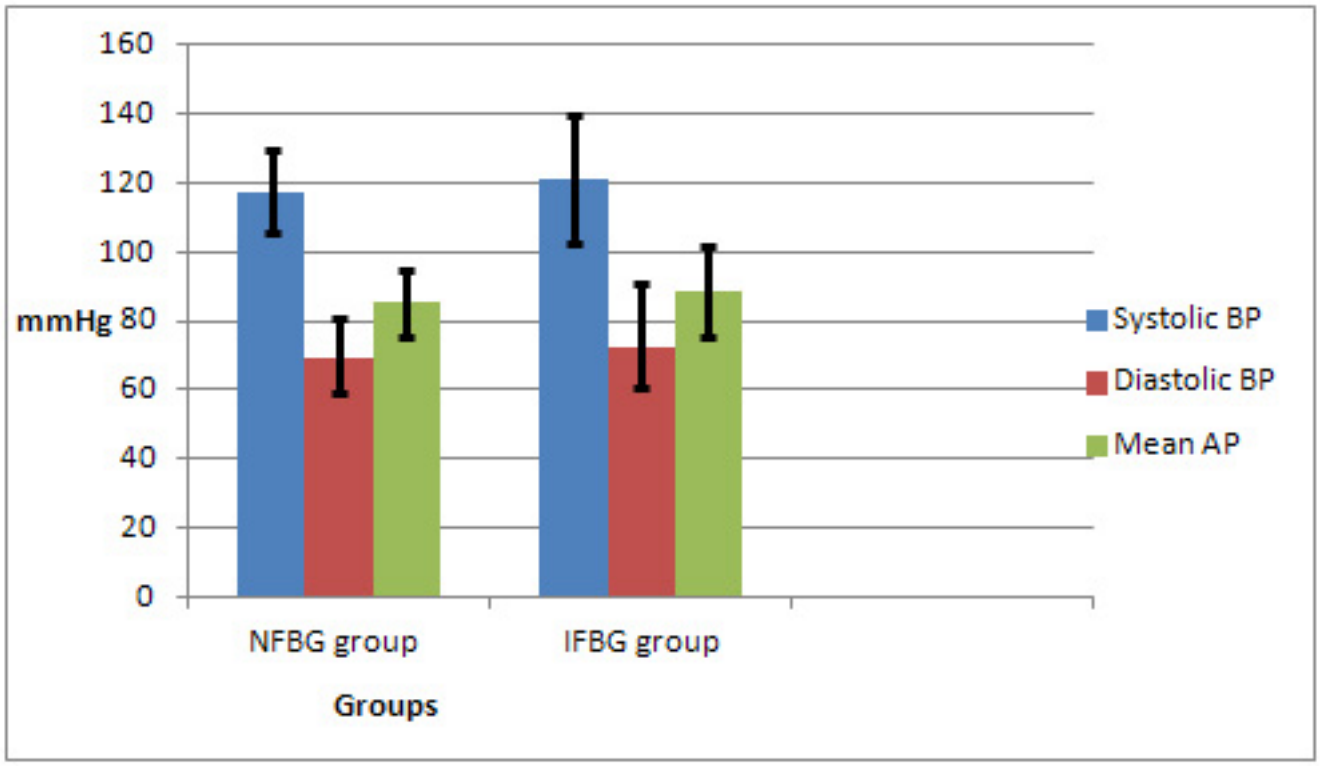

Table 6 : Pearson Correlation of Fasting Blood glucose level and (Body mass index and Blood Pressure) parameters of the studied group

Parameters	Fasting Blood Glucose	
	r	P value
Body mass index	0.109	< 0.001*
Systolic Blood Pressure	0.137	< 0.001*
Diastolic Blood Pressure	0.133	< 0.001*
Mean Arterial Pressure	0.174	< 0.001*

Figure 4 :Pearson Correlation of Fasting level and Body mass index parameters of the studied group

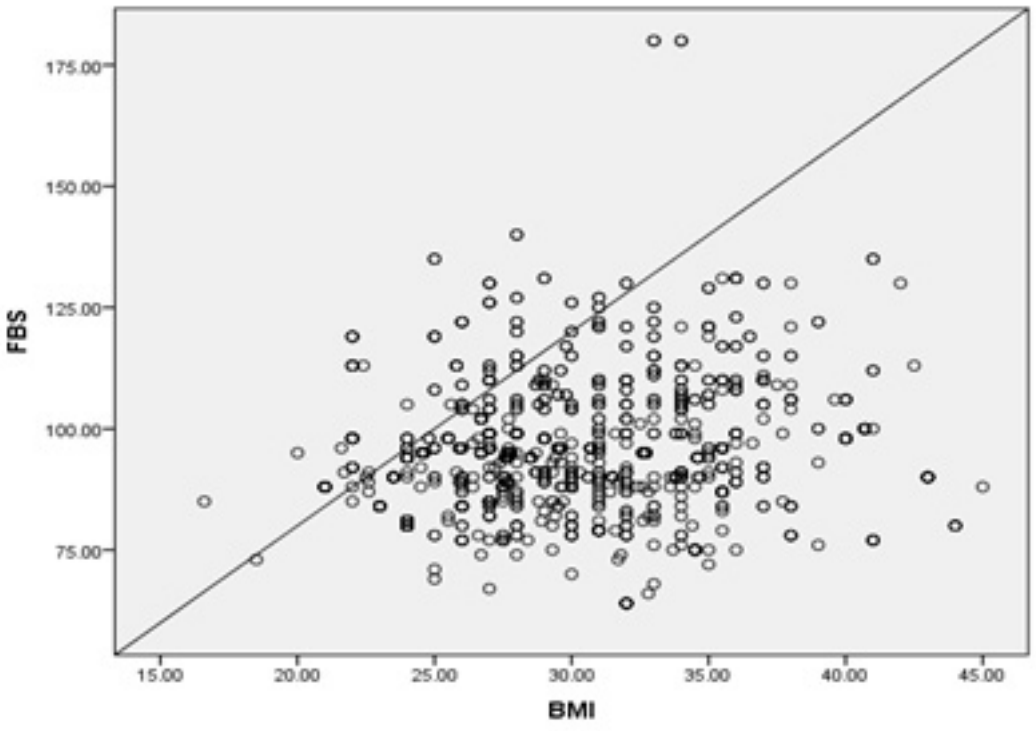

Figure 5: Correlation of FBG and Systolic blood pressure among the studied group

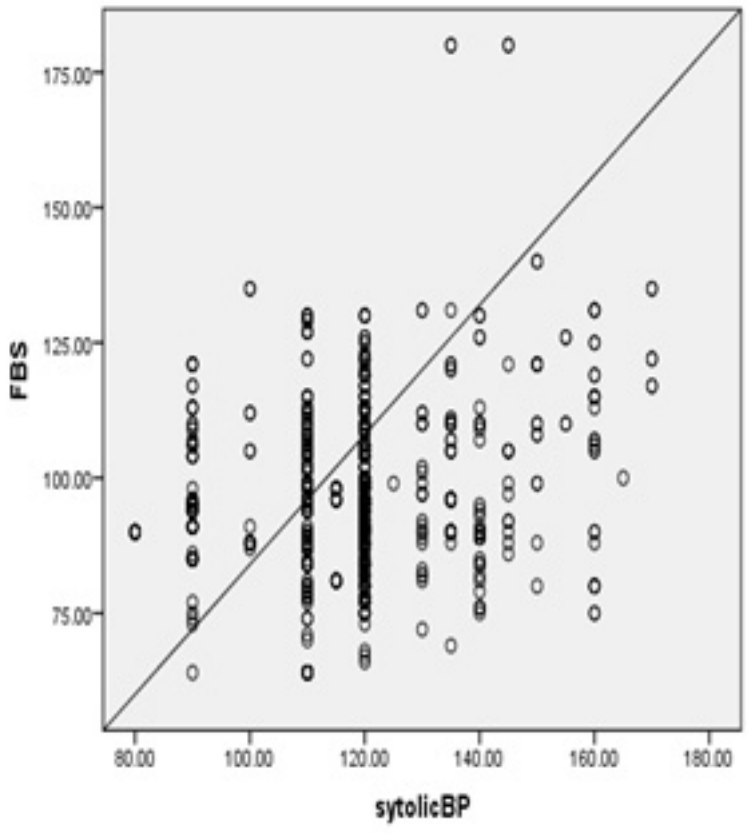

Figure 6: Correlation of FBG and Diastolic blood pressure among the studied group

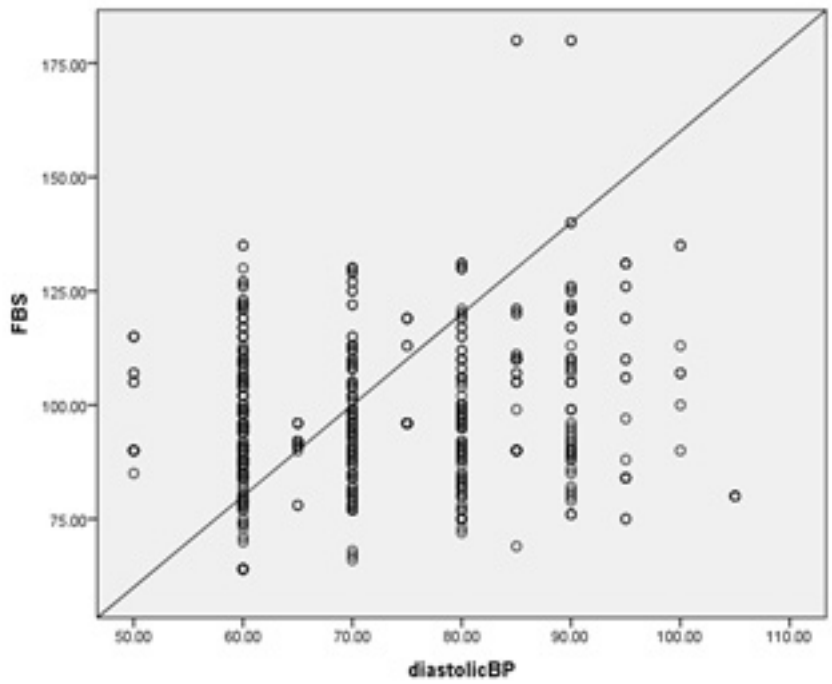

Table 7: Logistic Regression Analysis Of Risk Factors Associated With impaired Fasting Blood Glucose

Risk Factor Parameters	(Beta)	P value	Odds ratio	Confidence Interval Upper bound	lower bound
Age	0.098	0.527	1.103	0.741	1.547
Patient education	-0.326	<0.001	0.722	0.681	0.765
Hypertension(History)	-0.493	0.353	0.611	0.216	1.728
Hyperlipidemia (History)	1.442	<0.001	4.231	1.878	8.531
Chronic Viral hepatitis	0.592	0.404	1.697	0.490	5.887
Drugs	0.167	0.153	1.657	0.948	1.486
BMI	0.788	0.001	2.196	1.339	3.448
Blood Pressure	0.648	0.005	1.911	1.217	3.211

Discussion

Identification of impaired stages of fasting and two hour post-prandial blood glucose (which was given the term pre-diabetes) is of growing importance as interference through these stages by modification of its risk factors may delay the occurrence of type two DM [15 & 16]. So it is important to evaluate this metabolic alteration and determine the main risk factors associated with it in our population. Strict life style changes and weight reduction is an effective preventive measure [17].

This is a cross-sectional study and the primary research question was concerned with the prevalence of impaired fasting glucose in Menoufia governorate, Egypt. This study reported the prevalence of undiagnosed DM and impaired glucose tolerance at 4.2%, and 4.4 % respectively, while the isolated impairment of fasting blood glucose was 7.9 % of the studied group. Lower estimate was reported in Latin America; the CARMELA study reported a prevalence of IFG of only 2% [18]. Another study in Taiwan [19], had a prevalence of IFG so much higher (35.8%), while that of a USA study was 26% [20]. In Venezuela, prevalence of undiagnosed DM2 was 8.4% and that of IFG was 19.5% of their study population (2,230 individuals) [15]. Sinnott et al., [19] in their screening study for diabetes and prediabetes in Irish adults, reported a prevalence of IFG at 7.1% which is nearly similar to our finding , but they reported prevalence of undiagnosed diabetes at 1.8 % and 2.9 % for impaired glucose tolerance which is lower than this study. They explained this underestimation of DM type2 by usage of Fasting blood glucose only for screening.

In the current study, IFG was slightly higher in males (52.5) than females (47.5), which constituted no statistical significant difference between normal and impaired fasting groups. This finding disagrees with studies done by [15, 19], who reported significant increase in males and agrees with some other studies [20,21] who reported no significant difference between the sexes.

Highest prevalence of IFG was in the age group > 45 year (55.5%), with significant difference among normal and impaired fasting glucose groups. This result agrees with many studies [15, 19 and 22]. Studies attributed that to aging changes such as waist circumference [23], decreased lean mass [24] and diminished physical activity [25]. Atkins JL et al., explained that by the effect of aging on insulin resistance [24].

This study reveals that higher education was more prevalent among the normal fasting than the impaired fasting group (40.7 % versus 9.1 %). Education constituted a statistical significant difference among groups. Occupation, socioeconomic status, marital status had no statistically significant effect. Hao et al., 2014 [26], reported that impaired fasting glucose was prevalent among those of high socio-economic status in eastern China. Some studies reported no significant association between IFG and socio-economic standard of studied participants [15,22]. Aktar et al., [21] observed a positive association of educational level and socioeconomic standard with diabetes. In contrast, another study in China reported that the prevalence of diabetes was generally unaffected by educational level but was higher in the high-income group [27]. Many studies reported that low prevalence of diabetes in better educated, highly socioeconomic status group may be due to high health conscious level [28 , 29]. Diaz-Redonodo et al.,[6] reported that regarding risk factors of pre-diabetics, no statistically significant differences were found in terms of marital status or region of residence.

Regarding history of the patients, history of hypertension (OR=2.305, 95% CI 1.323 - 4.015), hyper-lipidemia (OR=4.77,95% CI 2.67 - 8.51) and viral hepatitis (OR=2.803,95% CI 1.354 - 5.804) were statistically significantly higher among the IFG group than the normal fasting group. A study reported hypertensive subjects had a 2.33 times higher risk of IFG(6). Bermúdez et al.,[15] found hypertension to be a risk factor for IFG, however this co-relation between hypertension and alteration of IFG depends on other factors different from IR, such as a certain level of chronic inflammation and oxidative stress. Diaz-Redonodo et al.,[6] reported that hypertriglyceridemia and low HDL-Cholesterol levels were also seen to be associated with prediabetes.

The current study showed that receiving medication for hypertension and corticosteroids was statistically significantly higher in the IFG group than the other group (14.1 %,12.1 versus 5.8%, 4.7 respectively) with p value =0.001. This may be attributed to that thiazide diuretics, which are a commonly used antihypertensive medication, could increase insulin resistance, affect glucose utilization, precipitate overt diabetes and worsen diabetes control [30].

Blackburn et al ., 2006 [31] showed that there is evidence indicating that thiazide diuretics and certain beta-blockers exhibit adverse glycemic effects. Wong et al., 2008 [32], showed no significant associations between antihypertensive class and impaired fasting glucose. The therapeutic benefits of glucocorticoids continue to expand across medical specialties, although the incidence of steroid-induced or steroid-exacerbated diabetes continues to rise [33].

In this study, history of current smoking, daily exercising, and relatives with diabetes shows non statistically significant difference between the IFG group and the normal fasting group. Some studies reported that smoking is a risk factor for prediabetes [34,35], however other studies didn't report an association [6,9]. Underestimation of positive family history of diabetes may be due to not enough information among individuals about diagnosed diabetes cases among the first degree relatives, who were not exposed to medical diagnosis before. Although physical exercising is recommended by WHO for protection from diabetes, this study showed no significant effect of it; other studies found the same finding [6,9].

The current study showed that there is a statistically significant difference between the normal and fasting blood glucose group regarding body mass index and blood pressure. This was confirmed by comparing the means; the correlation which was positively increasing with increase of the values of fasting blood glucose. The association between hypertension and prediabetes has been reported in many previous studies [6,9,36]. Some studies [15,20] found similar results regarding significant association of BMI on Fasting blood glucose. This disagrees with Sahai et al., 2011[37], as the notable finding in their study was the significantly higher prevalence of IFG among the low body weight population, raising the possibility of a higher prevalence of insulin deficient state

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In Logistic regression models of risk factors for Impaired Fasting Glucose for the population from Egypt, the risk factors that had the strongest prediction of impaired fasting blood glucose were history of hyper-lipidemia, obese participants and patient education. In the study done by Bermúdez et al.,[15], evaluation of the correlation between risk factors in a logistic regression analysis revealed the presence of insulin resistance to be the most tightly linked risk factor for IFG (OR=2.51; 95%CI=1.79-3.52; p<0.01), followed by age groups (?60 years: OR=2.31; 95%CI=1.23-4.35; p<0.01). Another study in multivariate analysis revealed the odds of developing pre-diabetes were 1.4 times more among those who were above the age of 45 years and 1.5 times more in those who were physically inactive [22].

Conclusion

Blood glucose in its impaired level is not a rare event and its identification in the high risk group as hypertensive

patient, patients with hyperlipidemia individuals > 45 years and obesity is important to deal with and not to ignore.

Recommendations: Based on the findings of this study , it is recommended that screening should be done to the high risk group for impaired fasting blood glucose as those with age > 45 year, with a history of hypertension even if controlled with medications, hyperlipidemia, obesity, sedentary lifestyle and low educated individuals. This group should modify their lifestyle and strictly control their blood pressure to safeguard against type 2 DM.

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