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THE PREVALENCE OF UNRECOGNIZED CASES OF DIABETES MELLITUS AND IMPAIRED FASTING BLOOD GLUCOSE IN PATIENT RECEPTION CENTER IN SULAIMANI TEACHING HOSPITAL

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ABSTRACT

Background: The prevalence of undiagnosed type II diabetes mellitus (DM) and impaired fasting glucose (IFG) is rising globally, often going undetected for years. **Methods:** In this cross sectional study 434 individuals enrolled from August 2012 to April 2013. Those who were diabetic, pregnant, and have history of recent surgery, trauma, or serious illness, were excluded from the study. Random capillary blood glucose were taken from all subjects measured, in the next visit after an overnight fasting, blood glucose, HbA1c, serum total cholesterol, triglyceride, high density lipoprotein were measured by enzymatic method. **Results:** Recently diagnosed diabetes mellitus were seen in 12(2.8%) and impaired fasting in 18(4.1%), who met the criteria of American Diabetes Association for diagnosis of diabetes and impaired fasting glucose (IFG), the mean age of normal group was 39.83±18.1,while mean age of hyperglycemic group (impaired and diabetes), was 50.00±15.2. Also mean BMI for normal was (25.65±4.7) respectively, compare to hyperglycemic group were (29.51±4.9) respectively, there was increase prevalence of hyperglycemia with increase age and this statistically significant with (p=0.003). There was high prevalence of overweight 15(8.6%) and 11(15.7) obese among this group and this statistically significant with (p=0.001). **Conclusion:** Using opportunistic screening for DM in major hospital in Sulaimani, Kurdistan region of Iraq, we detected 2.8% new patients with diabetes undiagnosed, 4.1 % impaired fasting glucose in the screened population.

KEYWORDS: Diabetes Mellitus, Impaired Fasting Blood Glucose**,** Prevalence, Unrecognized Cases**.**

INTRODUCTION

Diabetes Mellitus (DM) encompasses a range of metabolic diseases characterized by high blood sugar levels resulting from insufficient insulin production by the pancreas or an inadequate response of cells to insulin. It is categorized into four main types: type 1, type 2, gestational diabetes, and "other specific types".[1] Type 1 diabetes, caused by the destruction of insulin-producing beta cells, accounts for about 10% of diabetes cases in North America and Europe. It primarily affects individuals without prior health issues and typically presents normal insulin sensitivity in early stages. In contrast, type 2 diabetes, the most prevalent form, features insulin resistance and reduced insulin secretion, with the primary issue being decreased insulin sensitivity in early stages where interventions can reverse hyperglycemia through medications that enhance insulin sensitivity or decrease liver glucose output.[1,2]

Gestational diabetes mellitus (GDM), affecting 2%-5% of pregnancies, has similarities to type 2 diabetes, with possible resolution post-delivery, although a significant percentage of women may develop type 2 diabetes later. Untreated GDM can have adverse effects on both maternal and fetal health. A 2008 U.S. study highlighted a rise in pre-existing diabetes among pregnant women, showing a doubling of rates over six years.[3]

Other diabetes forms arise when body tissue receptors fail to respond to insulin. Genetic mutations, chronic

conditions like pancreatitis or cystic fibrosis, and certain drugs or toxins may lead to diabetes by affecting insulin production or action. As of 2010, approximately 285 million people worldwide were diagnosed with diabetes, primarily type 2, and projections indicate this number could nearly double by 2030, especially in developed nations. However, the highest increases are anticipated in Asia and Africa due to urbanization and adoption of Western dietary habits, although the exact mechanisms remain uncertain.[4,5]

The increasing prevalence of diabetes presents significant challenges in healthcare due to the high number of undiagnosed cases of type 2 diabetes and impaired glucose regulation, which are linked to increased morbidity and mortality rates, particularly from cardiovascular issues. Undiagnosed populations are at risk of complications, emphasizing critical public health concerns. Fasting blood glucose screening is practical, yet should target those with various risk factors for diabetes.[6,7]

Two diabetes screening strategies exist: population-based and opportunistic. Population-based screening assesses diabetes prevalence across an entire population but is usually costly and often inefficient. In contrast, opportunistic screening takes advantage of patient visits to healthcare facilities for timely diagnosis and intervention, typically proving more efficient. Regular screening for type 2 diabetes every three years, using a random blood glucose cut-off of 130 mg/dl, shows a favorable diagnostic yield while minimizing false positives and controlling costs.[8,9]

The American Diabetes Association suggested in 1997 that diabetes screening commence in non-diabetic individuals aged 45 and older, factoring in additional risks such as obesity and inactivity. Early diagnosis via opportunistic screening can lead to a reduction in significant microvascular complications and improve quality-adjusted life years. Notably, pre-diabetes remains largely unrecognized, with about a third of those affected unaware; in 2003, global pre-diabetes prevalence stood at approximately 314 million, expected to rise to 472 million by 2025. Key risk factors encompass family history, obesity, age, hypertension, dyslipidemia, and ethnicity, while metabolic syndrome, affecting about 25% of the U.S. population, further elevates diabetes and cardiovascular risks.[10-12] The study aimed to evaluate the prevalence of undiagnosed diabetes mellitus and impaired fasting blood glucose (IFG) within patients at Sulaimani Teaching Hospital and to examine the correlation between age, body mass index (BMI), and several risk factors concerning IFG and undiagnosed diabetes.

SUBJECTS AND METHODS

In this cross sectional study 434 individuals enrolled from August 2012 to April 2013, the individuals were selected randomly from patient reception in Sulaimani Teaching Hospital (patients and relatives). Written informed consent was taken from all subjects prior to enrollment. Those who were diabetic, pregnant, and those with a history of recent surgery, trauma, or serious illness, were excluded from the study. Each individual was screened only once.

A questionnaire paper prepared by a researcher and reviewed by the supervisors, then a pilot study was done on 20 subjects and according to the pilot study some changes done on the questionnaire. After taken a full demographic data, history of hypertension, history of 1" degree relative of diabetes mellitus, direct interview performed with each subject, phone number were taken from all subject for follow up.

Anthropometric measurement

Standing height and weight measurements were completed with the subjects wearing lightweight clothing and no shoes. Height was measured to the nearest cm and weight was measured to the nearest half kilogram (kg). Body mass index (BMI) was calculated as body weight in kilograms divided by the squared value of body height in meters (kg/m^2).

$$BMI=Wt.(Kg)/Ht.(M^2).$$

Subjects were considered as underweight if their BMI (<18.50) kg/m^2, normal weight if their BMI (18.50-24.99) kg/m, overweight if their BMI (25.00-29.99) kg/m2, obese if their BMI (≥30.00) kg/m^2.[13]

Diabetes Screening Protocol

Random Capillary Blood Glucose (RCBG) were taken from all subjects measured with a blood glucose meter (finger prick capillary), and to confirm the reading of glucose meter we make a comparison between laboratory reading and glucose meter reading on 20 subjects.

Those with random plasma glucose levels equal to or more than 140 mg/dl were considered as abnormal. Patient follow up occur by researcher and supervisor, we call those who considered abnormal and in the next visit, blood pressure in the left arm was measured using mercury sphygmomanometer after the subject had been seated for at least 5 minutes. Venous blood samples were sent to the Central Laboratory of Sulaimani/Directorate of health (DOH) after an overnight fasting, blood glucose, HbA1c, serum total cholesterol, triglyceride, high density lipoprotein (HDL), were measured by enzymatic method, and low density lipoprotein (LDL) calculated by Friedewald formula,

LDL (mg/dl)-TC-(1IDL-TG/5)

Testing criteria for diagnosis of diabetes mellitus and impaired fasting glucose (IFG) according to American Diabetes Association (ADA) Guideline for diabetes diagnosis (2013):

1. A fasting plasma glucose of ≥ 126 mg/dl (7.0 mmol/l) (after no caloric intake for at least 8 hours) or

2. A casual plasma glucose ≥200 mg/d (11.0 mmol/l) (taken at any time of day without regard to time of last meal) with classic diabetes symptoms increased unnation. increased thirst and unexplained and unexplained weight loss. The committee states that the fasting plasma glucose is the preferred test and recommends moving toward its universal use for testing and diagnosis because of its ease of administration, convenience, acceptability to patients, and lower cost in comparison to the OGTT
3. The committee defined a fasting plasma glucose value of 99 mg/dl as the upper limit of normal blood glucose. The committee also recognized two categories of impaired glucose metabolism that are considered risk factors for future diabetes and cardiovascular disease.

1. Impaired Fasting Glucose (IFG), a new category, when fasting plasma glucose is between 100 and 125 mg/dl (5.6-6.9) mmol/.
2. Impaired Glucose Tolerance (IGT) is when 2-hour sample results of the oral glucose tolerance test are between 140 and 199 mg/d (7.8-11.0) mmol/1.
3. Individuals with an HAle of 5.7-6.4% should be informed of their increased risk for diabetes as well as CVD and counseled about effective strategies to lower their risks.[14]

Statistical Analysis

Statistical Analysis was performed using Statistical Package for Social Science (SPSS) software version (16.0) Mean and there standard deviation (SDs) were used for the continuous variable, and frequencies and percentages were used for categorical variable in the analysis. Chi square, ANOVA, t-test w- as used to calculated p-value, p-value was considered to be statistically significant at <0.05 Spearman correlation analysis was used to estimate the relationship of related variables with the fasting plasma.

RESULTS

The total study sample was 434, with age range was from (12-90) year, patient were between age (20-29) year 104(24.0%), the men were 199(45.9%) and 235(54.1%) were women, furthermore 76.0% of the participant live in the urban compared with rural area 24.0%, the highest percentage of study sample 38.9% was housewife while the worker represent 22.4%, and clerks, student and old age were represent 18.4, 13.4, 6.9 respectively, nearly 3/4 of sample were married compared to the single subject were 1/4 of the sample, as show in table (3:1).

Table (1): Demographic characteristics of the sample.

Variables		No.	%
Age groups (years)	12-19	43	9.9
	20-29	104	24.0
	30-39	77	17.7
	40-49	70	16.1
	50-59	65	15.0
	60-69	37	8.5
	70-79	22	5.1
	80-90	16	3.7
Gender	Males	199	45.9
	Females	235	54.1
Residence	Urban	330	76.0
	Rural	104	24.0
Occupations	clerks	80	18.4
	Workers	97	22.4
	House wife	169	38.9
	Student	58	13.4
	Old age	30	6.9
Participants types	Patients	286	65.9
	Relatives	148	34.1
Marital status	Single	117	27.0
	Married	317	73.0

In this study positive family history of diabetes found in 108(24.9%) of the study sample, and history of hypertension found in 121(27.9%) subject, overweight and obsess represent 245(56.4%), while normal and underweight represent 189(43.6%), this some of risk factors of diabetes mellitus show in table (2).

Table (2): Characteristics of some risk factors for diabetes mellitus.

Variables		No.	%
Family history of diabetes mellitus	Positive	26	75.1
	Negative	108	24.9

History of hypertension	Positive	313	72.1
	Negative	121	27.9
Body mass index	Underweight	15	3.5
	Normal	174	40.1
	Overweight	175	40.3
	Obese	70	16.1

Table (3) showed the characteristics of diagnostic tests for DM, the 1st test made for all the study sample is RBS and show 50(12.0%) subjects considered as abnormal, 38(8.8%) impaired, 12(2.8%) diabetes and 384(88.5%) were normal, 2nd test is FBS was done only for subject who considered as abnormal after 1st test (50 subjects), and this showed 20(4.6%) normal, 18(4.1%) impaired fasting glucose and 12(2.8%) diabetes, to confirm the diagnosis 3rd test was done HbA1c and this showed that 20(4.6%) were normal, 17(3.9%) impaired, 13(3.0%) diabetes.

Table (3): Characteristics of diagnostic tests for DM.

Tests	Criteria	No,	%
Random blood glucose (RBG)	Normal RBG <140 mg/dl	384	88.5
	Impaired RBG (140-199) mg/dl	38	8.8
	Suspected diabetes ≥200mg/dl	12	2.8
Fasting blood glucose	No FBG readings	384	88.5
	Normal FBG ≤99 mg/dl	20	4.6
	Impaired FBG (100-125) mg/dl	18	4.1
	Diabetes ≥126mg/dl	12	2.8
HbA1c	No HbA1c readings	384	88.5
	Normal <5.6%	20	4.6
	Impaired (5.7-6.4)%	17	3.9
	Diabetes ≥6.5%	13	3.0

Among the 50 cases with abnormal glucose level after RBS exam confirmatory test on 2nd exam reviewed IFG 36.0%, diabetes 24.0%, and normal 40.0% as shown in figure (3).

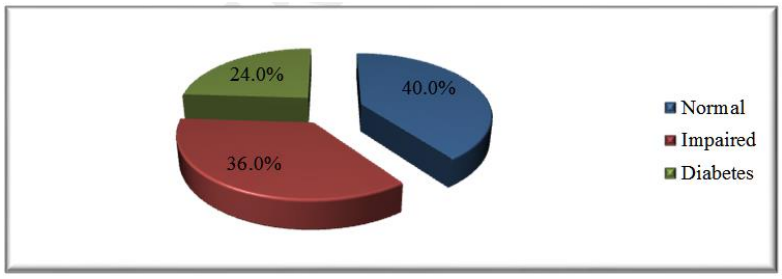

Figure (3): Distribution of studied sample according to ADA criteria.

Table (4) showed a comparison in mean ±standard deviation between normal and hyperglycemic group, the mean age of normal group was 39.83±18.1, while mean age of hyperglycemic group was 50.0±15.2. Also, mean weight and mean BMI for normal was (70.39±14.7, 25.65±4.7) respectively, compare to hyperglycemic group were (80.83±13.2, 29.51±4.9) respectively.

Table (4): Comparison in mean ±standard deviation between normal and hyperglycemic group.

	Group of blood sugar Mean ±SD	
	Abnormal (n=30)	**Normal (n=404)**
Age (year)	50.0±15.2	39.83±18.1
Body mass index	29.51±4.9	25.65±4.7
Random blood sugar (mg/dl)	197.57±59.1	108.88±20.5

Distribution of new hyperglycemic group by age in table (5), there was increase prevalence of hyperglycemia with increase age and this was statistically significant with (p=0.003), prevalence of recent hyperglycemia more among those at age of (40-49) years 10(33.3%), and 13(43.4%) above 50 years.

Table (5): Prevalence of hyperglycemic groups by the age.

Age groups (years)	Normal No.(%)	Abnormal No.(%)	Total No.(%)	p-value *
12-19	43(10.6)	0(0.0)	43(9.9)	**0.003**
20-29	102(25.2)	2(6.7)	104(24.0)	
30-39	72(17.8)	5(16.7)	77(17.7)	
40-49	60(14.9)	10(33.3)	70(16.1)	
50-59	61(15.1)	4(13.3)	65(15.0)	
60-69	32(7.9)	5(16.7)	37(8.5)	
70-79	20(5.0)	2(6.7)	22(5.1)	
80-90	14(3.5)	2(6.7)	16(3.7)	
Total	**404**	**30**	**434**	

***t-test**

Table (6) showed the BMI classes distribution among hyperglycemic group where there was high prevalence of overweight 15(8.6%) and 11(15.7%) obese among this group and this statistically significant with (p=0.001).

Table (6): Prevalence of hyperglycemic group among body mass index classes.

BMI classes	FBG groups		Total No.(%)	p-value *
	Normal No.(%)	Abnormal No.(%)		
Underweight	15(100.0)	0(0.0)	15(100.0)	0.001
Normal	170(97.7)	4(2.3)	174(100.0)	
Overweight	160(91.4)	15(8.6)	175(100.0)	
Obese	59(84.3)	11(15.7)	70(100.0)	
Total	404(93.1)	30(6.9)	434(100.0)	

***t-test**

Table (7) showed that one way t-test using to compare means of lipid profile of hyperglycemic group with cut value according to national cholesterol education program adult treatment panel III (NCEP ATP III). Approach to estimated hyperlipidemia, the mean and SD for LDL was 114.3±30.6 with significant p-value (0.009), the mean ±SD of HDL, TC, and TG were 45.43±118.12, 210±32.87, and 193±118.11 respectively which was above the normal level but with no significant p-values

.

Table (7): One way t-test for lipid profile for hyperglycemic group.

Investigations	Mean	Standard deviation	p-value*
LDL (mg/dl)	114.30	30.65	**0.009**
HDL (mg/dl)	45.43	118.12	0.066
TC (mg/dl)	210	32.87	0.099
TG (mg/dl)	193	118.11	0.055

*t-test

Within the hyperglycemic group (diabetes and impaired), the mean ±SD of the systolic blood pressure in impaired patient was 131.9±17.3 and this lower than that of diabetic patient which was 145.6±19.1 with significant (p=0.024), and for diastolic blood pressure the mean ±SD of impaired patient was 82.8±7.6, which was lower than that of diabetic patient which was 92.5±10.9 with highly significant (p=0.001). For lipid profile the mean of (LDL, HDL, TG, TC) for two group was above the normal level of (NCEP ATP III), and this for diabetes group was relatively higher than impaired with no significant p value, this difference between diabetes and impaired subject show in table (8).

Table (8): Comparison between impaired RBS and suspected diabetes.

Investigations	Studied groups Mean ±SD		p-value*
	Impaired RBS (n=38)	Suspected diabetes (n=12)	
SBP (mmHg)	131.9±17.3	146.6±19.1	**0.024**
DBP (mmHg)	82.8±7.6	92.5±10.9	**0.001**
LDL (mg/dl)	109.7±31.3	102.5±19.3	0.453
HDL (mg/dl)	46.3±12.0	46.7±15.1	0.921

TG (mg/dl)	171.5±108.0	175.2±53.1	0.909
TC (mg/dl)	201.1±39.1	211.9±29.6	0.381

*Independent t-test for two means

Figure () showed screening parameters of random blood sugar as screening test, the sensitivity and specificity of random blood sugar was 66.0%, 95.0% respectively, with accuracy 93.0% and with positive predictive value 8.0% negative predictive value 9.0% and this result was among all studied groups.

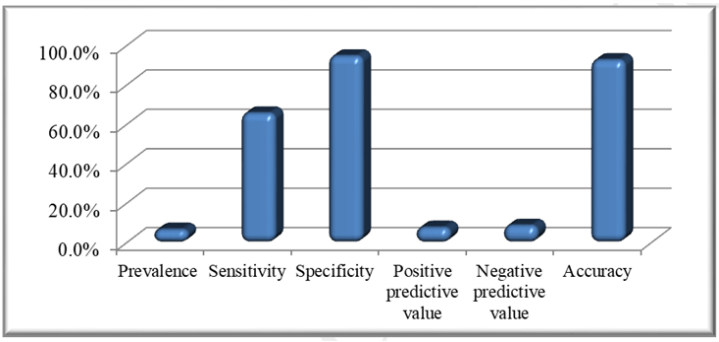

Figure (2): Screening parameters of random blood sugar.

DISCUSSION

In this cross sectional study in Sulaiman population its found the percentage of impaired fasting glucose was 4.1% and Undiagnosed Diabetes Mellitus (UN DM) was 3%. There are little data available about the prevalence of undiagnosed diabetes in this region, but in Baghdad city AL- Timimi et al.,[15] the frequency of IGT was 17.8% and 3.7% for UN DM. They measured both FBG and then made OGTT for all patient who FBG < 6.1 mmol for diagnosis of IGT, whereas in this study its use RBG and FBG for that purpose. In Basrah city Mansour et al., [16] UN DM found in (6.7%), in sample size (15505). In Turkey Satman et al.,[17] in population-based study of diabetes (according to the WHO recommendation) prevalence of UN DM was 2.3%and impaired was 6.7% were used FBG and OGTT for diagnosis and with sample size 29,050 and this large sample size different from our study. In Iran Hadaegh, [18] Tehran lipid and glucose study prevalence of UN DM and IFG was 4.9%, 7.3% respectively in sample size 9,489 and also measured FBO and OGTT.

In a population-based study, sample (n= 1653) from Southern Germany Rathmann et al.,[19] 2.0% for newly detected diabetes, 2.9% for IFG, 6.3% for IGT and 1.1% for combined IFG/GT, result of this study show that the prevalence of IFG is less than IGT for the same sample, and this go with this study that prevalence of IFG is less than IGT in other studies. The association between diabetes and gender has been the focus of several studies with inconsistent results[20,21] In this study its found female percentage of IFG is more than males (55.6% vs. 44.4%) while in UN DM males three times more than females (75%vs25%), and this gender different was not significant(p=0.084), In Turkey study Satman et al.,[17] also women higher than male in IFG and male higher in UN DM, which were consistent with this study.

In many studies, it was reported that the prevalence of diabetes increased with age (21,22), In the current study, in both genders, prevalence of undiagnosed diabetes and IFG Increased with age, whereas the high prevalence of IFG and UN DM found in age above 40 (76.7%) compared to the young group (23.4%) and this increase in prevalence with the age is significant (p=0.003), this result go with study in Baghdad AL- Timimi et al.,[15] And another study Mansour, et al.,[16] show that mean age was higher in diabetes than non-diabetes and this also go with this study.

In studied population, the risk confirmed by the high level of BMI found in a large proportion of the studied sample. Indeed (56.4%) of the subject were overweight and obese. This observation was noted before in study of AL- Timimi et al.,[15] The relationship between glucose levels and BMI was highly significant (p<0.001), thus its found that overweight and obese subject had higher prevalence of IFG and UN DM, and this goes with a study of AL- Timimi et al.,(15), Mansour et al.,[16] and Satman et al.,[17]

Hypertension had significant association with diabetes in this study for both systolic and diastolic blood pressure (p=0.024,0.001) respectively, and this result go with study Mansour et al.,(16) and Satman et al.,[17]

Also in this study the result suggest of LDL strongly related with hyperglycemia (p=0.009), also its found that the mean of TC, TG was above normal limit in hyperglycemic group and lower in HDL according to National Cholesterol Education Program Adult Treatment Panel II Approach to Dyslipidemias),[23] but this result statistically not significant. Although in other reported, that TG was more correlated to diabetes than LDL. in Chinese population.[24]

The association between blood pressure, hyperlipidemia and hyperglycemia can probably be related to the metabolic syndrome, Ferranin et al.,[25]

In the present study, its found that elevated TC,TG, LDL, low HDL obesity (BMI), hypertention. were important predictors of hyperglycemia which is a key representation of metabolic syndrome.[12] Risk of developing type 2 diabetes is five time more likely in individual with metabolic syndrome.[26]

In this study its found that RBG as screening test having specificity (95%), and sensitivity (66%) based in the diagnosis on FBG, and this agree with A recent expert panel recommended a similar cut-off point, an RBG 2 130 mg/dl, which has a more balanced sensitivity (63%) and specificity (87%), based on diagnosis by OGTT (27).The commonly held RBG threshold is ≥ 200 mg/dl, along with symptoms of polyuria, polydipsia, and unexplained weight loss to indicate a second test for confirmation of diagnosis. A RBG of 140-199 mg/dl is suggestive of pre-diabetes.[28] Based on diagnosis by OGTT, a RBG 200 mg/dl is insensitive but has a specificity approaching 100%, which, in the setting of symptoms, is unlikely to lead to a false-positive diagnosis.[29]

CONCLUSION

Using opportunistic screening for diabetes mellitus (DM) in a major hospital in Sulaimani, Kurdistan, Iraq, it was found that 2.8% of new patients were undiagnosed with diabetes and 4.1% had impaired fasting glucose. Key risk factors identified include age above 40, obesity, hypertension, and dyslipidemia. The random blood glucose (RBG) test demonstrated a specificity of 95%, sensitivity of 66%, and accuracy of 93%. Follow-up on 50 subjects with RBS >140 revealed that 38 met the WHO criteria for metabolic syndrome.

Limitation of the study

Several limitations of this study include; its cross-sectional design, making it challenging to establish causality between risk factors and outcomes. A limited sample size of 434 participants due to the study's time constraints. All cases are drawn from Sulaimani city, potentially limiting generalizability to other regions. Also, challenges in patient follow-up, particularly with older participants, those from rural areas, and individuals disinclined to cooperate.

REFERENCES

1. Rother KI. Diabetes treatment-bridging the divide. The New England Journal of Medicine, 2007; 356(15): 1499-501.
2. Gardner DG, Shoback DM, Greenspan FS. Greenspan's Basic and Clinical Endocrinology. 9th Ed. New York: McGraw-Hill Medical, 2011; 560.
3. Lawrence JM, Contreras R, Chen W, Sacks DA. Trends in the prevalence of preexisting diabetes and gestational diabetes mellitus among a racially/ethnically diverse population of pregnant women, 1999-2005. Diabetes Care, 2008; 31(5): 899-904.
4. Melmed S, Polonsky KS, Reed P, Kronenberg HM. Williams textbook of endocrinology (12th ed.). Philadelphia: Elsevier/Saunders, 2012; 1371-1435.
5. Wild S, Roglic G, Green A, Sicree R, King H. Global prevalence of diabetes: Estimates for the year 2000 and projections for 2030. Diabetes Care, 2004; 27(5): 1047-1053.
6. Franse LV, Di Bari M, Shorr RI, Resnick HE, van Eijk JT, Bauer DC, et al. Type 2 diabetes in older well-functioning people: who is undiagnosed? Data from the Health, Aging, and Body Composition study. Diabetes Care, 2001; 24(12): 2065-2070.
7. Unwin N, Shaw J, Zimmet P, Alberti KG. Impaired glucose tolerance and impaired fasting glycaemia: the current status on definition and intervention. Diabet. Med., 2002; 19(9): 708-723.
8. Engelgau MM, Narayan KM, Herman WH. Screening for type 2 diabetes. Diabetes Care, 2000; 23(10): 1563-1580.
9. Johnson SL, Tabaei BP, Herman WH. The efficacy and cost of alternative strategies for systematic screening for type 2 diabetes in the U.S. population 45-74 years of age. Diabetes Care, 2005; 28(2): 307-311.
10. Saudek CD, Herman WH, Sacks DB. A new look at screening and diagnosing diabetes mellitus. J. Clin. Endocrinol Metab., 2008; 93: 2447-53.
11. Eldin WS, Emara M, Shoker A. Prediabetes: a must to recognize disease state. Int. J. Clin. Pract., 2008; 62: 642-648.
12. Grundy SM, Brewer HB, Cleeman J, Smith SC, Lenfant C. Definition of Metabolic Syndrome Report of the National Heart, Lung and Blood Institute/American Heart Association Conference on Scientific Issues Retated to Definition Circulation, 2004; 109: 433-438.
13. WHO Expert Consultation. Appropriate body mass index for Asian populations and its implication for policy and intervention strategies, Lancet., 2004; 363: 157-163.
14. American Diabetes Association: Standards of medical care in diabetes, ADA Guideline criteria for diabetes diagnosis 2013. Diabetes Care, 2013; 36(suppl 1): S11-$66.
15. Al-Timimi DJ and Al-Ubaidy AK. The frequency of 2 hours post glucose loud hyperglycemia in subject with normal fasting glucose. Dohuk Medical J., 2007; 1(1): 105-110.
16. Mansour AA, Wanoose HL, Hani I, and Abed-Alzahrea A. Diabetes screening in Basrha, Iraq: a population -based cross-sectional study. Diabetes Res. Clin. Pract., 2008; 79(1): 147-50.
17. Satman I, Yilmaz T, Sengul A, Salman S, Salman F, Uygur S, et al. Population-based study of diabetes and risk characteristics in Turkey: results of the turkish diabetes epidemiology study (TURDEP). Diabetes Care., 2002; 25(9): 1551-1556.

18. Hadaegh F, Bozorgmanesh MR, Ghasemi A, Harati H, Saadat N, and Azizi F. High prevalence of undiagnosed diabetes and abnormal glucose tolerance in the Iranian urban population: Tehran Lipid and Glucose Study BMC Public Health, 2008; 8: 176.
19. Rathmann W, Haastert B, leks A, Lowel H, Meisinger C, Holle R, et al. High prevalence of undiagnosed diabetes mellitus in Southern Germany: target populations for efficient screening. The KORA survey 2000. Diabetologia, 2003; 46(2): 182-189.
20. Ramachandran A, Snehalatha C, Satyavani K, and Vijay V. Impaired fasting glucose and impaired glucose tolerance in urban population in India. Diabet. Med., 2000; 20(3): 220-224.
21. Ramachandran A, Snehalatha C, Kapur A, Vijay V, Mohan V, Das AK, et al. High prevalence of diabetes and impaired glucose tolerance in India: National Urban Diabetes Survey. Diabetologia, 2001; 44(9): 1094-1101.
22. Ozdemir L, Topcu S, Nadir I, Nur N, Arslan S, and Sumer H. The prevalence of diabetes and impaired glucose tolerance in Sivas, Central Anatolia, Turkey. Diabetes care, 2005; 28(4): 795-798.
23. Third Report of the Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults. National Institutes of Health, National Heart, Lung, and Blood Institute, Implications of recent clinical trials for the National Cholesterol Education Program Adult Treatment Panel III guidelines. Circulation, 2004; 110: 227-239.
24. Yun Q, Yudi L, Tiemei Z, Jianling B, Feng C, and Yi Z. The characteristic of impaired fasting glucose association with obesity and dyslipidaemia in a Chinese population. BMC Puplic Health, 2010; 10: 139.
25. Ferrannini E, Buzzigoli G, Bonadonna R, Giorico MA, Oleggini M, Graziadei L, et al. Insulin resistance in essential hypertention. N. Engl J.Med., 1987; 17: 350-357.
26. Stem M, Williams K, and Gonzalez-Villalpando C. Dose the metabolic syndrome improve identification of individuals at risk of type 2 diabetes and /or cardiovascular disease? Diabetes Care, 2004; 27(11): 2676-2681.
27. Tabaei BP and Herman WH. A multivariate logistic regression equation to screen for diabetes. development and validation. Diabetes Care, 2002; 25.
28. Expert Committee on the Diagnosis and Classification of Diabetes Mellitus: Report of the Expert Committee on the Diagnosis and Classification of Diabetes Mellitus. Diabetes Care, 1997; 20: 1183-1197.
29. Ziemer DC, Kolm P, Foster JK, Weintraub WS, Vaccarino V, Rhee MK, et al. Random plasma glucose in serendipitous screening for glucose intolerance: screening for impaired glucose tolerance study. J. Gen. Intern. Med., 2008; 23: 528-535.