# Is It Reasonable to Screen for Undiagnosed Diabetes and Prediabetes in Asymptomatic Individuals? A Sample from Baghdad

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**ABSTRACT:**

**BACKGROUND:**

Diabetes Mellitus is a complex chronic illness that has increased significantly around the world and is expected to affect 628 million in 2045. Undiagnosed type 2 diabetes may affect 24% - 62% of the people with diabetes; while the prevalence of prediabetes is estimated to be 470 million cases by 2030.

**AIM OF STUDY:**

To find the percentage of undiagnosed diabetes and prediabetes in a slice of people aged ≥ 45years, and relate it with age, gender, central obesity, hypertension, and family history of diabetes.

**METHODS:**

A cross sectional study that included 712 healthy individuals living in Baghdad who accepted to take part in this study and fulfilling the inclusion and exclusion criteria.

**RESULTS:**

From total 712 healthy participants, 373 (52.4%) screened negative for diabetes, 178 (25.0%) screened positive for diabetes and 161 (22.6%) had impaired fasting glucose. There was significant relation with central obesity, family history for diabetes and hypertension.

**CONCLUSION:**

It was concluded that screening for type 2 diabetes and prediabetes is reasonable, both conditions are common in people living in Baghdad and should be considered especially in people aged ≥45 years and those who are obese, have hypertension, and have a positive family history for diabetes.

**KEYWORDS:** Diabetes, prediabetes, screening.

## INTRODUCTION:

Diabetes Mellitus (DM) is a complex chronic illness that represents a group of metabolic disorders that cause hyperglycemia, with significant increase in prevalence around the world, from 30 million affected person in 1985 [1]; 424 million in 2017 and is anticipated to reach 628 million in 2045, with Type 2 DM represents 90% -95% of the cases [2]. This increase in prevalence is attributed to unhealthy diet, sedentary lifestyle, obesity, urbanization, aging or/and genetic factors [3], And it includes Iraq, as the prevalence of DM is 9.3% based on survey that was done in 2006-2007 reported by the International Diabetes Federation (IDF) in 2011 [4,5]. DM implies a significant burden on the society, individuals and health care system due to economic concerns regarding treatment, managing complications, disability, and productivity loss [1]. As it's a leading cause of blindness [2,6], nephropathy [2,7], neuropathy and cardiovascular diseases [8,9,10]. According to the WHO global report on diabetes 2016 "the percentage of undiagnosed type 2 diabetes differs widely – a recent data review from many countries revealed that between 24% to 62% of people who have diabetes were undiagnosed and untreated" this high proportion even involves high-income countries where the percentage of undiagnosed DM may be as high 30–50% [11]. This delay in diagnosis carries high risks, because these patients remain untreated for unknown period of time and are under the risk of developing the complications of diabetes [12,13] with possibility to prevent these complications by early diagnosis and intervention [14], so it is reasonable to say that screening programs is important to help in early diagnosis [15].

The American Diabetes Association (ADA) has recommended screening population for diabetes, this includes any adult with risk factors, all adults aged 45 years or older even if they don't have risk factors, and also these criteria include testing for prediabetes (Table 1) [14].

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**Table 1: ADA criteria for diabetes and prediabetes screening in adults 2018 (summarized).**

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|---|
| 1. Testing is considered in adults who have overweight or obese of any age and have the following risk factors: |
| • A1C ≥ 5.7% (39 mmol/mol), Impaired Glucose Tolerance (IGT), or Impaired Fasting Glucose (IFG) on previous testing |
| • first-degree relative with diabetes |
| • hypertension |
| • sedentary lifestyle |
| 2. Screening should be done for all people aged 45 years and more. |
| 3. Testing can be done by taking fasting plasma glucose (FPG), or by A1C as they are equally appropriate. |

Many risk factors play a role in diabetes prevalence, like age at 45 years or more [16], obesity with excess abdominal fat [17], hypertension because it coexists frequently with diabetes [14,18], and family history of diabetes (1). our study aims to estimate the percentage of patients with undiagnosed diabetes and prediabetes in a sample of people living in Baghdad aged ≥ 45years. And to study their relation with age, gender, central obesity, hypertension, and positive family history of diabetes.

## PATIENTS AND METHODS:

A cross sectional study was done in Baghdad Teaching Hospital, Medical City, from the 1st of march 2017 to 28th of February 2018. The studied sample included a total of 712 healthy persons who are patient's relatives at Baghdad Teaching Hospital. They were enrolled in this study after accepting to take part in this study and fulfilling the inclusion and exclusion criteria.

**Inclusion criteria:**

- Any adult aged 45 years or more, who didn't know if he has diabetes or not.
- Living in Baghdad.
- Those who complied with the overnight fasting (≥ 8 hours) agreement.

**Exclusion criteria:**

- Diabetics
- Pregnant women
- Participants on some medications, like glucocorticoids, thiazides, and atypical antipsychotics.

DATA collection was done by Interviewer administered questionnaire, to obtain information about patients' socio-demographic data, a detailed history including family history of diabetes and personal history of hypertension. Waist circumference and when needed blood pressure is measured, then an appointment was given for the next day to take overnight fasting blood sample. For central obesity by waist circumference, we used the revised IDF 2005 (rIDF) criteria, which states that males and females with waist circumference ≥ 94 cm, ≥ 80 cm have central obesity; respectively, which is recommended to be used in the Arab population until more specific data is available (19). The participants were considered to have hypertension if they were on treatment or their measured blood pressure was ≥140/90 mmHg (14). FPG was used for screening in this study as it is more convenient and according to the National Health and Nutrition Examination Survey data which indicated that FPG values can identify as many as one-third more undiagnosed patients of diabetes compared with A1C levels (16). Screening people was based on point 2 of the ADA Criteria for screening for diabetes or prediabetes in asymptomatic individuals (Table 1). Diabetes is considered when FPG ≥126 mg/dL. Fasting is defined as no caloric intake overnight for 8 hours or more. And prediabetes when FPG 100 mg/dL to 125 mg/dL (IFG) (14).

**Ethical considerations**

1. Ethical approval was derived from the Arab Board for Health Specialties.
2. Confidentiality was applied.
3. An oral consent was taken from the participants.
4. Participants who screened positive for diabetes and prediabetes were referred to the endocrine and diabetes clinic/Baghdad teaching hospital for management.

**Statistical analysis**

Analysis of data done by using the statistical package of SPSS-24 (Statistical Packages for Social Sciences- version 24). results presented in simple measures of frequency, percentage, mean, standard deviation, and range (minimum to maximum values). The significance of difference of different means (quantitative data) was tested using Students-t-test for difference between two independent means or ANOVA test for difference among more than two independent means. The significance of difference of different percentages (qualitative data) were tested using Pearson Chi-square test ($x^2$-test) with application of Yate's correction or Fisher Exact test whenever applicable. Statistical significance was considered whenever the P value was equal or less than 0.05.

## RESULTS:

The total enrolled participants were 712, of which 350 were males (49.2%) and 362 were females (50.8%). Their age range is 45-84years. (Table 2). From the total 712 participants, 178 participants screened positive for diabetes, representing (25%) of the sample. 161 participants found to have impaired fasting glucose (IFG), representing (22.6%) of the sample, and the rest 373 participants screened negative for diabetes, representing (52.4%) of the sample. 560 participant (78.7%) had Central obesity according to the rIDF criteria, 234 participant (32.9%) had family history of DM and 212 (29.8%) had hypertension. (Table 3, Figure 1)

**Table 2: Demographic data of the screened participants in Baghdad Teaching Hospital.**

| | | No | % |
|---|---|---|---|
| Gender | Male | 350 | 49.2 |
| | Female | 362 | 50.8 |
| Age (years) | 45---49 | 220 | 30.9 |
| | 50---54 | 134 | 18.8 |
| | 55---59 | 100 | 14.0 |
| | 60---64 | 98 | 13.8 |
| | 65---69 | 62 | 8.7 |
| | 70---74 | 46 | 6.5 |
| | 75---79 | 24 | 3.4 |
| | 80---84 | 28 | 3.9 |

**Table 3: Clinical characteristics of the screened participants in Baghdad Teaching Hospital.**

| Clinical characteristics | | No. | % |
|---|---|---|---|
| FPG (mg/dL) | Screened negative for DM | 373 | 52.4 |
| | IFG | 161 | 22.6 |
| | Screened positive for DM | 178 | 25.0 |
| Waist circumference (cm) Central obesity according to rIDF | Yes | 560 | 78.7 |
| | No | 152 | 21.3 |
| Family history of DM | Yes | 234 | 32.9 |
| | No | 478 | 67.1 |
| Hypertension | Yes | 212 | 29.8 |
| | No | 500 | 70.2 |

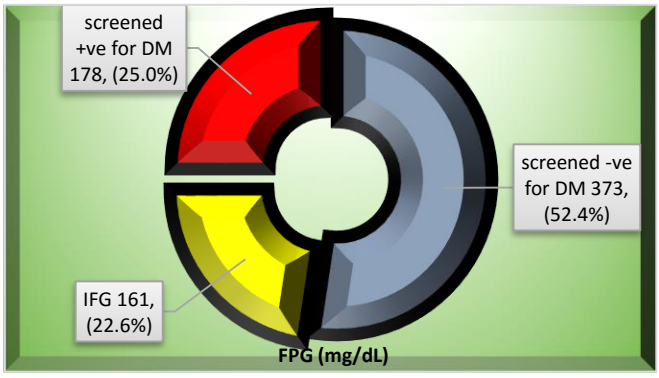


**Figure 1: Distribution of the participants according to FPG results in Baghdad Teaching Hospital.**

FPG (mean SD), is higher in males than females with a significant relation (P value 0.012), also the (mean SD) regarding the age, being highest at age range of 70-74 years (mean SD 126±62), followed by age range of 65-69 years (mean SD 122±55) and the rest is illustrated in (table 4) (P value 0.005). Also, it is higher in centrally obese participants than those who don't have central obesity with a significant relation (P value 0.019). Also, the (mean SD) is higher in participants with family history of diabetes than those with negative family history with a highly significant relation (P value 0.0001), and finally the FPG, although higher in participants with hypertension than those who don't have hypertension but with no significant relation (P value 0.074) (Table 4). From the 178 screened participants who screened positive for diabetes, 55.6% were males and 44.4% were females with no significant relation (P value 0.099). The relation of age categories to FPG results, there was no significant difference among the different age categories (P value 0.100). While 86.5% of the participants who screened positive for DM had central obesity with a significant relation (P value 0.007). Family history was positive in 50.6% of the participants who screened positive for diabetes, and negative in 78.6% of the participants who screened negative for diabetes with a highly significant relation (P value 0.0001). Hypertension is positive in 40.4% of the participants who screened positive for diabetes and negative in 73.5% of the participants who screened negative for diabetes with a significant relation (P value 0.002) (Table 5).

**Table 4: Mean SD of FPG distribution in relation to demographic data and clinical characteristics.**

| | | FPG (mg/dL) | | P value |
|---|---|---|---|---|
| | | No | Mean±SD (Range) | |
| Gender | Male | 350 | 116.05±41.84 (72-375) | 0.012* |
| | Female | 362 | 109.16±30.56 (75-380) | |
| Age (years) | 45---49 | 220 | 107.47±23.78 (81-208) | 0.005# |
| | 50---54 | 134 | 116.34±45.37 (75-380) | |
| | 55---59 | 100 | 113.73±25.44 (75-196) | |
| | 60---64 | 98 | 108.82±29.80 (72-245) | |
| | 65---69 | 62 | 122.42±55.01 (80-375) | |
| | 70---74 | 46 | 126.26±62.75 (87-370) | |
| | 75---79 | 24 | 108.67±20.39 (90-147) | |
| | 80---84 | 28 | 102.00±19.46 (89-167) | |
| Waist circumference (cm) (rIDF) | Central obesity | 560 | 114.22±38.32 (79-380) | 0.019* |
| | No central obesity | 152 | 106.37±29.15 (72-240) | |
| Family history of DM | Yes | 234 | 122.31±42.52 (75-380) | 0.0001* |
| | No | 478 | 107.77±32.45 (72-375) | |
| Hypertension | Yes | 212 | 116.31±36.82 (79-375) | 0.074 |
| | No | 500 | 110.95±36.54 (72-380) | |
| *Significant difference between two independent means using Students-t-test at 0.05 level | | | | |
| #Significant difference among more than two independent means using ANOVA-test at 0.05 level | | | | |

**Table 5: FBS categories according to different associated factors, Baghdad Teaching Hospital.**

| Characteristics | | FBS (mg/dL) | | | | | | P value |
|---|---|---|---|---|---|---|---|---|
| | | Screened -ve for DM | | IFG | | Screened +ve for DM | | |
| | | No | % | No | % | No | % | |
| Gender | Male | 171 | 45.8 | 80 | 49.7 | 99 | 55.6 | 0.099 |
| | Female | 202 | 54.2 | 81 | 50.3 | 79 | 44.4 | |
| Age (years) | 45---49 | 129 | 34.6 | 40 | 24.8 | 51 | 28.7 | 0.100 |
| | 50---54 | 72 | 19.3 | 26 | 16.1 | 36 | 20.2 | |
| | 55---59 | 46 | 12.3 | 23 | 14.3 | 31 | 17.4 | |
| | 60---64 | 50 | 13.4 | 28 | 17.4 | 20 | 11.2 | |
| | 65---69 | 26 | 7.0 | 18 | 11.2 | 18 | 10.1 | |
| | 70---74 | 18 | 4.8 | 14 | 8.7 | 14 | 7.9 | |
| | 75---79 | 12 | 3.2 | 6 | 3.7 | 6 | 3.4 | |
| | 80---84 | 20 | 5.4 | 6 | 3.7 | 2 | 1.1 | |
| Waist circumference (cm) (rIDF) | obesity | 279 | 74.8 | 127 | 78.9 | 154 | 86.5 | 0.007* |
| | No obesity | 94 | 25.2 | 34 | 21.1 | 24 | 13.5 | |
| Family history of DM | Yes | 80 | 21.4 | 64 | 39.8 | 90 | 50.6 | 0.0001* |
| | No | 293 | 78.6 | 97 | 60.2 | 88 | 49.4 | |
| Hypertensive | Yes | 99 | 26.5 | 41 | 25.5 | 72 | 40.4 | 0.002* |
| | No | 274 | 73.5 | 120 | 74.5 | 106 | 59.6 | |
| *Significant difference between proportions using Pearson Chi-square test at 0.05 level | | | | | | | | |

## DISCUSSION:

712 participants who are healthy and not known to have diabetes were screened for diabetes and prediabetes, 362 (50.8%) were women, and 350 (49.2%) were men, aged ≥ 45 to ≤ 84 years. 178 (25%) of all participants screened positive for diabetes, this falls within the global range reported by the WHO (24% to 62%) [11], and the global range of 24.1% to 75.1% found in a study by Beagley J et al. [20]. The results of this study were close to what Beagley J et al. also reported "that the prevalence of diabetes in the Middle East and North Africa countries was up to 25.9% and the proportion of undiagnosed diabetes from this 25.9% was up to 75% and that is 19.4%". The percentage of participants who had IFG in this study is 22.6% (161 participants), which is close to the results stated by Abbas Mansour et al., in Al- Basrah city (29.1%) [21], and to the results of a study by Liu et al., in northwest China (27.5%) [22], and to the study by Aekplakorn et al., 2015 in Thailand (18.9%) [23]. In relation to age; we subdivided the participants into age group categories, each category represents a 5 years range, this started from 45 years to 49, 50 years to 54, 55 to 59 and so on, the highest percentage of participants who screened positive for diabetes is in age category of 45-49 years (28.7%), followed by 50-54 years category (20.2%), and continued to decline progressively as age increases, representing 17.4%, 11.2%, 10.1, 7.9%, 3.4% and 1.1% for age category, although the relation with age was not significant (P value0.100), we can still see that the percentage of diabetes decreases with aging which is different from the expected, as diabetes increases with age. Up to 25% of the U.S. individuals aged 65 years or more have diabetes, and aging of population is considered as a significant factor in diabetes epidemic [24]. This can be attributed to that sample size in this study is smaller in the older age group, and also may be attributed to that with advanced age the patient has more chance to discover diabetes. If we compare our results in regards to age groups with a similar study by Abbas Mansour et al study in Al Basrah/Iraq, we can see that in both studies the peak of undiagnosed diabetes lies in a similar range of age, being 46-60 years in their study, and 45-59 in our study [21]. In relation to obesity; it is well known that obesity is a risk factor for diabetes, especially central obesity [14]. From the 178 participants who screened positive for diabetes, 154 (86.5%) had central obesity according to rIDF cut-off point, while in the 373 participants who screened negative for diabetes, 94 (25.2%) had no central obesity according to the rIDF cut-off point, (P value 0.007). In the participants with IFG, 127 (78.9%) of them was centrally obese according to the rIDF cut off point. So, we can see how important is the waist

circumference and central obesity as a risk factor for both diabetes and prediabetes. The relation of waist circumference as a risk factor for diabetes was also studied worldwide, in a cross-sectional study that was done in 9 countries in Africa, south America, and Asia they concluded that the higher the waist circumference, the higher probability of the presence of diabetes [25]. Family history plays an important role in diabetes; in our study we studied both, the positively screened for diabetes and IFG participants to family history of diabetes. We found that 234 (32.9%) of the participants had positive family history of diabetes, 90 (37%) of them screened positive for diabetes, and 64 (27.3%) of them had IFG, which means that 64.3% of the total participants who had family history had abnormal blood sugar results. Now, if we correlate the results of family history according to blood sugar categories, we will find that 50.6% of who screened positive for diabetes had positive family history and 39.8% of IFG category had family history, while 78.6% of those screened negative for diabetes had negative family history. This shows the importance of family history as a risk factor for diabetes. In the study by Abbas Mansour et al in Al Basrah/Iraq, 27.3% of the participants who had family history of diabetes also had diabetes and 28.4% who had family history of diabetes had prediabetes, combined together 55.7% of participants who had positive family history had abnormal blood sugar results [21]. Another study that was carried out in many Indian states, up to 27.9% of patients with diabetes had family history of diabetes [26]. Based on the frequent co-existence between hypertension and diabetes, we studied the effect and relation of hypertension as a risk factor for diabetes and IFG. We found that 212 (29.8%) of the participants had hypertension, of those, 34% screened positive for diabetes, 19.3% had IFG, which means that 53.3% of the participants with hypertension had abnormal blood sugar results. And if we look at blood sugar categories and relate them with hypertension, we'll find that 40% of the participants who screened positive for diabetes have hypertension, and 25% of the participants who has IFG also have hypertension. In the study by Abbas Mansour et al in Al Basrah/Iraq [21], 32.8% of the patients with hypertension, had diabetes, and 34.3% had prediabetes, these results are close to our results regarding diabetes and slightly higher regarding prediabetes, this may be due the difference in sample size, age range and the screening for prediabetes was by IFG only. Also, in a study in India included 10 populous cities about the coexistence of diabetes and hypertension, it was found that they present in up to 28.8% of the sample [26].

## CONCLUSION:

Screening for type 2 diabetes and prediabetes is reasonable, both conditions are common in Iraqi population and should be considered in people ≥45 years, especially those who are obese, hypertensive, have positive family history of diabetes.

**Recommendations**

Further studies to include younger age groups who are at increased risk as recommended by the ADA screening criteria to find out its eligibility for Iraqi population.

A national screening program should be considered by the Ministry of Health that should include screening, confirmation and management.

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