Original Article

Prevalence of Undiagnosed Diabetes and Impaired Glucose Tolerance in a Semi-urban Population from Calicut City

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Though the prevalence of Diabetes is increasing worldwide, a thorough knowledge of the prevalence of undiagnosed Diabetes a pre-diabetes is lacking. This study from India is to evaluate the prevalence of asymptomatic diabetes among adults with comorbidities and without any history of Diabetes. Prevalence of asymptomatic individuals with Diabetes and impaired glucose tolerancewas 3% and 15%, respectively. The high prevalence found in the study raises concern over the health care indices and the need for urgent public health action to control the pandemic. Regular screening for Diabetes in adults is required to prevent complications of long-term diabetes.

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Early detection of Diabetes is important. Long-standing diabetes may lead to end organ damage including Nephropathy, Neuropathy, Retinopathy, Cardiovascular events. However, in the general population, there is a prevalence of asymptomatic Diabetes that goes unnoticed[1] and may eventually increase the prevalence of long-standing disease.

ADA (2022) guidelines recommend that all adults without risk factors should be screened with a test for pre-diabetes and Type 2 Diabetes starting at age 35, instead of the earlier cut-off of 45 years. The new Standards of Care also emphasizes screening with a Fasting Glucose Test for undiagnosed Diabetes in all women who are planning pregnancy, especially if they have risk factors. It advocates that a risk-based approach should be considered in screening for pre-diabetes and/or Type-2 Diabetes in those with age $\geq$10 years/ onset of puberty, whichever is earlier, in youth who are overweight or Obese and who have at least one additional risk factor for Diabetes. If initial screening is normal, it should be repeated at a minimum interval of 3 years or more frequently if BMI is increasing. American Association of Clinical Endocrinology recommends screening for pre-diabetes and Diabetes in individuals about 45 years of age[2] and USPSTF recommends screening in adults aged 35 to 70 years who have overweight or Obesity[1].

In a highly populous country like India with wide diversity, Socio-economic status contributes to the

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> **Editor's Comment :**
> - There is a significant incidence of undiagnosed diabetes in our population.
> - Routine screening of adult population is necessary to pick the cases early and to introduce lifestyle changes earlier so as to slow the progression.
> - The health care system needs to be sensitised on the hidden burden of lifestyle diseases and the need to propagate healthy lifestyle and early screening.

disparities in the diagnosis of illnesses such as Diabetes Mellitus and also in healthcare delivery[3]. With the prevailing Healthcare Management System and due to a lack of insurance; in the present scenario, routine annual health check-up is not a norm among major part of the population in India[3]. Therefore, early recognition of an impending future illnesses burden is challenging.

As a Consultant Diabetologist with more than 18 years of clinical practice in Kerala (India), I have come across a large number of diabetic patients who were asymptomatic and were accidentally detected. Considering the risk of the complications of long-term Diabetes, there is a need to screen individuals irrespective of the existence of symptoms. In this study, we plan to expose the burden of undiagnosed Diabetes in our region by screening asymptomatic individuals with no history of Diabetes Mellitus, at camps conducted by the hospital.

With this study we aim to highlight the importance of routine screening of adult population for Diabetes especially in a country like India which is deemed to be the Diabetes capital of the world[4]. This will help in early detection of Diabetes and pre-diabetes so that lifestyle modification and treatment can be initiated early.

MATERIALS AND METHODS

Study Design :

A pilot observational study was conducted at KIMS Trust Hospital, Calicut over a period of 6 months from October 15th 2021 to April 15th 2022.

The patient population included adults over 18 years of age with existing comorbidities and without any prior history or knowledge of pre-existing Diabetes Mellitus. The study participants had experienced no symptoms of Diabetes Mellitus until the time of enrolment. All patients provided informed written consent prior to participation in the study.

Patient demographic characteristics, history of prevailing comorbid illnesses were recorded. Body weight was assessed in minimum comfortable clothing by trained staff to the nearest 0.1 kg, and height to the nearest 0.5 cm. Waist circumference was taken at the minimum abdominal girth and hip circumference was measured at the maximum protrusion of the hips at the level of the symphysis pubis to the nearest 0.1 cm. Based on the World Health Organisation Asia Pacific guidelines, Obesity was defined as BMI more than or equal to 25 kg/m 2 and abdominal adiposity as waist circumference above the 80th sex-specific centile (men: >90 cm; women: >80 cm)[5,6].

Blood Pressure (BP) was measured in the right arm in sitting position after a fifteen-minute rest using a validated automatic device (OMRON). Three readings were taken and the mean of the second and third measurement was used for the analysis. Systolic Blood Pressure (SBP) more than 130 mm Hg or Diastolic Blood Pressure (DBP) more than 80 mm Hg was taken as Hypertension in accordance with ACC/AHA guidelines[7].

A structured interview was used to elicit the medical history including use of prescription drugs. Subjects were asked regarding the frequency, mean duration and intensity (regular/ moderate/vigorous) of physical activity during leisure. Less than 1 h activity in a week was taken as low physical activity. History of Diabetes in parents was also assessed and documented as either paternal or maternal Diabetes or both.

Glycemic parameters including HbA1c levels, FBS and 2h PPBS were measured in all individuals. Blood Glucose was estimated by Hexokinase method (Roche Diagnostics). HbA1C values were assessed using turbidimetric inhibition immunoassay (Roche Diagnostics).Diagnosis of IGT and Diabetes was made according to the criteria of HbA1c levels 5.6-6.5 and >6.5; PPBS 140-199 and $\geq$200, respectively. Individuals with FBS$\geq$126 was considered as diabetic.

Data Analysis :

Data was collated and analyzed using Microsoft excel and GraphPad Prism v9.3. All categorical variables were represented as percentage proportions. All descriptive variables are represented as mean ± SD, min and max. Analysis was done separately for males and females. Age-specific prevalence (95% confidence intervals) of Diabetes, IGT, and IFG was calculated. An analysis was accounted for sampling weights and clustering to obtain point estimates, Standard Deviations and 95% confidence intervals. Sample design-based standard deviations were calculated from the standard errors. Trend tests (age) for the different Glucose tolerance categories were performed by including an ordinal variable in a logistic regression model. Crude age-sex-specific prevalence of newly detected diabetes, IFG, and IGT was also directly standardized to the Indian population.

For log-normal distributed variables, geometric means and Standard Deviation factors were calculated. The Number Needed To Screen (NNTS) to expose one subject with undetected Diabetes was computed for various risk factor-groups. NNTS (95%CI) were derived from sample design-based logistic regression models as the inverse of the estimated prevalence of undiagnosed Diabetes in the risk-groups. A p value of less than 0.05 was considered as statistically significant.

RESULTS

Table 1 provides the demographic characteristics and comorbid conditions of the study population. Majority of the population were female. Prevalence of other comorbidities is high in the study population with 65/68 having Hypertension. The mean HbA1c, FBS and 2h PPBS values are normal within the study population (Table 1). However, distribution of population based on the HbA1c criteria for IGT and diabetes

Table 1 — Demographic characteristics			
N	Total	Male	Female
	68	27	41
Age :			
Mean ± SD	62.4 ± 13.7	59.3 ± 15.2	64.3±12.4
Min	33	33	36
Max	90	87	90
Gender, N (%) :			
Male	28		
Female	42		
HbA1c	3.9 ± 0.8	4.0±0.7	3.9±0.8
FBS	83.8 ± 13.1	85.56 ± 13	82.6 ± 13.2
2h PPBS	121.3 ± 26.4	126.0 ± 5.6	118.3 ± 24.6
Comorbidities :			
Hypertension	65	25	40
Coronary artery disease	15	6	9
Dyslipidaemia	23	6	17

Table 2 — *Biochemical characteristics of the asymptomatic diabetic individuals*		
Biochemical characteristics	Individual 1	Individual 2
Age	75	44
Gender	F	M
FBS	142	132
2hr PPBS	210	210
HbA1c	8.1	6.8
History of Diabetes mellitus	N	N
Duration of diabetes	0	0
Insulin treatment	N	N
Duration of insulin treatment	0	0
Metformin treatment	N	N
Other OAD	N	N
Hypertension	Y	Y
Duration of Hypertension	28y	2y
One anti-hypertensives	Y	N
>One anti-hypertensives	N	Y
CAD	Y	N
CAD Duration	10y	0
Dyslipidaemia	N	N
Duration of dyslipidaemia	0	0
Drugs to treat dyslipidaemia	Y	N
UACR	268	Data not available
Blood Pressure (SBP/DBP)	150/80	150/90
Total Cholesterol	Data not available	227
Low density lipoprotein	Data not available	151
Triglycerides	Data not available	153
High density lipoprotein	Data not available	46
Hemoglobin	11.6	9.7
ESR	34	12
HbA1c	8.1	6.8
Serum Creatinine	1.1	0.9
Thyroid stimulating hormone levels	1.11	Data not available
Serum uric acid levels	Data not available	Data not available

indicated 2 individuals with HbA1c >6.5 and FBS >140. These 2 individuals (2.9%) were diabetic. Analysis based on the criteria of 2h PPBS helped identified additional 10 individuals in the state of pre-diabetes (Fig 1).

The characteristics and biochemical profile of the two asymptomatic diabetic individuals are provided in Table 2. Individual 1 was a 75-year-old female with HbA1c of 8.1 and Hypertension and CAD for over 28 and 10 years, respectively. Individual 2 is a 44-year-old male with HbA1c of 6.8 and Hypertension for 2 years.

The prevalence estimates using HbA1c identified two asymptomatic diabetic individuals. Based on the criteria for FBS the same two diabetic individuals were identified (Table 2).

With the criteria for 2h PPBS indicated that around 10 individuals with IGT and two having diabetes. A consolidated view based on this study findings indicate that the prevalence of asymptomatic diabetic individuals is about 3% and the prevalence of IGT among the study population was about 15%.

DISCUSSION

India is a large populous country with majority of the population being young adults. Environmental, lifestyle habits, diet and genetic factors have paved way for an alarming increase in Obesity, metabolism Related Disorders. The alarming prevalence of diabetes and its complications remain a threat and early diagnosis is essential to prevent complications including Cardiovascular Disorders and end organ failures at a later stage of life. A recent study conducted among adult population showed that about 45% of the individuals who are diabetic or IGT did not make conscientious effort to adopt lifestyle modifications. This was attributed to the adults mainly being asymptomatic[8].

The prevalence of asymptomatic T2DM in children has been on a rise[9]. Recent recommendations by ADA
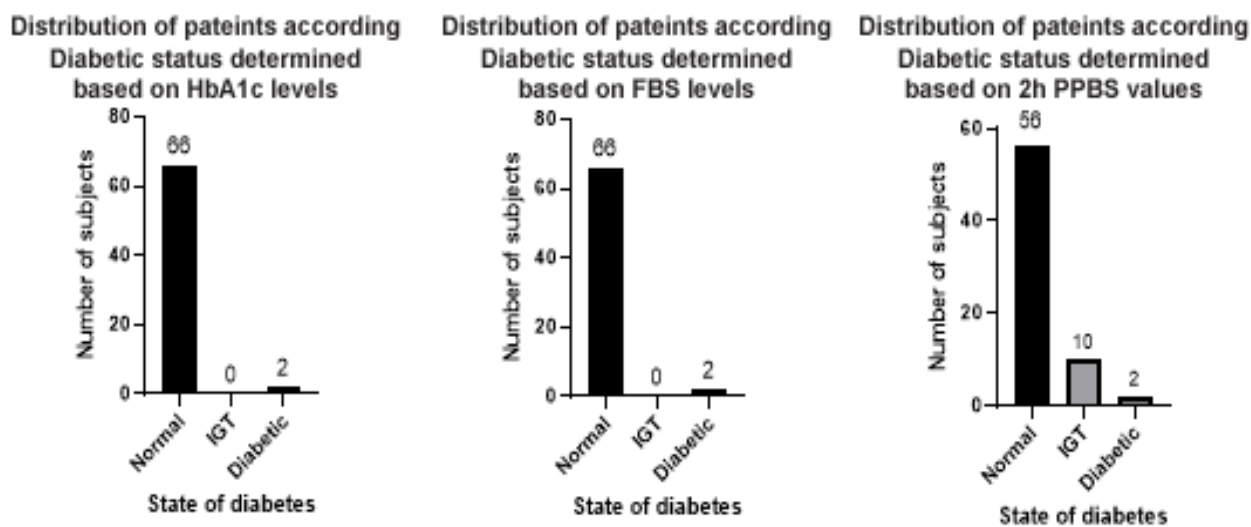

Fig 1 — Distribution of study population based on predicted diabetic status

and the Canadian Diabetes Association calls for risk assessment strategies to predict and screen for asymptomatic early T2DM among children based on family history, DM during gestation, signs of insulin resistance or conditions associated with insulin resistance[10].

Our study indicates that about 2% of the individuals could be asymptomatic and up to 15% could be having IGT. Although the proportions are seemingly small, given the current epidemic of Diabetes, this could translate to a large absolute number in millions among the general population. The DECODE study had corroborated that asymptomatic individual with high PPBS had increased Cardiovascular risk[11]. The PPBS level is suggested to be much relevant especially with advancing age than the fasting glucose levels. In the long-run, early detection could help build awareness and adopt proper measures to prevent lifetime complications of serious illnesses.

Limitations :

This is a retrospective study with a very small sample size. Therefore, statistical analysis and validation is limited. Family history, Obesity related data are unavailable. Most similar studies used Oral Glucose Tolerance Test for detecting the prevalence of diabetes and pre-diabetes, here we have used FBS, 2hr PPBS and HbA1C due to the practical difficulties involved in conducting the test at the camp sites and the financial constraints. However, the study results can be extrapolated by studying this in a large population.

Conclusion

Prevalence of asymptomatic diabetes poses concerns in the healthcare managements of an individual. Therefore, regular screening for Diabetes status in adults is warranted for timely management and to prevent the severe complications of long-term Diabetes. Furthermore, building awareness among these individuals will aid in the adoption of proper lifestyle measures at an early stage itself.

Taking into consideration the high cost involved in various steps of screening, diagnosis, monitoring, and management, it is imperative that cost-effective measures of Diabetes care are necessarily implemented. Public awareness, as well as updating the Medical Fraternity on various developments in the management of Diabetes, are required to combat the current Diabetes epidemic in India. Regular screening for Diabetes and associated non-communicable diseases in Urban areas should be considered by policy makers.

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