

## Biophysical Characteristics of Early Onset Type II Diabetes

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### Abstract

**Introduction:** Estimates by International Diabetes Federation in 2019 showed that 77 million individuals had diabetes in India. The early onset Type II diabetes is a prevalent disease among Indians which is understudied. The registry of youth-onset diabetes in India (YDR) has reported that over 25% of youth-onset type 2 diabetes were of age less than 25 years and over 57% were either overweight or obese and over 70% had HbA1C of more than 9% indicating poor control. The complications and severity of diabetes and hypertension is more in lean apparently healthy individuals.

**Objectives:** To study the biophysical characteristics of early onset diabetics (onset <40 years – group I) and compare with late onset type II diabetics (onset >40 years – group II) with short duration of onset.

**Materials & Methods:** Diabetics attending the Non Communicable Diseases out patient's department in Mahathma Gandhi Memorial Government Hospital, Trichy for routine check-up were included in this study. All the subjects were not having any chronic complications of diabetes (nephropathy, neuropathy, retinopathy etc). Subjects were selected without history of ketoacidosis and on oral hypoglycaemics only. Blood samples were collected in appropriate vacutainers for the estimation of Fasting Blood Glucose, Post Prandial Blood Glucose, Total Cholesterol, Serum Urea and Serum Creatinine. Estimation was done photometrically using suitable reagents. For all the subjects the urine was tested for urine sugar and protein which was negative at the time of examination.

**Results:** Total number of subjects were 116 out of which 37 were males and 79 were females. 52 % of group I individuals had family history of diabetes whereas only 39% of group II had family history. Hypertension was present in 78% of group I individuals and it was 56% in group II. The mean diabetes duration is about 3.7 years and mean BMI is 27.13. The total number of subjects under group I were 54 out of which there were 35 females and 19 males. In group II total number of subjects were 62 of which 44 were females and 18 were males. Obesity related disorders like dyslipidaemia, thyroid disorders were present in preobese category only in early onset diabetics including one cardiovascular disease, whereas dyslipidemia and thyroid disorder were distributed almost equally in all categories of BMI in normal onset diabetics. The hypertensives in the group I was more when compared with group II and the mean arterial pressure was comparably higher

in group I (Fig: 4). Also, cholesterol and creatinine levels were found to be lower in early diabetics than late onset diabetics.

**Conclusion:** The range of diabetes subgroups is becoming even more diverse in terms of association with other clinical conditions such as hypertension, thyroid dysfunction and other hormonal disturbances especially in early-onset multigenerational diabetes with genetic predisposition. The recent trend of normal or low BMI but metabolically obese is prevailing. Hence the disease is multifactorial and the progress is different in each individual.

**Keywords:** Early onset diabetes, Hypertension, Obesity, Body Mass Index (BMI).

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## Introduction

Estimates by International Diabetes Federation in 2019 showed that 77 million individuals had diabetes in India [1]. The India State-Level Disease Burden Initiative Diabetes study collaborators [2]. reported that the prevalence of diabetes is 65.0 million in the year 2016. According to this report, Tamil Nadu had the highest prevalence in 2016, followed by Kerala, Delhi, Punjab, Goa, and Karnataka and more in lower socio-economic states. [3]. Increased truncal fat despite normal or low BMI is associated with hyperinsulinaemia and insulin resistance [3,4].

The registry of youth-onset diabetes in India (YDR) has reported that over 25% of youth-onset type 2 diabetes were of age less than 25 years [5]. Most of these patients belonged to the high socioeconomic group, over 57% were either overweight or obese and over 70% had HbA1C of more than 9% indicating poor control. [6]. The early onset Type II diabetes is a prevalent disease among Indians which is understudied and is on rise as indicated by the cohort studies, the ICMR-INDIAB cohort (Indian Council of Medical Research-India Diabetes Study) [4] and the DMDSC cohort (Dr Mohan's Diabetes Specialties Centre) [7].

The predisposition of early onset diabetes among Indian population is increasing as the parents of the individuals are being type 2 diabetics, pattern of food intake, decreased physical activity and also genetic

predisposition of low beta cell function. [8,9]. The recent trend of normal or low BMI but metabolically obese is prevailing [10]. The metabolism is different in different individuals sometimes irrespective of obesity [11,12]. Moreover, the complications and severity of diabetes and hypertension is more in lean apparently healthy individuals. Hence the disease is multifactorial and the progress is different in each individual [13].

## Aim

To study the biophysical characteristics of early onset type II diabetics (onset <40 years) and compare with late onset type II diabetics (onset >40 years ) with short duration of onset ( 5 years)

## Methods

Diabetics attending the Non Communicable Diseases out patient department in Mahathma Gandhi Memorial Government Hospital, Trichy for routine check-up were included in this study. The data of these non-migrant native subjects was retrospectively collected from the OP registry. The diagnosis of diabetes type II was made according to WHO criteria based on Fasting and Postprandial blood sugar. All the subjects were not having any chronic complications of diabetes (nephropathy, neuropathy, retinopathy etc).

Subjects were selected without history of ketoacidosis and on oral hypoglycaemics only. For all the subjects the urine were tested for urine sugar and protein which was

negative at the time of examination. Blood samples were collected in appropriate vacutainers for the estimation of Fasting Blood Glucose, Post Prandial Blood Glucose, Total Cholesterol, Serum Urea and Serum Creatinine. The biochemical parameters were analysed in automated autoanalysers photometrically using respective standard reagents.

### Statistical Analysis

Patients were classified into 2 categories based on onset of diabetes as early onset diabetics (onset < 40 years) with normal onset type II diabetics (onset > 40 years these 2 categories will be called group I and group II respectively. All the patients were of age less than or equal to 50 years.

Data analysis was carried out using the Statistical Package for Social Sciences (SPSS) program and the results were tabulated as descriptive information (i.e., frequency, percentage, mean and standard deviation) and comparison of continuous variables between groups are shown as box plots.

### Results

Total number of subjects were 116 out of which 37 were males and 79 were females.52

% of group I individuals had family history of diabetes whereas only 39% of group II had family history Hypertension was present in 76% of group I individuals and it was 56% in group II. The mean diabetes duration was about 3.7 years and mean BMI was 27.13. The total number of subjects under early onset diabetes were 54 out of which there were 35 females and 19 males. In onset diabetes the total number of subjects were 62 of which 44 were females and 18 were males. Obesity related disorders like dyslipidemia, thyroid disorders were present in preobese category only in early onset diabetics including one cardiovascular disease, whereas dyslipidemia and thyroid disorder were distributed almost equally in all categories of BMI in normal onset diabetics.

There was not much difference (Fig: 3) in the fasting blood sugar levels in both the groups of diabetics whereas post prandial sugar had a wide range in early diabetics ranging from more than 200 to less than 300. The hypertensives in the group with early onset was more when compared with normal diabetics and the mean arterial pressure was comparably higher in early diabetics (Fig: 4). Also, cholesterol and creatinine levels were found to be lower in early diabetics than late onset diabetes.

**Table 1: Categorization of the groups according to BMI**

	< 40 years (Group I)			40 – 50 years (Group II)		
	Non obese	Pre obese	obese	Non obese	Pre obese	obese
Total number	19	23	13	20	27	15
Females	12	17	6	12	19	13
Males	7	6	6	8	8	2
Hypothyroidism		1		1	1	2
Dyslipidaemia		1		1	1	
Cardiovascular Disease		1				

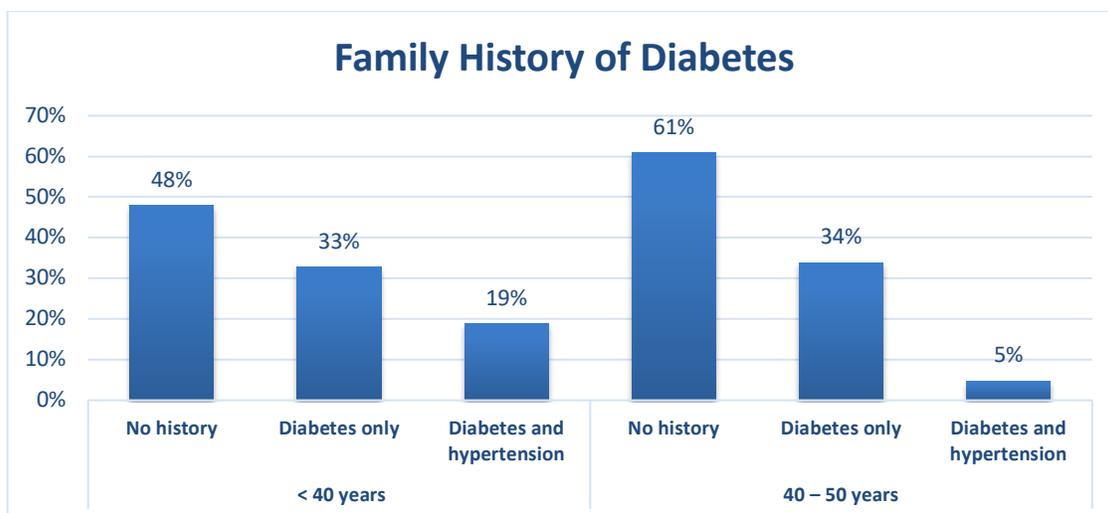


Figure 1: Family History of Diabetes in both the groups

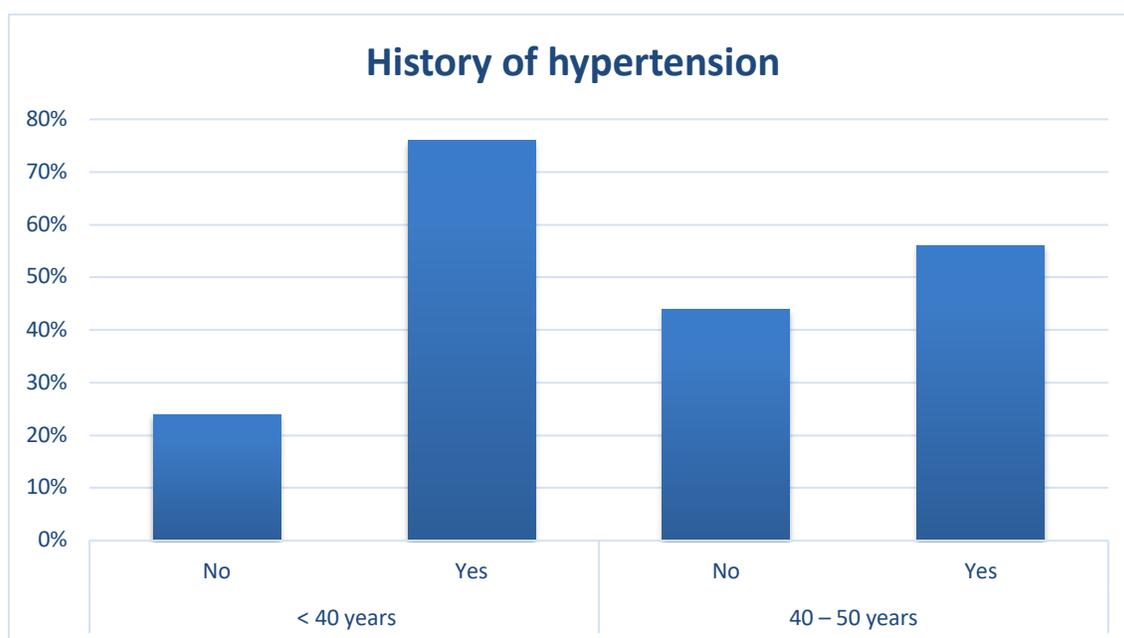
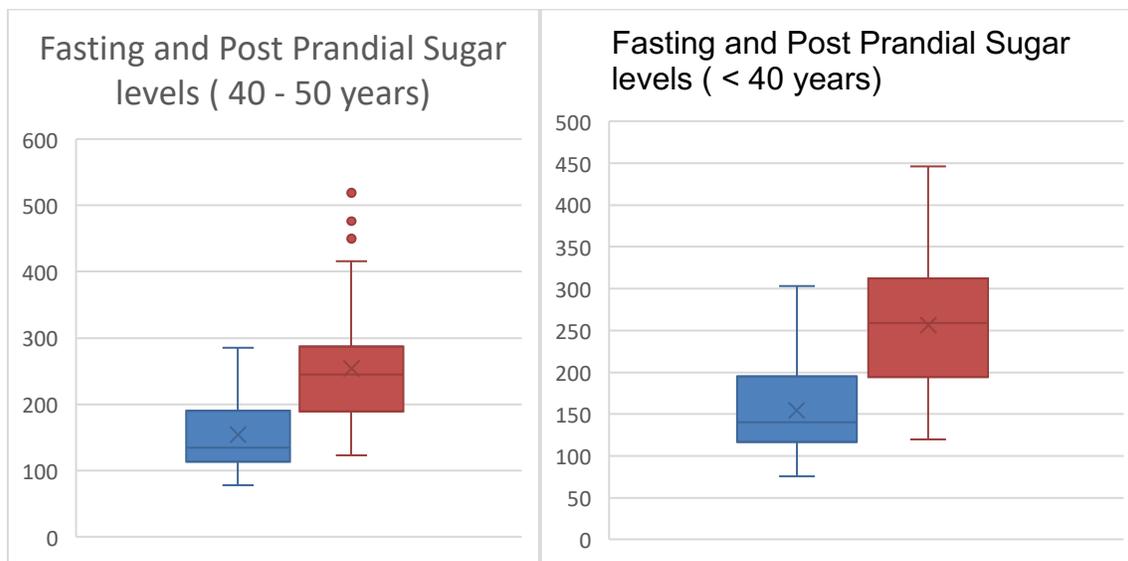


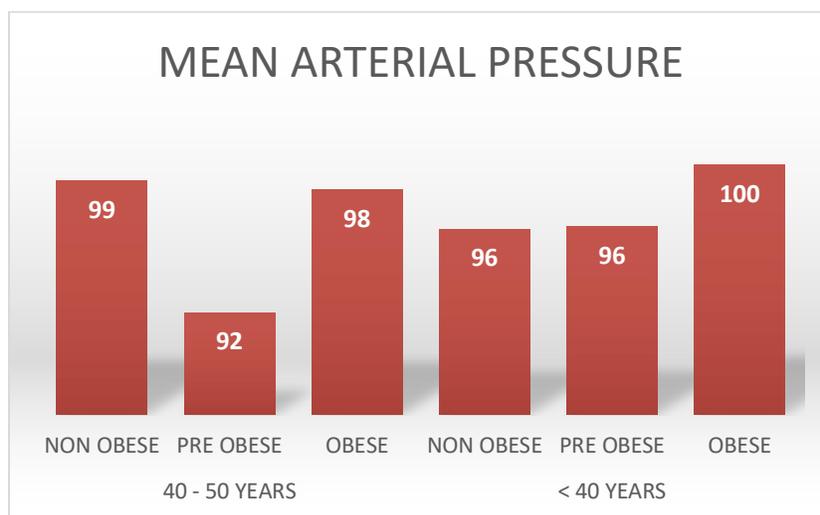
Figure 2: Percentage of hypertensives in < 40 years and in 40 – 50 years

Table 2: Means of The Variables

Parameters	< 40 years (Group I)	40 – 50 years (Group II)
Age	41.14	46.35
Dm Duration	5.4	2.18
Body Mass Index	27.0	27.18
Mean Arterial Pressure	97.02	95.5
Fbs	154.5	153.9
Ppbs	256.5	254.14
Total Cholesterol	188.8	190.38
Urea	21.6	20.6
Creatinine	0.7	0.8



**Figure 3: Fasting and Postprandial sugar values – comparison in both the groups**



**Figure 4: Mean Arterial Pressure in the different BMI groups**

**Table 3: Student T Test Comparison Between The Groups**

	<b>F</b>	<b>Sig.</b>	<b>t</b>	<b>df</b>	<b>Sig.(2-tailed)</b>
Age	7.657	0.007	6.836	114	<b>0.000</b>
Dm Duration	11.024	0.001	- 4.835	114	<b>0.000</b>
Body Mass Index	1.058	0.306	0.140	114	<b>0.889</b>
Mean Arterial Pressure	0.001	0.973	- 0.639	114	<b>0.524</b>
Fbs	0.000	1.000	- 0.060	114	<b>0.952</b>
Ppbs	0.034	0.854	- 0.155	114	<b>0.877</b>
Total Cholesterol	0.116	0.734	0.182	114	<b>0.856</b>
Urea	0.015	0.902	- 0.925	114	<b>0.357</b>
Creatinine	2.265	0.135	0.567	114	<b>0.572</b>

## Discussion

This study was done in a tertiary care Government Hospital hence the data corresponds to the urban and rural population of lower socioeconomic status.

The prevalence of early -onset diabetes with almost normal BMI was 24–39% amongst Asian Indians according to the study conducted by Moneeza K. Siddiqui *et al.* [8]. Previous studies have shown that family history of diabetes greatly increased the odds ratio for developing diabetes at an earlier age [9,11]. Our study also had similar finding that diabetes family history was significantly different between group I and group II as shown in a south Asian study [16]. Hypertension and diabetes were associated with common risk factors, including obesity, lipid profile and BP. Also, as both are predisposing factors of metabolic syndrome, both occur together in individuals [11-13].

Moreover, Prehypertension is associated with increased cardiovascular risk and insulin resistance [14,15]. San Antonio Heart Study had shown that individuals with prehypertension are at greater risk of diabetes than those with normal BP [15] In particular, a BP of 130–139/85–89 mm Hg was associated with incident type 2 diabetes, indicating that prehypertension subcategories may differ in diabetes risk. [14,15]. In concurrence with this, our study also found that the occurrence of hypertension was 78 % and 58% among group I and II diabetes patients. Although the clinical impact of these BP categories requires further analysis, active BP control in the former subcategory should be considered to reduce the development of diabetes.

These findings indicate the importance of glucose surveillance in both prehypertensive and hypertensive subjects. A number of studies have investigated the association of this thin-fat phenotype with diabetes risk [16-18]. In concurrence with this in our study

the preobese group developed cardiovascular disease & dyslipidemia. A population-based cross-sectional study [19] showed that early-onset diabetes group had lower systolic blood pressure (SBP), total cholesterol, low density lipoprotein cholesterol, 2-hour post prandial blood glucose and urine albumin creatinine ratio. There was no significant difference in body mass index whereas we observed a slightly lower BMI in group I.

## Conclusion

A remarkable increase in the prevalence of early- onset diabetes has become a global trend especially in India. Early onset diabetes is a complicated, heterogeneous disease which outranges usual classification of type I or type 2 diabetes. Diabetes is being associated with other clinical conditions such as hypertension, thyroid dysfunction and other hormonal disturbances especially in early- onset multigenerational diabetes with genetic predisposition.

Early onset diabetes is a high-risk condition with significant risks of developing premature micro-vascular and macrovascular complications.

Larger cohort studies should be conducted to conclude the changes occurring in early onset diabetics. Genetic studies can throw some light on the etiopathogenesis of early onset diabetics. Since the complications are more and the burden of the disease is increasing, screening appropriate individuals for early diagnosis of diabetes, associated clinical conditions and identification of complications will lead to suitable optimization of medical care. Thus, preventive measures and disease modifying drugs are to be explored.

## References

1. Pradeepa R, Mohan V. Epidemiology of type 2 diabetes in India. *Indian J*

- Ophthalmol. 2021 Nov;69(11):2932-2938.
2. India State-Level Disease Burden Initiative Diabetes Collaborators. The increasing burden of diabetes and variations among the states of India: The Global Burden of Disease Study 1990–2016. *Lancet Glob Health* 2018; 6: e1352–62.
  3. Anjana RM, Deepa M, Pradeepa R et al. Prevalence of diabetes and prediabetes in 15 states of India: results from the ICMR-INDIAB population-based cross-sectional study. *Lancet Diabetes Endocrinol.* 2017; 5(8):585–596
  4. Sharp PS, Mohan V, Levy JC, Mather HM, Kohner EM. Insulin resistance in patients of Asian Indian and European origin with non-insulin dependent diabetes. *Horm Metab Res.* 1987; 19(2):84–85.
  5. Praveen PA, Madhu SV, Mohan V, Das S, Kakati S, Shah N, et al. Registry of Youth Onset Diabetes in India (YDR): rationale, recruitment, and current status. *J Diabetes Sci Technol.* 2016 Aug 22;10(5):1034–41.
  6. Hockett CW, Praveen PA, Ong TC, Amutha A, Isom SP, Jensen ET, et al. Clinical profile at diagnosis with youth-onset type 1 and type 2 diabetes in two pediatric diabetes registries: SEARCH (United States) and YDR (India). *Pediatr Diabetes.* 2021 Feb;22(1):22–30.
  7. Ranjit Mohan Anjana, M.D., Rajendra Pradeepa, Ph.D., Mohan Deepa, Ph.D. Cd. et al. 907 The Indian Council of Medical Research–India Diabetes (ICMR–INDIAB) Study: Methodological details; *J Diabetes Sci Technol* 2011;5(4):906-914
  8. Moneeza K. Siddiqui<sup>1</sup> & Ranjit Mohan Anjana<sup>2</sup> & Adem Y. Dawed<sup>1</sup> & Cyrielle Martoeau<sup>1</sup>; Young-onset diabetes in Asian Indians is associated with lower measured and genetically determined beta cell function; *Diabetologia.* 2022; 65:973–983
  9. Da-Wei Wang, Jing Yuan; Early-onset diabetes involving three consecutive generations had different clinical features from age-matched type 2 diabetes without a family history in China; *Endocrine.* 2022; 78:47–56.
  10. Norbert Stefan. Metabolically Healthy and Unhealthy Normal Weight and Obesity; [www.e-enm.org](http://www.e-enm.org) 487; *Endocrinol Metab.* 2020; 35:487-493
  11. Emma Wilmot and Iskandar Idris; Early onset type 2 diabetes: risk factors, clinical impact and management. *Ther Adv Chronic Dis.* 2014;5(6) 234–244.
  12. Haslam DW, James WP. Obesity. *Lancet* 2005; 366: 1197–1209.
  13. Alberti KG, Zimmet PZ . Definition, diagnosis and classification of diabetes mellitus and its complications. Part 1: diagnosis and classification of diabetes mellitus provisional report of a WHO consultation. *Diabet Med.* 1998; 15: 539–553.
  14. Player MS, Mainous AG 3rd, Diaz VA, Everett CJ. Prehypertension and insulin resistance in a nationally representative adult population. *J Clin Hypertens.* 2007; 9: 424–429.
  15. Mullican DR, Lorenzo C, Haffner SM . Is prehypertension a risk factor for the development of type 2 diabetes? *Diabetes Care.* 2009; 32: 1870–1872.
  16. Hall LML, Moran CN, Milne GR et al. Fat oxidation, fitness and skeletal muscle expression of oxidative/lipid metabolism genes in south Asians: implications for insulin resistance? *PLoS One.* 2010; 5(12): e14197.
  17. Chandalia M, Abate N, Garg A, Stray-Gundersen J, Grundy SM. Relationship between generalized and upperbody obesity to insulin resistance in Asian Indian men. *J Clin Endocrinol Metab.* 1999; 84(7):2329–2335.

18. Tillin T, Hughes AD, Godsland IF et al. Insulin resistance and truncal obesity as important determinants of the greater incidence of diabetes in Indian Asians and African Caribbeans compared with Europeans: the Southall and Brent revisited (SABRE) cohort. *Diabetes Care*. 2013; 36(2):383–393.
19. Zou, X. et al. The characteristics of newly diagnosed adult early-onset diabetes: a population-based cross-sectional study. *Sci. Rep*. 2017;7: 46534.