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ORIGINAL ARTICLE

Diabetes burden among young Indians below the age of 35 years: A retrospective analysis of nationwide screening campaign

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Abstract

Objective Several studies have reported the rising prevalence of diabetes in young adults globally. ADA currently recommends routine screening for diabetes starting at the age of 35 years. Indians are known to develop diabetes at a younger age, although there is a scarcity of large studies looking at the prevalence of diabetes in Young Indians. Objective of the study was to assess prevalence of diabetes in young Indians below the age of 35 years.

Methods The data of 225,955 individuals from a nationwide screening campaign was analyzed for the prevalence of diabetes among individuals younger than 35 years.

Results The overall prevalence of diabetes among those below 35 years, 30 years, and 25 years of age was found to be 17.9%, 13.3%, and 9.8% respectively. Among those with a family history of diabetes, the prevalence was as high as 40.1%, 31.8%, and 26.4% respectively.

Conclusions The current study highlights a very high prevalence of diabetes in young Indians. It might be worth considering screening for diabetes as early as 18 years of age among Indians, especially in those with a family history of diabetes.

Keywords Prevalence of diabetes · Diabetes in young · Diabetes prevalence in young Indians

Introduction

According to the latest edition of the IDF Atlas, India is one of the countries with the highest burden of diabetes in the world. As of 2021, India has an estimated 74.2 million adults living with diabetes, which accounts for nearly 10% of the global diabetes population. The number of people with diabetes in India is projected to increase to 124.9 million by 2045 [1]. A recently published ICMR INDIAB study reported the overall weighted prevalence of diabetes in India as 11.4%,

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raising the estimated prevalence to 101 million [2]. Phase I results of the ICMR INDIAB study which was published in 2011 also raised concern regarding the take-off point in the prevalence of diabetes being at 25–34 years of age [3]. The prevalence of diabetes among young adults and children in India is increasing, though there is limited data available on the exact prevalence in this age group. According to some studies, the prevalence of type 2 diabetes among young people in India ranges from 2 to 5%. The increasing trend of obesity and sedentary lifestyles in this age group is believed to be a major contributor to the rise in diabetes prevalence.

The age structure of India is characterized by a large youth population and a relatively small older population. The country has a young age pyramid, with a large base and a narrow top. Approximately 60% of India's population is below the age of 35 years.

The American Diabetes Association (ADA) recommends that all people should be screened for type 2 diabetes starting at age 35 [4], although risk-based screening is suggested after the onset of puberty or after 10 years of age in children and adolescents who are overweight or obese and who have one or more additional risk factors for diabetes [5]. The Indian Council of Medical Research (ICMR) recommends that screening for type 2 diabetes should be performed in all individuals above 30 years of age and earlier in people with one or more risk factors [6]. Based on the review of published and unpublished data, Misra et al. reported high prevalence of diabetes in Indians below the age of 30 years and recommended that screening for diabetes should begin at the age of 25 years in Indians [7]. Recently, released RSSDI guidelines recommend opportunistic screening, community screening, and risk assessment-based screening, although there is no mention of any specific age at which universal screening is recommended [8]. Routine screening at an earlier age might be relevant with Indian context as several studies in past have suggested that Indians develop diabetes a decade earlier compared to the Caucasians.

In the present study, we evaluated the prevalence of diabetes in young adults below the age of 35 years by retrospectively analyzing the data collected from Defeat Diabetes Campaign. In addition, subsets below the age of 30 years and 25 years were separately analyzed. The contribution of family history in the risk of developing diabetes was also analyzed in various age groups.

Methods and Materials

Research Society for the Study of Diabetes in India (RSSDI) had launched a mass awareness campaign on 1st July 2021, the details of which have been published elsewhere [9]. During the campaign, nationwide screening camps were simultaneously conducted at 10,258 sites on 29th Sept 2021. Various parameters like age, gender, fasting status, current status—diabetes or not, medication status—on antidiabetic medicine or not, etc., were captured during the camps using a mobile application. Capillary blood glucose (CBG) values obtained with glucose monitoring devices were also captured in the application. Data from all sites was collected and analyzed centrally. After data cleaning, a total data of 2,25,955 individuals between the age of 18–80 years was included in the analysis.

A person was labeled as having diabetes if he/she had reported having pre-existing diabetes; his/her CBG value in fasting state was equal to or more than 126 mg/dl, or non-fasting CBG value was equal to or more than 200 mg/dl. Individuals who had no history of pre-existing diabetes but were found to have diabetes during analysis were labeled as Newly Detected diabetes. Prevalence of diabetes was calculated based on the total number of individuals with diabetes (pre-existing plus newly detected) and the total sample size included in the analysis.

In addition to calculating the prevalence of diabetes in the overall cohort, prevalence in young subsets below the age of 35 years, below the age of 30 years, and below the age of 25 years was separately calculated. The prevalence data among young individuals was also analyzed for age categories: 30–34 years, 25–29 years, and 18–24 years. Impact of family history was analyzed by comparing prevalence of diabetes among people with positive and negative family history in different age groups (Fig. 1).

The data used for this retrospective analysis is obtained from a mass screening camp, which has its own inherent bias, and it cannot be expected to represent the population at large. People with diabetes and their relatives are more likely to attend such camps. In order to adjust for this bias, we separately analyzed the prevalence of diabetes among people who did not report to have diabetes and also denied having any family history of diabetes presuming this to be the low-risk population.

Results

Total data of 225,955 individuals with 142,391 males and 83,434 females was included in the analysis. One hundred thirty individuals reported their gender as “Others.” And 78,694 (34.8%) reported to be having pre-existing diabetes, while 21,380 (9.5%) new cases were identified. Prevalence of diabetes among young individuals below is the age of 35 years has been summarized in Table 1.

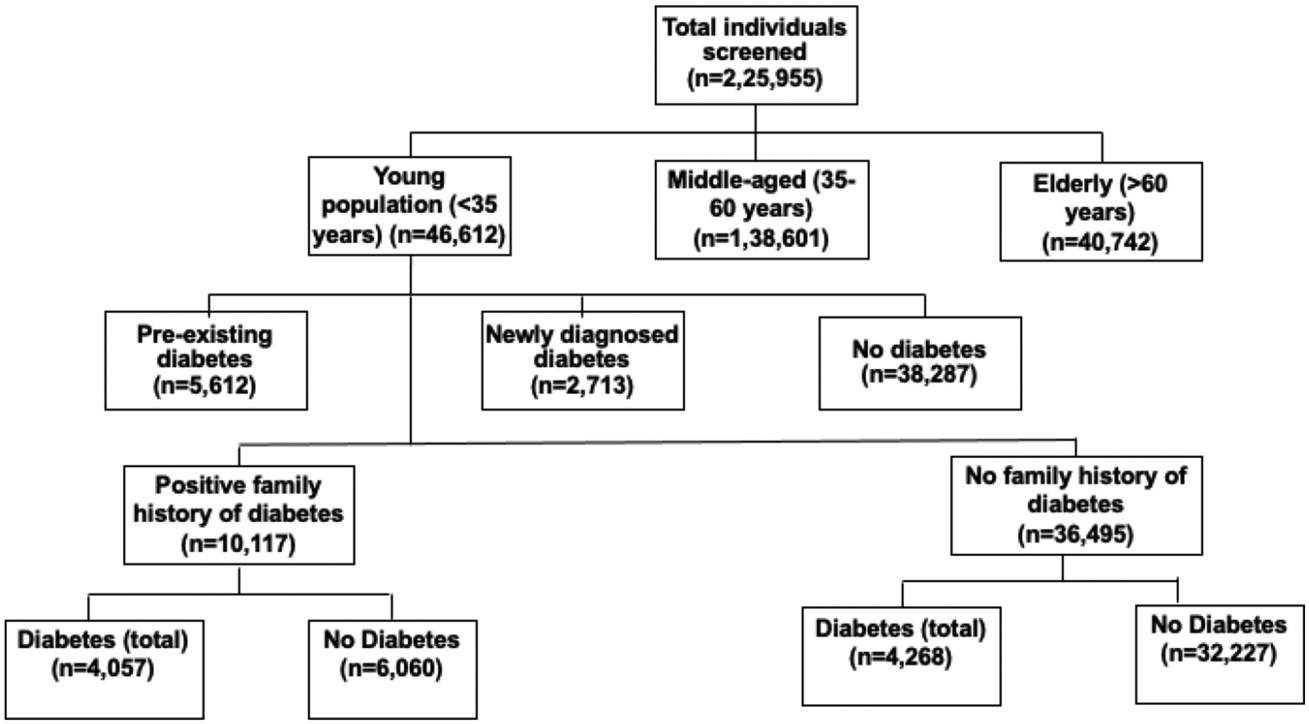

Fig. 1 Flow chart depicting the methodology used for analysis

Table 1 Prevalence of pre-existing diabetes, newly detected diabetes, and total prevalence of diabetes among various age groups

		Pre-existing diabetes	Newly detected diabetes	Total individuals with diabetes
< 35 Years	Males (28,027)	3393 (12.1%)	1675 (6%)	5069 (18.1%)
	Females (18,562)	2218 (12%)	1037 (5.6%)	3256 (17.5%)
	Total (46,612)	5612 (12%)	2713 (5.8%)	8325 (17.9%)
< 30 Years	Males (16,461)	1438 (8.7%)	783 (4.8%)	2221 (13.5%)
	Females (11,446)	995 (8.7%)	496 (4.3%)	1491 (13%)
	Total (27,925)	2434 (8.7%)	1280 (4.6%)	3714 (13.3%)
< 25 Years	Males (7465)	487 (6.5%)	265 (3.6%)	752 (10.1%)
	Females (5828)	349 (6%)	206 (3.5%)	555 (9.5%)
	Total (13,299)	836 (6.3%)	472 (3.6%)	1308 (9.8%)

Below 35 years of age

Out of 46,612 individuals below the age of 35 years, 28,027 were males, and 18,562 were females. Twenty-three individuals reported their gender as other. A total of 8325 (17.9%) individuals were found to have diabetes, of which 2713 (5.8%) were newly detected.

Among 28,027 males below the age of 35 years, 3393 (12.1%) reported having pre-existing diabetes, while 1675 (6%) new cases were identified. Prevalence of diabetes among females below the age of 35 years was 17.5% of which 5.6% were newly detected.

Below 30 years of age

A total of 3714 (13.3%) of 27,925 individuals were found to have diabetes, out of which 1280 (4.6%) were newly detected. The overall prevalence of diabetes among males and females below the age of 30 years was 13.5% and 13% respectively, while the prevalence of pre-existing diabetes was 8.7% in both males and females.

Below 25 years of age

The prevalence of diabetes was 9.8% even among individuals below the age of 25 years. Out of 7465 males and 5828

females who were included in analysis, 265 (3.6%) males and 206 (3.5%) females were newly detected diabetes during the camp.

Age categories

Prevalence of diabetes in different age categories, 30–34 years, 25–29 years, and 18–24 years is separately listed in Table 2. The prevalence was highest in the age category of 30–34 years and lowest among 18–24 years of age.

Family history

People with positive and negative family history were separately analyzed for prevalence of diabetes. The number of people with newly detected diabetes, pre-existing diabetes, and total number of diabetics in both (with positive and negative family history of diabetes) in different age groups is summarized in Table 3. Those with positive family history had a very high prevalence of diabetes compared with those without the family history. The prevalence of diabetes increased with rising age.

Low-risk population

The prevalence of diabetes among various age groups of low-risk population are summarized in Table 4. Overall prevalence in adults between 18 and 80 years of age was 13.1% in this subset. Among low-risk individuals, the prevalence of diabetes was found to be 6%, 4.7%, and 3.5% in < 35 years, < 30 years, and < 25 years age groups respectively.

Discussion

The current study highlights the high prevalence of diabetes among young adults in India. Even in adults below 35, 30, and 25 years of age, where routine screening is not recommended, the prevalence was found to be as high as 17.9%, 13.3% and 9.8% respectively. The corresponding figures among those with a family history of diabetes were as high

Table 2 Prevalence of pre-existing diabetes, newly detected diabetes, and total prevalence of diabetes among various age categories

Age categories		Pre-existing diabetes	Newly detected diabetes	Total individuals with diabetes
30–34	Males (11,566)	1955 (16.9%)	892 (7.7%)	2847 (24.6%)
	Females (7116)	1223 (17.2%)	541 (7.6%)	1764 (24.8)
	Total (18,687)	3178 (17%)	1433 (7.7%)	4611 (24.7%)
25–29	Males (8996)	951 (10.6%)	518 (5.6%)	1469 (16.3%)
	Females (5618)	646 (11.5%)	290 (5.2%)	936 (16.7%)
	Total (14,626)	1598 (10.9%)	808 (5.5%)	2406 (16.5%)
18–24	Males (7465)	487 (6.5%)	265 (3.6%)	752 (10.1%)
	Females (5828)	349 (6%)	206 (3.5%)	555 (9.5%)
	Total (13,299)	836 (6.3%)	472 (3.6%)	1308 (9.84%)

Table 3 Prevalence of diabetes among those with positive and negative family history in various age groups

Age group (years)		Positive family history				Negative family history			
		Total	Newly detected diabetes	Pre-existing diabetes	Total diabetes	Total	Newly detected diabetes	Pre-existing diabetes	Total diabetes
< 35	Males (28,027)	6067	406	2147	2553 (42.1%)	21,960	1269	1246	2515 (11.5%)
	Females (18,562)	4047	236	1267	1503 (37.1%)	14,515	801	951	1752 (12.1%)
	Total (46,612)	10,117	642	3415	4057 (40.1%)	36,495	2071	2197	4268 (11.7%)
< 30	Males (16,461)	2966	167	859	1026 (34.6%)	13,495	616	579	1195 (8.9%)
	Females (11,446)	2195	98	517	615 (28.0%)	9251	398	478	876 (9.5%)
	Total (27,925)	5164	265	1377	1642 (31.8%)	22,761	1015	1057	2072 (9.1%)
< 25	Males (7465)	1115	53	280	333 (29.9%)	6350	212	207	419 (6.6%)
	Females (5828)	977	36	183	219 (22.4%)	4851	170	166	336 (6.9%)
	Total (13,299)	2092	89	463	552 (26.4%)	11,207	383	373	756 (6.7%)

Table 4 Prevalence of diabetes in various age groups of low-risk population

Age groups (years)		Not at risk	Total diabetic	Prevalence (%)
18–80	Males	74,833	10,223	13.7
	Females	45,093	5508	12.2
	Total	120,008	15,744	13.1
< 35	Males	20,714	1269	6.1
	Females	13,564	801	5.9
	Total	34,298	2071	6.0
< 30	Males	12,916	616	4.8
	Females	8773	398	4.5
	Total	21,704	1015	4.7
< 25	Males	6143	212	3.5
	Females	4685	170	3.6
	Total	10,834	383	3.5

as 40.1%, 31.8%, and 26.4% among those below 35, 30, and 25 years of age respectively. Among low-risk individuals (those who did not report to have diabetes or family history of diabetes), the prevalence of diabetes was found to be 6%, 4.7%, and 3.5% in < 35 years, < 30 years, and < 25 years age groups respectively.

Data from ICMR Young Diabetes Registry (YDR) reported that out of 5,546 youth onset diabetes patients (diagnosis ≤ 25 years of age) studied, 25.3% of them were found to have T2DM [10]. The results from the current study are much lower than reported in YDR; this could be due to referral bias in YDR, which is an observational multicenter clinic-based registry. The ICMR-INDIAB study reported that the take-off point for diabetes was in the age group of 25–34 years in both urban and rural areas. The study reported a significantly higher prevalence of diabetes in the urban than in rural areas in all age groups [11]. The Chennai Urban Epidemiology Study (CURES) [12] that surveyed 26,001 adults in Chennai, South India, reported a 3.7% and 10.2% prevalence of diabetes among those aged 20–29 and 30–39 years respectively. The study also reported a temporal shift in the age at diagnosis of diabetes to a younger age in CURES compared with the National Urban Diabetes Survey (NUDS) (CURES vs NUDS, 20–29 years 6.6 vs 5.4%, 30–39 years 25.2 vs 19.7%). The Centre for cArdio-metabolic Risk Reduction in South-Asia (CARRS) Study, which studied three metropolitan cities in South Asia (Chennai and Delhi in India & Karachi in Pakistan), reported that the prevalence of diabetes rose sharply at 25–34 years [13]. In the recent report of the National Family Health Survey (NFHS-5) (2019–2021 that screened 2,078,315 individuals aged ≥ 15 years across all the states of India), the prevalence of diabetes among 15–29 years was reported to be 5.1 (95% CI: 5.0–5.2%), which used random blood glucose above 140 mg/dL for diagnosing diabetes. In our study, we report a much higher prevalence of diabetes, 13.3% [14].

Another study based on data obtained through the Comprehensive National Nutrition Survey (CNNS) reported the prevalence of diabetes to be 8.4% among Indian adolescents (10–19 years) [15]. A recently published systematic analysis of global burden of type 2 diabetes in adolescents and young adults concluded that there has been significant increase in age standardized incidence rates for type 2 diabetes in adolescents and young adults globally [16]. Another systematic review of published studies on incidence of type 2 diabetes in children and adolescent aged 20 years and under concluded that the three countries with highest estimated number of incident cases were China, India, and United States of America [17].

In a large country like India with 60% population below the age of 35 years, regular mass screening of young adults may be challenging. But this study highlights the importance of family history. In adults below the age of 35 years, the prevalence of diabetes was as high as 42.1% among those with family history of diabetes, while it was 11.5% among those without family history. Evidence from studies have shown that 60% to 80% of T2DM individuals have a family history of diabetes in their first-degree relatives [10, 18, 19]. A study among Asian Indian Adolescents showed that parental history of type 2 diabetes increases the risk of not only glucose intolerance but also other cardiometabolic risk factors like overweight, low high-density lipoprotein cholesterol, and high blood pressure [20].

This is probably the first study evaluating the prevalence of diabetes in India with a huge sample size of 225,955 with a nationwide geographical spread but has several limitations in terms of its methodology. Data was collected from 10,258 sites in one single day, and there was no standardization with regard to the use of glucose monitors. In large community-based nationwide screening campaigns, such as this, the use of standardized glucose monitors is challenging due to logistical and financial constraints. However, these campaigns provide an excellent opportunity to reach a wide audience efficiently. Diagnosis of new-onset diabetes was based on one single reading of CBG. Guidelines from the American Diabetes Association (ADA) [21] state that repeating the same test in a new blood sample at a different time to confirm the diagnosis is preferred, and though conducting an oral glucose tolerance test using venous plasma samples is considered the gold standard method for screening diabetes, it may not be feasible in nationwide epidemiological studies, owing to challenges, such as, shortage of phlebotomists, nonavailability of quality-controlled laboratories, and varied methods of glucose estimation. A simple fingerstick test using less than a drop of blood, that provides the glucose values in a few seconds, is much more suitable for large screening campaigns. Though CBG has a greater coefficient of variation than venous plasma, national studies, such as the

National Family Health Survey (NFHS) and ICMR-INDIAB study [22, 23], have used CBG for diabetes screening, and studies have shown a good correlation between CBG and venous plasma estimations [24]. Factors like fasting status and history of pre-existing diabetes were self-reported. The major limiting factor of this study is sampling bias as the data was collected from voluntary camps which are more likely to be attended by people with diabetes and their family members. The selection bias is due to the voluntary nature of participation. It is likely to include individuals who are already self-motivated, such as those who are proactive about their health, leading to an over-representation of certain demographics or individuals with diabetes. The sampling bias associated with our study limits the study results to be extrapolated to the entire population. Despite this limitation, the sub-analysis of low-risk population by excluding people with pre-existing diabetes and those with family history of diabetes revealed high prevalence of diabetes in individuals below 35 years of age. Additionally, uploading a significant volume of data by this large-scale screening camp may introduce its own set of challenges. However, we have taken proper quality control measures to keep check on the errors of data entry, transfer, or storage.

Conclusions

The current study reveals a high prevalence of diabetes in young Indians below the age of 35 years. The cut-off age of 35 or 30 years for routine screening probably needs to be further lowered for the Indian population. In people with a strong family history of diabetes, it might be worth screening for diabetes from as early as 18 years of age.

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Declarations

Ethical clearance Approval was obtained from ACE Independent Ethics Committee, Bangalore, India, for using data collected during the camp for publication in future.

Consent for publication This being retrospective analysis of data collected during voluntary camps, consent was not obtained from individual participants.

Conflict of interest The authors declare no conflict of interest.

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