Controversies & Consensus in Diabetes Management

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Diabetes in India - An Epidemiological Review

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Introduction
Diabetes mellitus is a heterogeneous group of disorders characterized by chronic hyperglycemia due to disturbances in carbohydrate, protein and fat metabolism which result from either a defect in insulin action or secretion or a combination of the two. Diabetes is one of the commonest chronic non-communicable diseases affecting the society at large both in developed and developing countries. It is generally classified as type 1, type 2 or other specific types. Type 1 diabetes, although less common than type 2 diabetes, is increasing each year in both rich and poor countries. In most high-income countries, the majority of diabetes in children and adolescents is type 1 diabetes. Globally, all types of diabetes are on the increase, type 2 diabetes in particular. While diabetes has been known for many centuries, the prevalence has reached epidemic proportions only recently. According to the 6th edition of International Diabetes Federation Diabetes Atlas, it is estimated that there are currently 387 million people with diabetes worldwide and this number is set to increase to 592 million by the year 2035. The major proportion of this increase will occur in developing countries of the world (about 80%) like India, where the disorder predominantly affects younger adults in the economically productive age group. People with diabetes in developing countries face a greater threat from complications than those in wealthier countries. Diabetes dramatically increases the risk for a wide variety of complications from retinopathy to peripheral neuropathy to cardiovascular disease, which, if undetected, can have a devastating impact on quality of life and place a substantial burden on health care costs. This chapter will discuss the trends in the epidemiology of diabetes in India.

Epidemic of Diabetes in India
Epidemiology of diabetes in India has an extensive history. The problem of diabetes has been rising in leaps and bounds in India particularly type 2 diabetes. The number of people with diabetes in India started to rise gradually in the 1980s and in the 1990s and from the year 2000 onwards, there has been an explosion of the number of people with diabetes in India. Various state-specific surveys on type 2 diabetes done in the past decade have shown highly variable prevalence rates, but a definite increasing trend can be seen from their findings. However, most of the studies have been performed at single locations and many have not sampled representative populations covering both rural and urban areas. There have been very few studies which have sampled respondents at multiple locations.
Burden of Type 1 Diabetes

Type 1 diabetes probably accounts for 5 to 10% of all diagnosed diabetes. About 40 to 60% of persons with type 1 diabetes are younger than 20 years of age at onset, thus making diabetes one of the most common severe chronic diseases of childhood affecting 0.3% of the general population by the age of 20 years and 0.5 to 1% during the lifespan [9]. The worldwide prevalence of type 1 diabetes is 0.1% to 0.3%, with 78,000 new cases every year, especially among young individuals (<5 years). Some 79,100 children under 15 years are estimated to develop this type of diabetes annually worldwide [10]. The South East Asia Region (SEAR) has a high prevalence of type 1 diabetes in children, with an estimated 77,900 children affected. In 2013, alone an estimated 12,600 children under the age of 15 in SEAR developed type 1 diabetes [11]. India due to its sheer size (1.2 billion people) accounts for most of the children with type 1 diabetes in the SEAR.

Although it is type 2 diabetes which is more prevalent and the main driver of the diabetes epidemic in India, it is to be noted that prevalence of type 1 diabetes in India is also on the rise, whether this is due to better detection and awareness is not clear. Moreover, most of the data are from clinic based studies or registries and there are few population based studies on the prevalence of type 1 diabetes in India.

In the 1990's, Menon et al [7] had done an overview of childhood onset diabetes mellitus in India. Prevalence of juvenile diabetes (onset below 15 years) among all diabetes hospital/clinic based data was presented and the prevalence ranged from 0.8% to 3.61% during the period from 1964 to 1989. In 1992, Ramachandran et al [8] reported that the prevalence of type 1 diabetes in children aged less than 15 years was 0.26 per 1000. The same investigator showed that the incidence for the 4 year period was 10.5/100,000/year [8]. However, Bai et al [10,11] did not find any cases of type 1 diabetes in their studies in school and college students in Chennai. Data from the Bangalore TIDM registry group reported an incidence rate of 1.68 per 10,000 in 1997 [12].

A study from Kurnool district in 2008, showed a prevalence of 18.3/100,000 in the 0 to 14 years age group [13]. Clinic based data show that more than 60% of the type 1 diabetes patients registered were childhood and adolescent onset type 1 diabetes patients. A Chennai based diabetes tertiary centre reported among a total of 2630 subjects with diabetes in the young, the proportion of type 1 diabetes subjects were found to be 1135 (43.2%) [14]. Table 1 presents the prevalence of type 1 diabetes from various clinic based studies in India [8,15-30].

The Indian Council of Medical Research (ICMR) recently set up a national registry of diabetes in the young (onset < 25 years of age). In spite of a number of studies describing the prevalence, distribution and possible causes of diabetes, many government and public health planners still remain largely unaware of the current magnitude and in particular the increases in young diabetes and its serious complications. Special efforts must be made to collect data, especially in those countries where diagnosis may be missed.

Burden of Type 2 Diabetes

The problem of diabetes is growing in epidemic proportions worldwide, particularly in Asia and more specifically in India. The earliest documented study on prevalence of diabetes in India was done in Calcutta (now Kolkata) in 1938 [37], and of the 96,300 medical records checked, 1% was found to have diabetes diagnosed by glycosuria. The first multicentre study done by the ICMR was conducted between 1972 and 1975 in both urban and rural areas [38]. In this study more than 34,000 individuals were screened in 6 regions of the country (Ahmedabad,
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Table 2: Multicentric studies on Diabetes Prevalence in India
the results of the next ICMR survey conducted in one urban area (Delhi) and 5 rural areas around Kalpa, Trivandrum, Kolkata, Delhi and Ahmedabad showed an urban prevalence of 4.1% and rural prevalence varying from 0.4% to 3.9% [50]. In 1994, a study from Ludhiana, Punjab reported a rural prevalence of 4.6% [51], while a study from rural Tamil Nadu reported a prevalence of 4.9% [52]. In Chennai, a rapid rise in diabetes prevalence from 8.2% to 11.6% was demonstrated over a period of 5 years [53,54]. In 1998, Guwahati reported a prevalence of 8.2% [55]. In 2000, Kerala showed a very high diabetes prevalence of 16.9% in urban areas, 10.1% in the midland, 6.8% in the highland and 3.6% in coastal areas and the Kashmir Valley study reported a prevalence of 6.1% [56]. A study done in Mumbai in 2001 showed a diabetes prevalence of 7.5% when using the ADA criteria and 4.6% using the WHO Criteria [57] while a prevalence of 10.3% was reported in a slum area in Delhi [58]. From the north east, a study from Manipur conducted in 2001 reported a prevalence of 4% [59].

The Chennai Urban Population Study (CUPS) [60], which looked at the prevalence of diabetes in two socio-economic groups (middle income and low income) in Chennai showed that the middle income group had an age standardized prevalence of 12.4% while in the low income group the prevalence was 6.5%. A follow-up study done after 10 years in the same two colonies showed convergence of the prevalence rates of diabetes in the middle income group (15.4%) and the low income group (15.3%) [61]. Another population based study - National Urban Diabetes Survey (NUDS) was conducted in six large cities from different regions of India in 2001. The study showed that the age standardized prevalence of type 2 diabetes was 12.1%. The prevalence was the highest in Hyderabad (16.6%), followed by Chennai (13.5%), Bengaluru (12.4%), Kolkata (11.7%), New Delhi (11.6%) and Mumbai (9.3%) [62].

The Prevalence of Diabetes in India Study (PODIS) [63] was carried out in 108 centres (49 urban and 59 rural) in different parts of India to look at the urban-rural differences in type 2 diabetes and glucose intolerance in the year 2004. According to ADA criteria, the prevalence of diabetes was 4.7% in the urban and 1.9% in the rural areas. The prevalence of diabetes according to WHO criteria was 5.6% and 2.7% among urban and rural areas respectively. The Sentinel Surveillance Systems for cardiovascular disease (CVD) was carried out in Indian industrial populations, in ten centres from different parts of the country. Using the ADA criteria, this study documented prevalence of diabetes to be 10.1% and the prevalence of self reported diabetes to be 5.6%.

Studies done in the last decade have shown even higher prevalence rates of diabetes from different parts of India. A study conducted in the Punjabi Bhatia community [64] in 2004, reported a prevalence of 16.8% while a study from Mysore in 2005, reported a prevalence of 3.8% [65]. In 2006, the Chennai Urban Rural Epidemiology Study (CURES) showed an age standardized prevalence of 14.3% in Chennai [66]. The Amrita Diabetes and Endocrine Population Survey (ADEPS) done in the urban areas of Ernakulam district in Kerala reported a high prevalence of diabetes (19.5%). A study from Rajasthan showed a prevalence of 16.7% [68]. A study conducted in rural Maharashtra, reported a prevalence of 9.3% Deo et al [69], while another study reported a high prevalence of 13.2% in rural Andhra Pradesh [70]. However, a study on the camel milk- consuming “Raica” community in Rajasthan reported a total absence of diabetes in this community [71].

In Tamil Nadu, the prevalence of diabetes was highest in the metropolitan city of Chennai (18.6%) in 2008, followed by the smaller towns (16.4%) and the periurban villages (9.2%) [72]. In another survey done in 2008 in an industrial cohort from 5 sites
in India namely Delhi, Hyderabad, Bangalore, Chennai and Trivandrum, the prevalence of diabetes in this population was found to be 10.1% [79]. In the same year, the WHO ICMR NCD Risk Factor Surveillance Study [74] was conducted in 44,523 individuals aged 15-64 years from six sites namely Delhi, Bahrinagpur, Madhya Pradesh, Maharashtra, Mizoram, Kerala, Tamil Nadu and Jharkhand. The overall prevalence of 'self reported diabetes' (i.e. based on questionnaire and with no blood glucose testing) was found to be 4.5%. In Kerala [73] the crude prevalence of diabetes in a rural community was reported to be 14.6%. The Integrated Disease Surveillance Project (IDSP), Phase I included 7 states namely Andhra Pradesh, Madhya Pradesh, Maharashtra, Mizoram, Kerala, Tamil Nadu and Jharkhand. The prevalence of self reported diabetes in this study ranged from 1 to 6% in the different states studied [76]. A study from coastal Karnataka conducted in 2010 [77] reported a diabetes prevalence of 16% whereas another study from the rural areas of the interior of the same state showed a prevalence of 10% [78].

In Puducherry, the overall prevalence of diabetes in 2011 was reported to be 8.6% [79]. In Goa in western India, the prevalence of diabetes in rural areas was estimated to be 10.3% [80]. A study from Chandigarh [81] reported an age adjusted prevalence of diabetes of 11.1%, while in an affluent population of Lucknow city, the prevalence rate of diabetes was found to be 21.1% [82]. A study done in Tenali town of Andhra Pradesh in 2012, showed an overall prevalence rate of diabetes of 18%, compared to 4.7% in the same town in 1984 [83]. The Jaipur Heart Watch done in 2012 among 739 urban, middle class subjects in the city of Jaipur reported a prevalence of 15.5% in men and 10.8% in women [84]. Another cross sectional study conducted in 2012 to assess the cardiovascular risk factors in Asian Indians [85] in 16,198 adults in 11 medium sized cities across the country (Jammu, Chandigarh, Karnal, Bikaner, Ahmadabad, Jaipur, Lucknow, Patna, Dibrugarh, Madurai, Hyderabad, Belgaum, Indore and Nagpur) reported prevalence of diabetes to be 16.7% in men and 14.4% in women. Prevalence of diabetes reported in 2014 amongst rural hilly population of North Eastern India (Upper Siang) was 19.8% [86].

The currently available estimates of diabetes prevalence in India are regional. No study on diabetes has systematically sampled all the states in the country or even sampled a single state completely. Thus there was felt to be an urgent need for a large well planned national study, which could provide a reliable nationwide data, not only on prevalence of diabetes, but also on pre-diabetes and related non communicable disease like obesity, hypertension, dyslipidemia, and coronary artery disease [3]. This led to the Indian Council of Medical Research-India Diabetes (ICMR -INDIAB) study. This community based national survey was conceived with the aim of obtaining the prevalence of diabetes and prediabetes in India as a whole, covering all the 28 states, the National Capital Territory (NCT) of Delhi and 2 of the union territories (UTs) in India with a total sample size of 1,24,000 individuals in a phased manner [87]. In addition, the study will provide a reliable nationwide data of related non communicable disease like obesity, hypertension, dyslipidemia, and coronary artery disease.

ICMR-INDB study is an ambitious and complex survey using robust sampling techniques, standardized methods, appropriate quality assurance. It involves a three-phase data collection and is the first representative national diabetes survey to be conducted in India involving whole states of the country [88]. A stratified multi-stage sampling design has been adopted to select 4000 individuals from each state (2800 individuals in rural areas and 1200 individuals in urban areas). Phase I of ICMR-INDB study included 3 states namely Tamil Nadu, Maharashtra, Jharkhand and one Union Territory name-
ly Chandigarh located in the south, west, east and north of the country, respectively. The INDIAB-North East Phase comprises of the 8 North-Eastern states namely Assam, Arunachal Pradesh, Manipur, Meghalaya, Tripura, Sikkim, Mizoram and Nagaland and Phase II involves the rest of the country. Currently, Phase I of the study has been completed and Phase II and north east component are under progress.

The ICMR-INDIAB study- Phase I, reported that the prevalence of diabetes (both known and newly diagnosed) to be 10.4% in Tamilnadu, 8.4% in Maharashtra, 5.3% in Jharkhand and 13.6% in Chandigarh [89]. This study reported the prevalence of known diabetes to be 6.0% in Tamilnadu, 2.5% in Maharashtra, 2.4% in Jharkhand and 6.2% in Chandigarh and newly diagnosed diabetes to be 4.4%, 5.9%, 2.9% and 7.4% respectively. The ratio of newly diagnosed to known diabetes was more than 1:1 in all areas, except Tamilnadu, where it was 1:0.7. The overall number of people with diabetes in India in 2011 was estimated to be 62.4 million [89] and this was similar to the IDF projection for India, which gave a figure of 61.3 million people with diabetes in India in the age group of 20-79 years [90]. Figure 1 shows the weighted prevalence of diabetes in urban and rural population. From the data available from the ICMR-INDIAB study, it is astonishing to note that there are high prevalence rates of diabetes not only in urban areas but also in rural areas in India. Thus, it is clear that the epidemic of diabetes is now shifting to the rural areas as well. This may be attributed to rapid epidemiological transition involving globalization, changes in dietary habits and decreased physical activity. The urban-rural differences in diabetes prevalence were most marked in Jharkhand, where rural-urban disparities in socioeconomic status are among the highest in India [89].

A particularly disturbing trend observed in India is the shift in onset of diabetes to younger ages (adolescents and children) [23,91]. Until recently, type 1 diabetes was not only the most common form of diabetes seen in youth, but also perhaps the only form of diabetes seen in children.

![Figure 1: Weighted prevalence of diabetes in urban and rural population.](image-url)
and adolescents. However, this trend has started changing slowly. In all four regions studied in the ICMR INDIAB study, the take-off point in prevalence was at 25-34 years with a decline after age 65. The weighted prevalence of prediabetes in the ICMR-INDIAB study (Phase I) among urban residents of Tamilnadu, Maharashtra, Jharkhand and Chandigarh was reported to be 9.8%, 15.2%, 10.7% and 14.5% and that among rural residents 7.1%, 11.1%, 7.4% and 14.7% respectively. Table 2 lists all the multicenter studies on the prevalence of diabetes in India till date.

Thus, the various epidemiological studies conducted in India, shows that the prevalence is higher in urban India and also increasing faster as compared to rural population. These studies show that there is a 10 fold increase in the prevalence of diabetes in India in both urban and rural areas. The number of people with diabetes in India has increased from 19 million in 1995 to 66.8 million people in 2014 (1) (Figure 2) (3, 89, 92-93). These figures are predicted to increase to 109 million by 2035 (1). Apart from this, India has a large pool of prediabetic subjects who have a high potential to develop type 2 diabetes. According to the ICMR-India Diabetes (INDIAB) study, over 77 million people in India have prediabetes (90).

Of the 480 subjects (254 urban and 226 rural) with self-reported diabetes in the four regions studied in Phase I of the ICMR-INDIAB study, good glycemic control (glycated haemoglobin [HbA1c] <7%) was observed only in 31.1% of urban and 30.8% of rural subjects (86). This study also showed that the mean HbA1c levels among subjects with self-reported diabetes are high in all the regions studied, with no significant differences between the urban and rural areas. In urban areas, the mean HbA1c was highest in Chandigarh (8.7%) followed by Tamilnadu (8.3 ± 1.9%), Jharkhand (8.2%) and Maharashtra (8.0%). In rural areas, the mean HbA1c was highest in Chandigarh (9.4%) followed by Jharkhand (8.3%), Tamilnadu (8.1%) and Maharashtra (7.9%). The results show that levels of glycemic control in India remain
unacceptably poor with > 60% of diabetic subjects failing to meet the recommended HbA1c goal of <7%. The large number of individuals with poorly controlled diabetes, particularly in rural areas, is worrying as this could potentially translate to a development of chronic complications in this segment of the population, where diabetes care is currently not available, accessible, or affordable. Microvascular and macrovascular disease causes considerable mortality and morbidity both among diabetic patients. In Type 2 diabetes the risk of some of these complications (e.g., coronary artery disease) may start even before onset of diabetes sets in. The prevalence of coronary artery disease was 21.4% among diabetic subjects compared to 9.1% in subjects with normal glucose tolerance in the CUPS study. A few studies, mostly clinic based, have looked at the prevalence of diabetic complications in India. The CURES Eye Study showed that approximately 1 in every 5 diabetic individual, may develop DR. The CURES group reported that the prevalence of peripheral vascular disease to be 8.3%, neuropathy to be 26.1% and overt nephropathy 2.2% while that of microalbuminuria, 26.9%.

Conclusion

From the current scenario of diabetes in India, it is clear that prevention of diabetes and its complications is the urgent need of the hour. Thus, the diabetes epidemic which is currently threatening the health of developing nations like India, particularly the youth, needs local solutions with active community participation backed by strong government initiatives. It also calls for coherent and well-planned approach as most developing countries also have inadequate funds and resources. The first step would be convincing policy makers of the need for preventive approaches. Modifying the obesogenic environment will require a broad range of multi-sectoral policy measures (e.g., subsidies for agriculture and healthy food production [vegetables, fruits, whole grains, wheat, pulses etc]; urban planning; changes in transportation; school curricula; worksite policies; nutrition facts labeling of food items, making health food options available at school and workplaces, compulsory physical activities in educations institutes, regulatory mechanism for fruits and vegetable prices, etc) and need to involve the community. The leading role for this multi-sectoral approach to tackle the diabetes burden in India must obviously come from the Ministry of Health. However other Government departments including Education, Social Welfare, Finance, Transport, Culture, Sport and Youth Affairs, in addition to non-governmental organizations (NGO's) and religious, family and community welfare organizations should all work together. Only such a concerted effort would lead to a successful diabetes prevention program in India.

References


33. Zargar AH, Bhar MH, Laway BA, Masoodi SK.


58. Misra A, Pandey RM, Devi JR, Sharma R, Vikram NK, Khanna N. High prevalence of diabetes, obesity and dyslipidaemia in urban slum population in


79. Bharati DR, Pai R, Kar S, Rekha R, Yamuna TV, Basu M. Prevalence and determinants of diabe-


