

Diabetes Mellitus: Indian Perspective

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ABSTRACT

A tremendous increase in the coexistence of diabetes and hypertension has been observed recently in India. Apart from lifestyle and genetic factors, socioeconomic status, age, gender, occupation and lack of awareness are also contributing to the tremendous increases in the prevalence of both the diseases. Hypertension has been long recognised as one of the major risk factors for chronic disease burden, morbidity and mortality in India, attributable to 10.8% of all deaths in the country. Even though microvascular complications are frequently linked to hyperglycaemia, studies have also proven the critical involvement of hypertension in the development of these co-morbidities. The co-occurrence of hypertension in diabetic patients considerably escalates the risks of coronary heart disease, stroke, nephropathy and retinopathy. The annual expenditure for diabetes for the Indian population was estimated to be 1541.4 billion INR (\$31.9 billion) in 2010. The expense of diabetes care further escalates in the presence of complications or co-morbidities. Generally, a diabetic patient with hypertension spent an average of 1.4 times extra than a diabetic patient without hypertension. Even though diabetes and hypertension are considered as important risk factors for cardiovascular and chronic kidney diseases, the awareness about the prevention, treatment and control of these diseases remains alarmingly low in the developing countries like India. The healthcare system in India should focus on better hypertension screening and control, especially in diabetic patients, to minimise the burden of the dual epidemic.

India, with one of the largest and most diverse populations of people living with diabetes, experiences significant barriers in successful diabetes care. Limitations in appropriate and timely use of insulin impede the achievement of good glycemic control. The current article aims to identify solutions to barriers in the effective use of insulin therapy viz. its efficacy and safety, impact on convenience and life-style and lack of awareness and education. Therapeutic modalities, which avoid placing an undue burden on patients' life-style, must be built. These should incorporate patient-centric paradigms of diabetes care, team-based approach for life-style modification and monitoring of patients' adherence to therapy. To address the issues in efficacy and safety, long-acting, flat profile basal insulin, which mimics physiological insulin and show fewer hypoglycemic events is needed. In addition, therapy must be linked to monitoring of blood glucose to enable effective use of insulin therapy. In conjunction, wide-ranging efforts must be made to remove negative perception of insulin therapy in the community. Patient-and physician - targeted programs to enhance awareness in various aspects of diabetes care must be initiated across all levels of health-care ensuring uniformity of information. To successfully address the challenges in facing diabetes care, partnerships between various stakeholders in the care process must be explored.

Keywords: Delivery of health-care; diabetes mellitus; health-care disparities; insulin; life-style; medication adherence; patient compliance; patient-centered care; physician-patient relations; safety.

INTRODUCTION

The developmental origins of health disease (DOHaD) hypothesis proposes that altered environmental influences (nutrition, metabolism, pollutants, stress and so on) during critical stages of fetal growth predisposes individuals to diabetes and

other non-communicable disease in later life. This phenomenon is thought to reflect permanent effects ('programming') of unbalanced fetal development on physiological systems. Intrauterine programming may underlie the characteristic Indian 'thin-fat' phenotype

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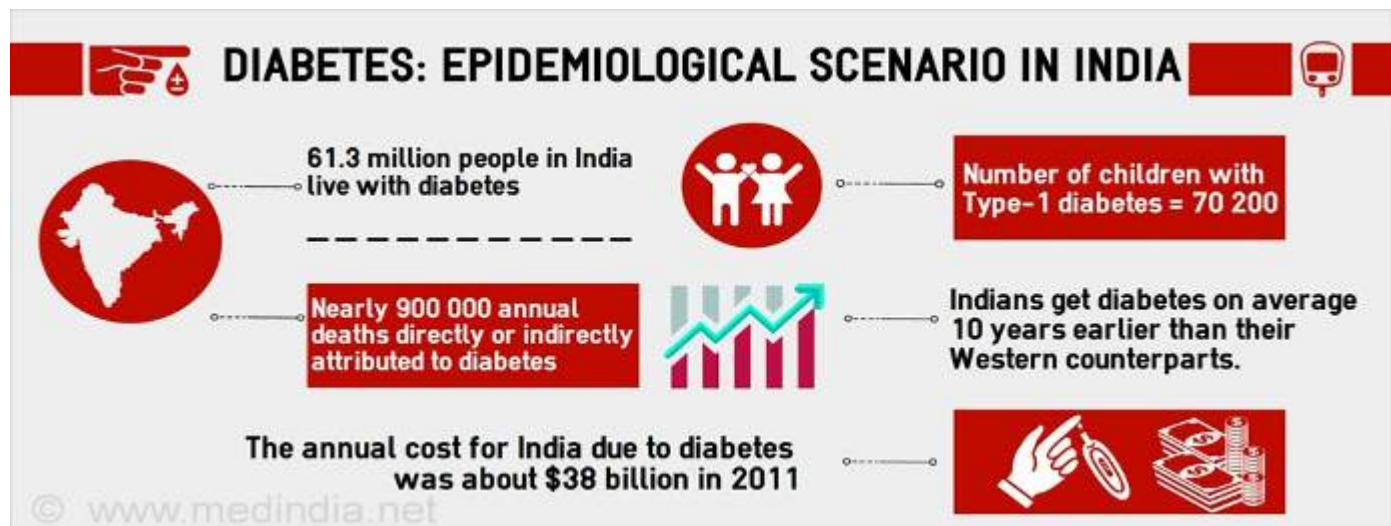


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and the current unprecedented epidemic of diabetes on the backdrop of multigenerational maternal undernutrition in the country. India has been at the forefront of the DOHaD research for over two decades. Both retrospective and prospective birth cohorts in India provide evidence for the role of impaired early-life nutrition on the later diabetes risk. These studies show that in a transitioning country such as India, maternal undernutrition (of

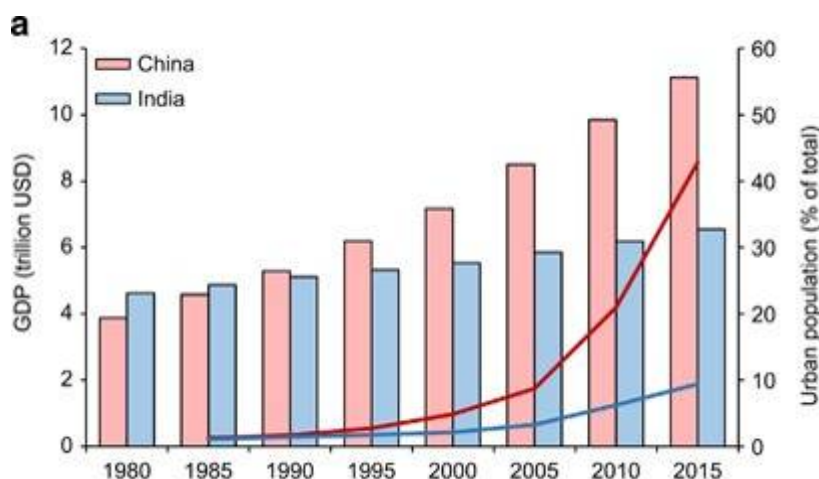
micronutrients) and overnutrition (gestational diabetes) co-exist, and expose the offspring to disease risk through multiple pathways. Currently, the Indian scientists are embarking on complex mechanistic and intervention studies to find solutions for the diabetes susceptibility of this population. However, a few unresolved issues in this context warrant continued research and a cautious approach.[1,2]

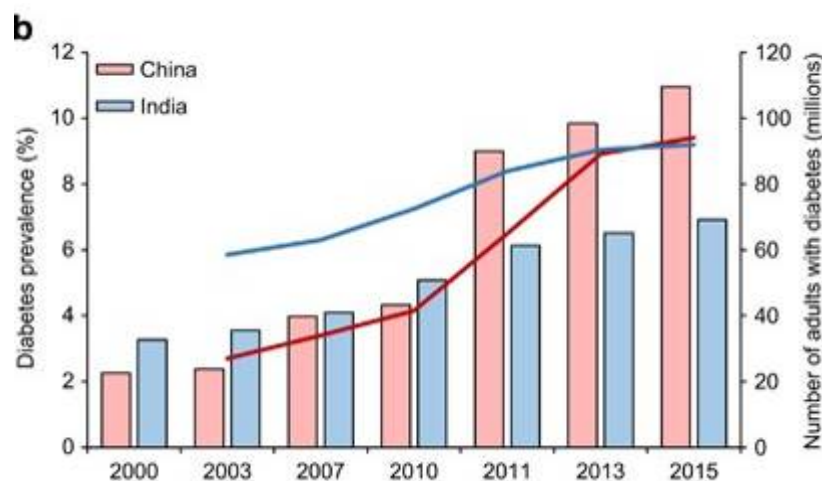


Diabetes is one of the leading causes of morbidity and mortality worldwide and a major problem in India. In 2012, 60% of all deaths in India were due to non-communicable diseases (NCDs), including cardiovascular diseases (26%), chronic respiratory diseases (13%), cancer (7%), diabetes (2%) and other NCDs (12%) . Currently accounting for 43% of total disability adjusted life years (DALYs), the prevalence of NCDs is expected to increase in the coming years due to ongoing large-scale urbanisation and increasing life expectancy .

The prevalence of diabetes in 2013 in India is only slightly higher than the world average (9.1% vs. 8.3% worldwide) [3]. However, due to its very large population, India has the world’s largest population living with diabetes after China. In 2013, there were 65.1 million people between 20 and 79 years of age with diabetes and this number was predicted to rise to 109 million by 2035. The growing epidemic of type 2 diabetes in India has been highlighted in several studies .

Studies have shown large regional and socioeconomic differences in the prevalence of type 2 diabetes in India. Self-reported prevalence is lower in rural areas than in urban areas ranging from 3.1% in rural areas to 7.3% in urban areas .The disease appears to be more prevalent in the south of the country as compared to the northern and eastern parts . However, the absence of large well-planned national studies on diabetes prevalence have led to incomplete and unreliable nationwide data on the prevalence of diabetes in India .[3,4]





Financing and delivery of health care in India has been left largely to the private sector. In 2012, public health care funding was lower in India than other countries in the region, with a general government funding for health accounting for 33% of total health expenditure in India compared to an average of 52% in the South East Asia region. Nevertheless, at 4% of India's gross domestic product (GDP) the share of health expenditure is equivalent to the average of the South East Asia region.

At the 56th World Health Assembly in Geneva in 2012, universal health coverage was identified as essential to consolidate public health advances. While various health programmes and policies have previously attempted to achieve universal health coverage in India, there is still a long way to go. In 2010, only about 19 percent of the population (240 million people) was covered by the country's central and state government-sponsored health insurance. When including private insurance and other schemes, some 25 percent of the population (300 million people) was covered. Thus, the financial burden of health care falls heavily on individuals with the government contributing to one third of total health spending and out-of-pocket payments representing about 58% of total health spend in 2012.

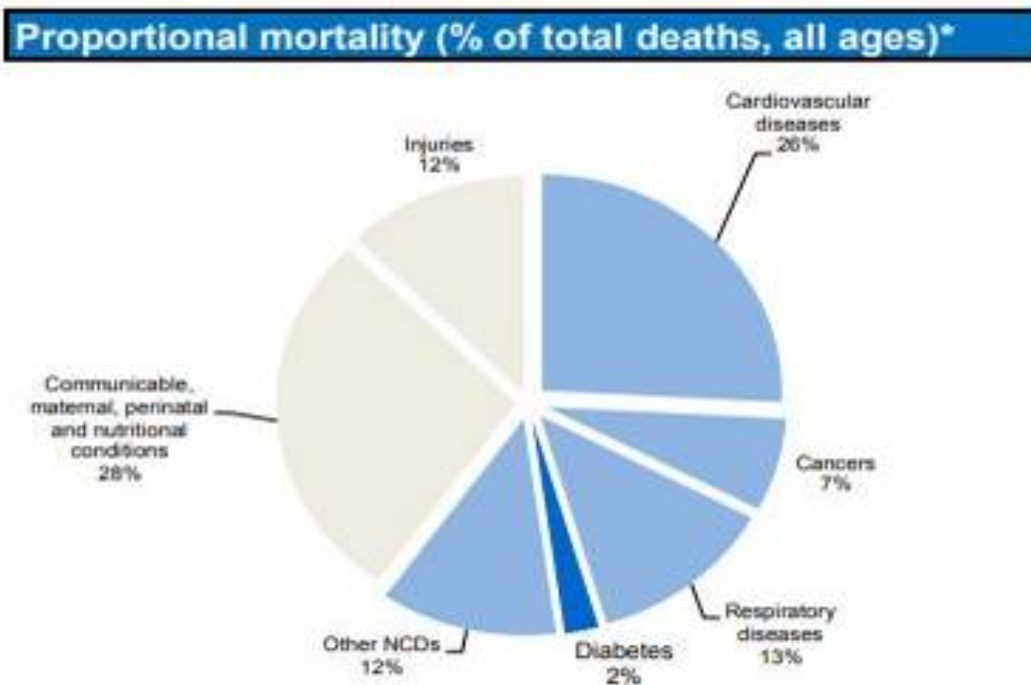
The assessment of the economic and social impact of diabetes in India is important for several reasons. First, India is considered the diabetes capital of the world, yet not enough is done to tackle the disease. An article published in 2007 suggests that an estimated USD 2.2 billion would be needed to sufficiently treat all cases of type 2 diabetes in India. In comparison, health spending per capita in 2012 was USD 61. Second, by 2025, most people with diabetes in developing countries will be in the 45 to 64 year age group, thus threatening the economic productivity of the country and the income-earning ability of individuals. Third, the management of diabetes and its complications can be expensive, which poses serious obstacles to the strengthening of the Indian health care system and the Government's plan to achieve universal health coverage by 2022.[5,6]

As the burden of diabetes on total health care spending is likely to increase and, potentially, will have important consequences on the sustainability of health care financing, this study presents a critical review of the literature on cost of illness of diabetes and its complications in India and also makes recommendations on areas requiring further attention and research.

Discussion

Diabetes mellitus (DM) is a chronic metabolic disorder characterized by persistent hyperglycemia, due to impaired insulin secretion, resistance to peripheral actions of insulin, or both. The prevalence of type 2 diabetes (T2DM) in India is around 7.3%. It is seen that commonly patients take consultation from general practitioners, mostly MBBS and AYUSH doctors. Also, doctors qualified to treat T2DM, who possess either of the following degrees, i.e., MD Medicine, DNB Medicine, DM Endocrinology, or Diploma/Fellowship in Diabetology are expected to follow the guidelines given by various professional bodies like the American Diabetes Association. Looking at the present epidemiology of T2DM in different geographic locations of India and the scarcity of qualified diabetologists, it is likely that care received by the patients may vary in quality. The present study was conducted with an objective to understand the symptoms of T2DM at diagnosis, treatment protocols followed by various categories of medical practitioners, and awareness among the patients regarding diabetes reversal by lifestyle modification in India. The rationale of this study was to provide an analysis of the quality of diabetes care received by the patients. A total of 48.2% of the participants were tested for HbA1c at the time of diagnosis. The essential investigations to be done at the time of diagnosis as given by the ADA guidelines, which are both fasting and post-prandial blood sugar and HbA1c were done by 38.1%. A total of 3% and 2.7% of the

participants were diagnosed to have diabetes only on the basis of only post-prandial and fasting blood sugar, respectively. [7,8] Before starting antidiabetic medications, 45.7% got their lipid profile done; 28.7%, 26.1%, 14.8%, and 18.3% got their serum creatinine, blood urea, urine micro albumin, and serum glutamic-pyruvic transaminase (SGPT) checked, respectively. A total of 15.8% were evaluated for retinopathy, 14.5% for vitamin B12, and 13.5% for vitamin D levels. After being diagnosed with diabetes, 54.9% were started with antidiabetic medication on the same day, whereas 16.4% had not started any antidiabetic medication yet. Diabetes care is complex and requires many issues beyond glycemic control.



The standard guidelines are intended to provide clinicians, patients, and researchers with the components of diabetes care, treatment goals, and tools to evaluate the quality of care. These recommendations favorably affect the health outcomes and quality of life of the patients diagnosed with T2DM and, therefore, must be followed meticulously by all the medical practitioners irrespective of their qualification and specialization. One of the important aspects our article infers is that there are parts of India where doctors with specialization are not available, which does not mean that the doctors available in that area should not be allowed to treat the patients with T2DM; however, these doctors must follow the guidelines proposed by various bodies nationally and internationally, instead of following the local trends of management of T2DM.[9,10]

Results

This study has aided in adding to the pre-existing data on diabetes care given in India. The results of this study are found to be barely satisfying the global standards of diabetes care proposed by various bodies, and this is the condition in metro cities of India, which questions the care given in rural areas, where there is a scarcity of health professionals and services. Therefore, it implies the need for training and continued medical education of all the doctors belonging to different fraternities, who practice management of T2DM patients on a regular basis. T2DM has reached epidemic proportions and is one of the leading causes of premature morbidity and mortality worldwide. Frequent eating, overeating, junk food, and low levels of physical activity are commonplace and are major factors for the global epidemic of obesity. Given that lifestyle modification is safe and cost-effective, its importance should be stressed not only upon the diagnosis of diabetes but throughout the course of the disease.[11,12] Once type 2 diabetes is diagnosed, it is of utmost importance that patients receive optimum standard of care to avoid complications. Considering the high cost incurred at various steps of screening, diagnosis, monitoring, and management, it is important to realize that cost-effective measures of lifestyle modification should gain importance among all medical practitioners and should be practiced routinely.

India lies to the north of the equator between 6° 44' and 35° 30' north latitude and 68° 7' and 97° 25' east longitude. India's coastline measures 7517 km in length; of this distance, 5423 km belong to peninsular India and 2094 km to the Andaman, Nicobar, and Lakshadweep island chains. The Indian climate is strongly influenced by the Himalayas and the Thar Desert. Four major climatic groupings are predominant in India: tropical wet, tropical dry, subtropical humid, and montane. [13,14]

DIABETES IN INDIA			
NUMBER OF INDIANS WITH DIABETES		PREVALENCE IN ADULTS ABOVE 20 YEARS	
1990	26 million	1990	5.5%
2016	65 million	2016	7.7%
HIGHEST PREVALENCE IN 2016			
Tamil Nadu		Kerala	
		Delhi	

Rapidly changing socioeconomic demographics have changed the global landscape of diabetes. Geographically, the prevalence of diabetes has been studied by many expert groups. The extreme locations contribute to variance in the diabetes prevalence rates, not only across the longitude and latitude, but also across rural and urban areas of the country.[15,16]

Considering the enormous burden of diabetes in India, it is important to realize the necessary cost-effective measures of diabetes care: early screening, tight metabolic control, monitoring of risk factors, and assessment of organ damage. Economic analyses of diabetes care in India found that the cost of providing routine care is only a fraction of the overall cost and is perhaps still manageable. However, when this is not available or its quality is poor, the overall direct and indirect costs escalate with disastrous health and economic consequences to the individual, his or her family, and society, particularly due to the onset of the micro- and macrovascular complications of the disease. Published data from several epidemiologic, experimental human and animal studies, and from several large trials like the Diabetes Control and Complications Trial, the Kumamoto study, and the UK Prospective Diabetes Study Group have convincingly demonstrated the importance of tight metabolic control in arresting and preventing the progression of target organ damage.[17,18]

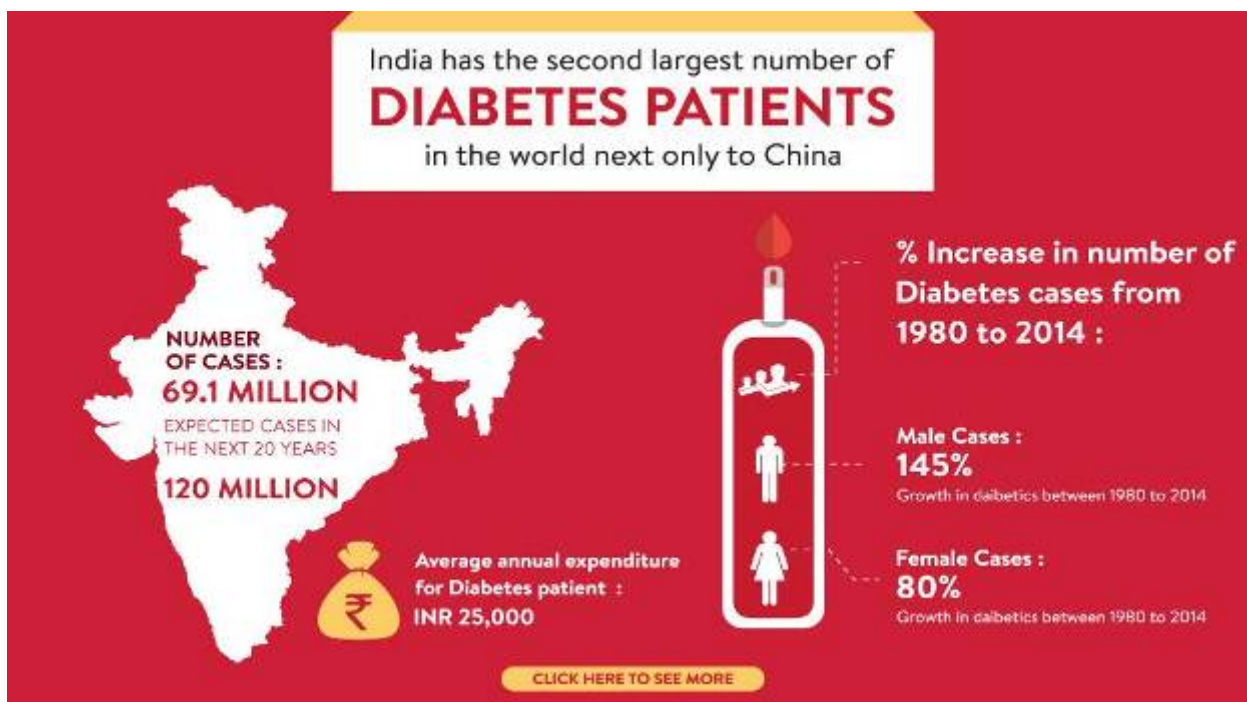
Conclusions

Diabetes is one of the most widespread lifestyle diseases affecting people globally. In a recent study in the Annals of Epidemiology, Elsevier, it was concluded that diabetes has risen sharply in India in the last couple decades both in urban and rural populations across all age groups (20-99 years) and gender demographic.

India has the second largest population of diabetics with 76 million people suffering currently. By 2025, 10% of the population is likely to be affected by diabetes.

Pain-points & solutions

Close monitoring of blood sugar requires uncomfortable blood draws and needle pricks. Continuous glucose monitoring (CGM), a compact medical equipment consisting of a small sensor, which needs to be changed every 10-14 days, inserted on the abdomen or upper arm to take readings from interstitial fluid in real time and a monitor to display results, is capable of ameliorating this discomfort.



Instead of finger pricking, patients can simply scan the sensor to receive results. Some CGM devices have a smartphone app and some allow patients to add caregivers to the data stream. The real time results can notify patients of impending hypoglycaemia. CGM also effectively eliminates finger stick testing and is capable of identifying nightly fluctuations, storing data, help reducing HbA1C levels and maintaining a healthy blood glucose range.

Almost 25% of Type 1 Diabetes patients already use CGM devices and it is expected that 50% patients will start using them between 2020-2025.[19]

The major companies involved in the Indian CGM market include Abbott, Medtronic., Dexcom etc. to name a few. For instance, the Abbott Freestyle Libre device was recently launched in India and has quickly gained popularity amongst Type 1 and Type 2 Diabetes patients. By 2021, Abbott is primed to launch their software to collate the data on smart devices.

Advent of digital apps has simplified diabetes management and control. The primarily used apps can be grouped under glucose tracker apps, blood glucose knowledge apps and calorie tracker and exercise apps. The adoption of digital diabetes monitoring solutions is anticipated to rise at a CAGR of 21% by 2027.

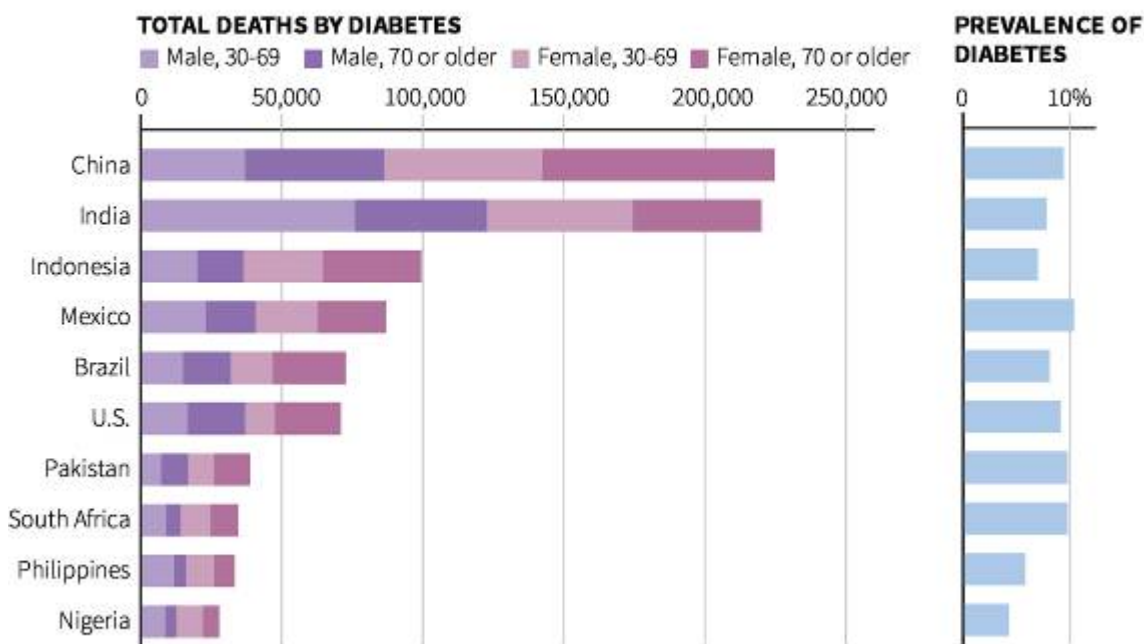
Technologically healthy- The emergence of health apps

Several startups in India are using deep learning and artificial intelligence to track diabetes patients’ status, provide diet plans, and offer specialist advice.

HealthifyMe, Bengaluru, established in 2012, works on lifestyle diseases. With conversational artificial intelligence (AI), Ria, capable of answering nutritional queries by combining technological prowess and advice from professionals, suggests diet routines to better manage diabetes.

Deaths caused by diabetes

According to World Health Organization, an estimated 1.5 million deaths are directly attributed to diabetes each year globally. Below are the top ten countries with the most deaths by diabetes in 2015.



Note: Data for prevalence of diabetes is of 2016. Source: World Health Organization

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Artelus, 2015, based in Bengaluru, USA and Dubai, uses a deep-learning, AI powered algorithm, DRISTi to allow early detection of diabetic retinopathy from high-powered images of the patients’ retina.

BeatO, based in Delhi, established in 2015, provides smart diet options by identifying the patients’ glycaemic index and suggesting proper food items.

Oburculum, founded in 2016 in Chennai, is a unique app that uses AI on genomic data to swiftly diagnose disease like diabetes, cancer and neurological disease with surprising efficiency and prevent delay.

ChironX, 2017, headquartered in Gurugram, detects retinal disorders associated with diabetes by analysing retinal fundus images with an accuracy of more than 95%.

Wellthy Therapeutics, based in Mumbai and Bengaluru, is bringing affordable disease management to patients with readily available nutritionists, fitness coaches and counsellors to guide them into preventing, managing and even reversing chronic conditions.

Artificial intelligence-based healthcare has received much impetus in India in recent years. Bridging the gap between patients and doctors and making healthcare affordable for people across all income strata has been the basic motive for developing AI-based solutions. The market might be prepared for AI technologies but there are several impediments ahead, most importantly, data security. AI-based healthcare services require collection of data from previous studies which must be protected to prevent misuse and identity theft.



Pancreas on silicon

Scientists from Harvard University in the US are attempting to develop Islet chips to study beta cells of the pancreas that produce insulin. Islet chips are microchips that monitor whether the donated or manufactured beta cells are capable of normal functioning and insulin release. Diabetes mellitus directly results from insulin desensitization of the body. Pancreas beta cells can be transplanted but that does not ensure their functionality. Islet chips can help determine this before transplant. Although this technology is at the nascent stage, it presents an exciting prospect on the road towards reduction and eventual eradication of diabetes.

Enormous strides have been made to merge our lives with technology, enabling us to simplify life in every possible way. Healthcare is a significant part of daily routines, especially for those with chronic diseases such as diabetes. Monitoring apps, AI-based technology, etc. are making healthcare more streamlined and convenient for patients as well as caregivers.[20]

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