Review Article

Reconsidering the history of type 2 diabetes in India: Emerging or re-emerging disease?

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ABSTRACT

The emergence of type 2 diabetes in India, coinciding with the country's rapid economic development in the past several decades, is often characterized as a modern epidemic resulting directly from westernization. We draw on India's agricultural, linguistic, medical, economic, religious and gastronomic history to examine the possibility that type 2 diabetes mellitus may have existed in ancient India, having subsequently declined in the two centuries leading up to the present. The implications of such a possibility vis-à-vis the role of westernization in the global diabetes aetiology are discussed. Additionally, an argument is made for careful application of the terms 'westernization' and 'globalization' in discussions of chronic disease aetiology, where their often totalizing discourses may obscure the sociocultural particularities of manifestations of these conditions in various global arenas.

Natl Med J India 2008;21:288–91

INTRODUCTION

Why study the history of diabetes in India?

As the world shifts from a high prevalence of infectious diseases to chronic diseases, type 2 diabetes mellitus (T2DM) is becoming a major international health concern. India, in particular, is poised to become the world's leader in the prevalence of T2DM, and it already has a larger number of people with diabetes than any other country in the world.[1] Chronic diseases such as diabetes are causing substantial economic and life losses in low- and middle-income countries.[2] The International Diabetes Federation projects that by 2025, the Southeast Asia region will harbour approximately 82 million people with diabetes, with India contributing the vast majority.[3] The recent increase of diabetes in India and the projections for the future constitute a major public health problem.

Most medical and epidemiological studies of diabetes maintain this forward focus on the impending threat of diabetes, and understandably so. However, by focusing so heavily on future projections, studies may inadvertently overlook the socio-historical contexts out of which the contemporary pandemic of T2DM has arisen. This omission may have important implications, since an essential part of preventing and controlling any disease is an understanding of the factors that have led to its emergence. A first step toward understanding the aetiology of diabetes is to acknowledge that causative factors may manifest differently from context to context, even if they share some characteristics.

To better understand the factors that have led to the population-wide emergence of T2DM in varied social contexts, we use India as a case study to illustrate our point that a historical analysis may be useful in understanding the aetiology of diabetes and, further, how it may challenge existing ideas about the definition and importance of westernization as a risk factor for diabetes. Our preliminary analysis of historical texts and secondary scholarship allows us to speculate that some 'elite' subgroups in pre-modern India may have been exposed to many of the known risk factors for T2DM, including a high-sugar and high-fat diet, sedentariness, old age and relative economic prosperity. Linguistic analyses of ancient Sanskrit medical texts further suggest that T2DM was, at the very least, enough of a presence in ancient India to warrant a substantial number of references in these treatises.

INDIA'S HISTORY WITH SUGAR AND DIABETES

One important risk factor for T2DM, and perhaps one of the most promising arenas for treatment, is diet. Consumption of sugar, the archetypical refined carbohydrate, is clearly linked to T2DM, and India is often credited with having 'invented' sugar—having developed the technology to reduce cane juice to its crystalline form—around 400–500 BCE, when the earliest worldwide mentions of cane sugar consumption appear in Sanskrit texts.[4,5] Indeed, the English word 'sugar' is derived from the Persian *sakkar*, which itself comes from the Sanskrit term *Œarkarœ*, meaning 'gravel' and referring to the crystalline or granular form of processed sugar.[5] These references suggest that sugar in its processed form was first used in the Sanskrit-speaking groups of ancient India.

Several ancient texts suggest that this sugar consumption may have had deleterious effects on health; among these, some of the most well-known references come from the Ayurvedic textbooks *Charaka samhita* and *Su§ruta samhita* (dating perhaps as far back as 1000 BCE and 600 BCE, respectively). These, along with the *Atharvaveda*, contain some of the oldest known descriptions and classifications of diabetes, with sufficient detail to remove most doubts about whether or not they were actually writing about diabetes. The *Su§ruta samhita* in particular treats diabetes in great

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detail; it enumerates multiple symptoms such as overabundance of urine, sweet urine, weight loss, impotence and ulcers. It even differentiates between hereditary, early-manifesting 'thin' diabetes, and later-onset, food-related 'fat' diabetes, classifications obviously analogous to modern types 1 and 2.[6,7] Both texts identify overnutrition and lack of exercise as causes of some forms of diabetes, and they recommend dietary control and regular exercise as remedies, along with various Ayurvedic treatments.[6,8]

In the *Samhita*s, diabetes is usually referred to as *madhumeha* or *iksumeha*, Sanskrit terms that connote the sweetness of the urine that is a symptom of the condition (*madhu* means 'honey' in modern Hindi).[6,7] There are many other Sanskrit words that refer to various types of diabetes and symptoms (Table I).[9] To provide just one of the more than 20 examples, *bahumètra* is a specific type of *prameha* (urinary disease) in which the patient experiences excessive passage of urine, one distinctive symptom of diabetes.

Based upon the clear descriptions and classifications discussed above, we can conclude that T2DM probably existed in ancient India. However, because there is no epidemiological record, it is impossible to know with any certainty to what extent this illness affected the population. That it is discussed by physicians whose patients perhaps belonged to the upper socioeconomic classes suggests that T2DM may have been confined to the upper strata of the population; on the other hand, however, the proliferation of Sanskrit terms suggests that the illness had an important enough presence to warrant so many descriptors.

TABLE I. Sanskrit words associated with diabetes

Number	Sanskrit term	English translation
1	bahumètra	making water in excess; diabetes
2	haridrŒmeha	yellow diabetes; suffering from it
3	hastimeha	a kind of diabetes; suffering from it
4	iksumeha	diabetes or diabetes mellitus; suffering from diabetes
5	ksaudrameha	the disease diabetes mellitus
6	madhumeha	honey-like or saccharine urine, diabetes; the state of passing saccharine urine
7	madhuprameha	honey-like or saccharine urine, diabetes
8	meha	urinary disease, excessive flow of urine, diabetes
9	mehaghn´	'curing diabetes', Indian saffron
10	mètrŒt´sŒra	diabetes
11	n´lameha	blue diabetes; voiding bluish urine
12	pistameha	flour-like diabetes; suffering from it
13	prameha	urinary disease (general term applied to all urinary disease, of which there are 21 varieties including diabetes, gleet, gonorrhea, etc.)
14	sŒndrameha	a kind of diabetes; suffering from it
15	sŒndraprasŒdameha	a kind of diabetes
16	somaroga	diabetes or a similar disease
17	surŒmeha	a kind of diabetes
18	udakameha	'watery urine', a sort of diabetes
19	udamehin	having watery urine or diabetes
20	vasŒmeha	a kind of diabetes; suffering from it
21	vidradradhikŒ	a kind of abscess (which accompanies diabetes)
22	vinatŒ	an abscess on the back or abdomen accompanying diabetes
23	z´tameha	diabetes caused by or attended with cold
24	zuklameha	whitish diabetes
25	zukrameha	seminal diabetes

Source: Monier–Williams' Sanskrit dictionary[9]

WHAT FACTORS MAY HAVE CONTRIBUTED TO DIABETES IN ANCIENT INDIA?

The historical economic features of the Indian subcontinent provide evidence of an environment that may have been conducive to T2DM for some groups. The influx of Aryan-speaking people from central Asia between 2000 and 1500 BCE resulted in a new Aryan elite and solidification of the *varna* (caste)-based social structure.[10] Until the beginning of the economic decline between the thirteenth and sixteenth centuries, India produced the largest share of the world's gross domestic product[11] (Fig. 1). This relative affluence may have resulted in high per capita availability of calories, at least for elite groups, but wealth and access to rich foods were almost certainly unequally distributed.[12,13] Hence, our suggestion that wealthier classes would have been disproportionately affected by T2DM in ancient times, as they usually are in contemporary India.[14]

Genetically or phenotypically determined body composition and ideals of beauty also raise questions about the existence of T2DM in ancient India. As with western art, ancient Indian artwork reflects the idealized body types of the eras in which it was produced. Judging from this art, a full figure appears to have been valued as an index of prosperity, health and even social power;[13] historic paintings and sculptures depict full-figured people and deities with conspicuous bellies. Contemporary research suggests that Indians may be genetically or phenotypically predisposed to store body fat viscerally.[15,16] Ancient Indian artistic images, then, may be early depictions of a fat storage pattern that is still common in the subcontinent, posing a higher risk for T2DM and heart diseases than fat stored on the hips or buttocks.[17,18] Indeed, one scholar has gone so far as to suggest that the corpulent Hindu elephant-god *Gane§a*, whose food of choice is *ladoo* (sweet gram flour balls held together with sugar and *ghee*), has an appetite and a physique that may be an early representation of central obesity, insulin resistance, and possibly the 'classic' T2DM.[19]

Along with high-sugar diets, prosperity and abdominal fat stores, long life expectancy is another known risk factor for T2DM,[20] and life expectancy may have been relatively high for some ancient Indians. Several Sanskritic rituals specifically

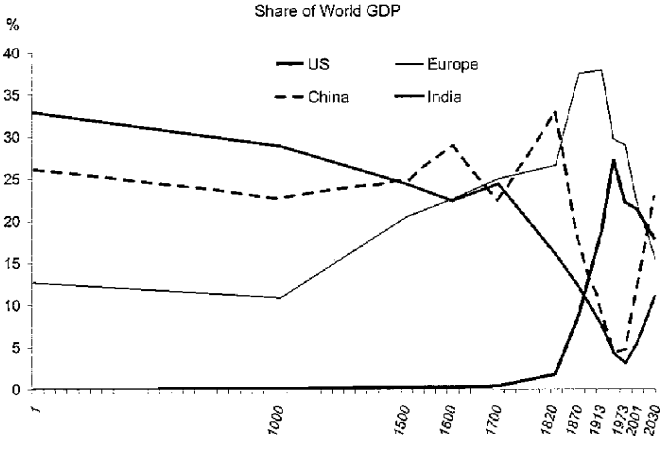

FIG 1. India was once the world's largest economy, but it was surpassed by China during the Mughal period between the thirteenth and the sixteenth centuries, and further declined during and after British colonization. Now, India's economy is once again on the rise. Reproduced and adapted with permission from Goldman-Sachs[28] with additional data from OECD.[52]
GDP gross domestic product

commemorate old age, including the *Sashtiabdapoorthi* (60th birthday celebration), the *Sathabishekam* (80th birthday celebration), and the *Kanakabhishekam* (celebrated when the first born son's first son begets a first son).[21] The possibility of long life expectancy reinforces the speculation that some groups may have been relatively affluent, and constitutes evidence of another potential risk factor for T2DM in these groups.

Given the importance of diet in the aetiology of T2DM, ancient Indian diet and food culture would also have played a role. We have already discussed evidence for the historical use of refined sugar, and saturated fats have also been central to the Indian diet for millennia. Historically, the most valued source of dietary fat has been *ghee*, or clarified butter, the use of which is documented as far back as the *Rigveda* (dating around 1500 BCE). Regarded as one of the 5 holy substances derived from the sacred cow, ghee is thought to confer ritual purity to foods.[22] As such, ghee was (and still is) used in everything from Ayurvedic medical preparations to cooking and sweet-making, although its relatively high price skews its use toward wealthier groups.[23,24] Rich foods made with ghee play (and, we suspect, have played in the past) an important role in traditional occasions such as weddings, new year and harvest festivals. Overall, the emphasis on rich foods, valuation of a full figure, relatively high life expectancy, consumption of saturated fat and sugar by the wealthy, and general economic affluence could have combined to produce T2DM in some groups in ancient India.

Fifty years ago, T2DM was less common in India than it is today. Improved diagnostic techniques have undoubtedly contributed to the observed increases, but serial population-based studies in Chennai have demonstrated increasing prevalence independent of new diagnostic practices.[25,26] This implies that other factors have contributed to the recent upsurge of T2DM, and we suggest that economic changes may play a role. India's economy declined significantly during the eighteenth and early nineteenth centuries, before which its economy was relatively prosperous[11,27,28] (Fig. 1). Although British colonization certainly did not destroy the economy, it did reshape India's independent economy of handicraft workers and self-sufficient peasants into an export-oriented agricultural system, with small profits for farmers and limited industrialization that, until very recently, was forced to depend on foreign technology.[29] There was a period of economic hardship and slow recovery during and after colonization with more frequent famines, increased social stratification and reduced per capita income.[27] At the end of colonization in 1947, the literacy rate was 17% and life expectancy at birth was 32.5 years.[29]

Generally, economic hardship reduces the incidence of chronic diseases on a population level. During Cuba's economic crisis of 1989–2000, for instance, a population-wide decrease in caloric intake and increase in physical labour resulted in substantially lower mortality from diabetes and other chronic diseases.[30] Akin to the situation in Cuba, the relatively more impoverished conditions of colonial and post-colonial India could have resulted in lower levels of T2DM during the two centuries leading up to the present. As with ancient times, no population-level statistics on the prevalence of T2DM are available for the colonial period, so our discussion remains speculative. By 2004, however, conditions in India had improved significantly; life expectancy at birth had increased to 63 years and the literacy rate was 61%.[31] Along with this improvement in development-related indicators has come India's rapid increase of T2DM, but the historic evidence suggests that T2DM may have existed at some level and in some subgroups in India for millennia.

WHAT FACTORS ARE CONTRIBUTING TO THE CONTEMPORARY RESURGENCE OF DIABETES IN INDIA?

Some diabetes-inducing factors are unique to the present time, and our emphasis on a historical perspective is by no means an attempt to undermine the importance of these factors. Many modern Indian diets are a risk factor for T2DM. Consumption of dairy products, sugars and saturated fats has increased substantially since the 1970s, along with a reduction in dietary fibre[24]—patterns that have been linked to insulin resistance in South Asian populations.[32,33] Adoption of large-scale food production and packaging techniques, including the addition of preservatives, sugars and hydrogenated fats, is partly responsible for this dietary shift.[34] This is especially a concern in wealthy groups; it is estimated that the richest 5% of India's population consumes one-third of all available dietary fat in the country,[24] and there is evidence that economic and social inequalities are increasing.[35] High socioeconomic status groups in India, unsurprisingly, have the highest prevalence of diabetes.[14]

In addition, higher levels of sedentariness and mechanized transportation are doubtless contributing to T2DM in contemporary India.[25] As sedentary occupations become increasingly available and the middle class expands, exercise levels are decreasing, resulting in the double burden of higher caloric intake and reduced activity, particularly in urban areas, but rapidly spreading to semi-urban and rural locales as well.[36,37] The combination of reduced physical activity and nutrition transition has been associated with increasing population-level T2DM prevalence in India and elsewhere.[26,38]

Much recent work on T2DM has substantiated the hypothesis that Indians may be genetically, nutritionally and/or environmentally predisposed toward higher body fat percentages, insulin resistance and greater visceral fat storage than other populations, even when the body mass index (BMI) remains within WHO's normal range.[39,40] The bodily propensity of many Indians to store fat viscerally, whether the result of foetal programming, genetics, diet or some other factor, is a salient population-specific risk factor for T2DM with important implications for its past prevalence in India, as well as its future.[41]

CONCLUSIONS

Because they encompass such a broad range of biological, economic and sociocultural factors relating to diet, food production, workplace structure and activity, the related concepts of 'westernization' and western-led 'globalization' are often treated as uniform, static forces that are propelling the global increase in T2DM.[42–46] However, we should be wary of the totalizing discourses that may result from over-reliance on these terms to explain T2DM.[47] One important aspect of a shift away from generalized discussions of globalization will be an understanding of the particular social and historical contexts out of which chronic diseases have arisen.

Informed by this perspective, we have attempted to consolidate the evidence suggesting that diabetes may have existed in India before the era of globalization, in the hope of stimulating more in-depth research. This paper has asked and attempted to answer questions about what particular features of Indian societies may have been responsible for the potential existence of T2DM in pre-modern India, and which among those features may be relevant to the present occurrence of the disease. An understanding of T2DM with respect to India's economic and cultural history reframes the recent increases as a possible peak in a long-standing trend, rather

than an unprecedented phenomenon. Clearly, however, further work is needed on the history of all chronic diseases, including T2DM in India.

Despite the lack of concrete epidemiological evidence, it is both intellectually and medically valid to consider a historical reframing of diabetes in India. Such an approach foregrounds the social and cultural aspects of the disease, areas that have great potential for behaviour-change prevention and treatment. This approach might even illuminate new therapeutic routes from sources such as Ayurveda, whose herbal treatments for diabetes have documented hypoglycaemic properties.[48–51] A broadening of our perspective to include influences over a larger span of time not only allows historical analysis of multiple causal elements of T2DM; it also implies new directions for treatment and prevention.

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