

Epidemiology of NIDDM in Indians

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Epidemiology is the study of the distribution and determinants of disease frequency in man. The application of epidemiology to the study of non-insulin dependent diabetes mellitus (NIDDM) has provided valuable information on several aspects of this disease such as its natural history, prevalence, incidence, morbidity and mortality in diverse populations around the world. In addition, it has led to the identification of the cause of the disease and the possible preventive measures that could be instituted to arrest or delay the onset of this disease which has reached epidemic proportions in both, the developed and the developing nations [1].

Prevalence of NIDDM in Indians

The prevalence of NIDDM varies in different geographic regions and also in different ethnic groups [2]. The first authentic data on the prevalence of diabetes in India came from the multicentric study conducted by the Indian Council of Medical Research (ICMR) in the early seventies [3]. This study reported a prevalence of 2.3% in the urban and 1.5% in the rural areas. The criteria used in this study were different from those set by the WHO Expert Committee on Diabetes Mellitus.

Many epidemiological studies carried out in different parts of the world reported an interesting finding that Indian migrants settled abroad had a high prevalence of NIDDM [4] which was believed to be due to greater affluence and a change to a more sedentary life style as compared to the native Indian population. However, the local host populations living in identical environment in these countries still has only a low prevalence rate of diabetes. Assuming that Indians as an ethnic group have a high degree of genetic predisposition to develop diabetes, one could expect higher prevalence of diabetes among the native urban populations with a comparable affluent life style. A study by Verma et al [5] using a questionnaire method reported a prevalence of 3.1% in an affluent area in Darya Ganj, New Delhi. Our own studies using the WHO criteria showed a prevalence of 5% in an urban township in South India [6]. The prevalence when adjusted to the age distribution of the migrant population in Southall, London [7] and in Fiji [8] increased to 10% and 9% respectively. The findings in the above studies clearly point to a rising prevalence of NIDDM in India which is

probably related to improved living conditions and changing life styles in the urbanised regions.

If environmental factors do have a significant role in unmasking diabetes, one would expect a lower prevalence in the rural areas where the populations follow a conventional life style. Such an urban-rural difference in the prevalence rate was found in a recent survey conducted by the Diabetes Research Centre in Madras on two populations belonging to the same ethnic group but with different socio-economic status [9]. The age-adjusted prevalence of diabetes was 8.2% in the urban (8.4% in urban men and 7.9% in urban women) and 2.4% in the rural population (Table 1). The prevalence rate of diabetes showed no significant sex difference. Low prevalence of diabetes in rural India has been reported by several authors [3]. We have also noted that Indians in general had higher upper body adiposity despite their lean body mass. This study brought into focus the high prevalence rate in urban India which is comparable to that in migrant Indians. Age, body mass index (BMI) and waist : hip ratios showed positive association with diabetes in both populations. Despite the low BMI in the rural population, upper body adiposity and BMI were positive risk factors in this relatively nonobese population.

Table 1
Age-Adjusted Prevalence of Diabetes and IGT in the Two Populations

		Prevalence (%)	
	No.	Diabetes	IGT
Urban			
Total	900	8.2	8.7
Men	457	8.4	8.8
Women	443	7.9	8.3
Rural			
Total	1038	2.4	7.8
Men	520	2.6	8.7
Women	518	1.6	6.4
Diabetes	urban vs. rural	$\chi^2 = 29.4, P < 0.001$	
IGT	urban vs. rural	NS	
Diabetes	urban vs. rural men	$\chi^2 = 14.2, P < 0.001$	
IGT	urban vs. rural men	NS	
Diabetes	urban vs. rural women	$\chi^2 = 21.1, P < 0.001$	
IGT	urban vs. rural women	NS	

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Table 2 shows the results of a multiple regression analysis which highlighted that the habitat, age, BMI and upper body adiposity (WHR) were significant contributing factors for NIDDM.

Table 2

Multiple Regression Analysis Showing Variables Significantly Associated with NIDDM in Indians

	Rural-Urban	Age	BMI	Waist:Hip Ratio
Coefficient(B)	0.930	0.643	0.262	0.555
Standard Normal Variate (Z)	2.21	6.59	2.45	3.28
Odds Ratio (OR)	2.534	1.903	1.30	1.742

Prevalence of undetected diabetes

The new to known ratio was 1 : 2 in an urban population while the corresponding data for the rural population was 3 : 1 [9]. Similar findings have been reported for urban and rural populations of migrant Indians [4]. These differences are probably due to marked changes that have occurred in the quality of the food consumed by the urban population. Urbanisation has probably led to a transition from consumption of natural forms of food to more refined food. This in combination with less physical activity could probably lead to unfavourable adiposity and hence increase the risk of developing diabetes. This observation is of great significance in view of the fact that an internal migration from conventional living style to a sedentary and westernised pattern is enough to unmask the genetic trait in the Indian subjects.

Factors influencing the prevalence of NIDDM

Age and sex have been found to be the most positively associated parameters with NIDDM in both the urban and the rural populations surveyed in Madras [9]. The prevalence of diabetes was 41 % in the age group 55-64 years. It has been reported that in Southall, UK, Asians aged 40-64 years had five times higher prevalence of diabetes as compared to Europeans. Almost all the epidemiological studies have shown a male preponderance among the Indian diabetics inspite of increased rates of obesity in women.

Prevalence of Impaired Glucose Tolerance (IGT)

The ratio of the prevalence of IGT/diabetes is variable in different populations and is usually around

the rural populations (8.7% and 7.8%) despite a four fold lower prevalence of diabetes in the rural population (Table 1). This observation assumes significance in view of our earlier observation that about 35% of the subjects with IGT became diabetic during a mean follow-up period of 5 years [11]. With increasing urbanisation one would expect a higher conversion rate of IGT to overt diabetes and hence the prevalence rate of diabetes could be expected to rise in India in the near future.

Familial aggregation in NIDDM

There are a number of epidemiological evidences to indicate a strong genetic component in the causation of NIDDM. Our studies have shown an increased familial aggregation of NIDDM with higher prevalence of NIDDM among Offspring of Conjugal Diabetic Parents (OCDP) [12]. A recent analysis of the family history of NIDDM patients attending our centre has shown a positive family history of 62% with 53% having first degree relatives with. diabetes (under publication). An increasing risk of diabetes with increasing familial aggregation has been shown by the development of diabetes in the offspring two decades earlier than their parents. The cumulative risks of developing diabetes in the offspring by the age of 70 years increases from 41 % in families with one diabetic parent to 64% in those with positive family history on the non-diabetic parental side and to 73% in those with both parents having diabetes.

Evidences from epidemiological studies described so far clearly point out that Indians as an ethnic group have a very high risk of developing diabetes. With increasing urbanisation and increased life expectancy, a phenomenal increase like an epidemic of diabetes has been foreseen by many epidemiologists (Table 3) [13]. This may pose a severe burden on the health care system in India and it calls for appropriate strategies to effectively tackle this problem.

Table 3
Projected Number of People with Diabetes in some Countries*

Nation	Estimated number of people with diabetes	
	year	
	1990	2000
	(Millions)	
People's Republic of China	6	14
India	15	35
Africa	7	20
United States of America	10	18

* Ref. 13

Concluding remarks

Similar prevalence rate of NIDDM in the migrant and native Indians in affluent areas suggest the high genetic risk for diabetes in ethnic Indians. Age, urban-rural factor, body mass index and abdominal adiposity (waist:hip ratio) were positively associated with NIDDM. Migration from rural to urban environment with changes in life style may have contributed to the increased prevalence of diabetes.

REFERENCES

1. Zimmet PZ. Challenges in Diabetes Epidemiology: from West to the Rest. *Diabetes Care* 1992; 15 : 232-52.
2. West KM. Diabetes in the tropics: some lessons for western diabetology. In: *Secondary Diabetes: the spectrum of the diabetic syndromes*. Podolsky S, Viswanathan M (eds). Raven Press, New York 1980; 249-55.
3. Ahuja MMS. Epidemiological studies on diabetes mellitus in India. In: *Epidemiology of Diabetes in Developing Countries*. Ahuja MMS (ed). Interprint, New Delhi 1979; 29-38.
4. Ramaiya KL, Kodali VRR, Alberti KGMM. Epidemiology of diabetes in Asians of the Indian subcontinent. *Diabetes Metab Rev* 1990; 6 : 125-46.
5. Verma NPS, Mehta SP, Madhu S, Mather HM, Keen H. Prevalence of known diabetes in an urban Indian environment: the Daryaganj Diabetes Survey. *Br Med J* 1986; 293 : 423-4.
6. Ramachandran A, Jali MV, Mohan V, Snehalatha C, Viswanathan M. High prevalence of diabetes in an urban population in South India. *Br Med J* 1988; 297 : 587-90.
7. Mather HM, Keen H. The Southall Diabetes Survey: prevalence of known diabetes in Asians and Europeans. *Br Med J* 1985; 291 : 1081-5.
8. Zimmet P, Taylor R, Ram P et al. The prevalence of diabetes and impaired glucose tolerance in the biracial (Melanesian and Indian) population of Fiji: a rural-urban comparison. *Am J Epidemiol* 1983; 118 : 673.
9. Ramachandran A, Snehalatha C, Dharmaraj D, Viswanathan M. Prevalence of glucose intolerance in Asian Indians: urban-rural difference and significance of upper body adiposity. *Diabetes Care* 1992; 15 : 1348-55.
10. Zimmet P, Finch C, Dowse G. The Epidemiology of Diabetes Mellitus. In: *The Diabetes Annual/5*. Alberti KGMM, Krall LP (eds). Elsevier, Amsterdam 1990; 1-21.
11. Ramachandran A, Snehalatha C, Naik RAS, Mohan V, Shobana R, Viswanathan M. Significance of impaired glucose tolerance in an Asian Indian population: a follow-up study. *Diab Res Clin Pract* 1986; 2 : 173-8.
12. Ramachandran A, Snehalatha C, Mohan V, Viswanathan M. Development of carbohydrate intolerance in offspring of Asian Indian conjugal Type 2 diabetic parents. *Diab Res Clin Pract* 1990; 8 : 269-73.
13. Zimmet P. Diabetes care and prevention around the world in 80 ways. *International Diabetes Federation Bulletin* 1991; 36 : 29-32.