EPIDEMIOLOGY OF NIDDM IN INDIANS

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Epidemiology is the study of the distribution and determinants of disease frequency in man. There has been an upsurge in the epidemiological studies relating to diabetes over the last 2 decades and this has led to much better understanding of the social, behavioral and environmental components of Non-Insulin Dependent Diabetes Mellitus (NIDDM), a disease that has reached epidemic proportion not only in developed nations but also in many developing nations.[1]

Prevalence of NIDDM in Indians

The prevalence of Non-Insulin Dependent Diabetes Mellitus (NIDDM) varies in different geographic regions and in different ethnic groups.[2] The first authentic data on the prevalence of diabetes in India was the result of a multicentric study conducted by the Indian Council of Medical Research (ICMR) in the early seventies.[3] There had been paucity of well-defined epidemiological studies in India for a long time. Over the years many epidemiological studies done in different parts of the world brought out an interesting finding that Indian migrants who were settled abroad have a high prevalence of diabetes[4] (Table 1). This led to the belief that migrant Indians have a higher prevalence of diabetes probably because of greater affluence and changes in life style compared to the native Indian population. Although this explains the difference in the prevalence between native and migrant Indian populations, it does not adequately explain lower prevalence rates in the local host populations living in identical environment. These studies thus concluded that Indians as an ethnic group have a high risk of developing diabetes and this susceptibility may be genetic in nature.

If it is so, one would except higher prevalence of diabetes among the native Indians who are living in the urban areas. The recent studies (Table 2) have proved this to be true. Verma et al[5] found a prevalence of 3.1% in an affluent area in Darya Ganj, New Delhi by questionnaire method. Ramachandran et al,[6] using the WHO criteria, noted a prevalence of 5% in a township in South India. The prevalence, when adjusted to the age distribution of the migrant population

Table 2 : Epidemiological Studies of the Prevalence of Diabetes Mellitus in India

Year	Author	Place	Prevalence (%)
1971	Tripathy et al	Cuttack	1.2 (Urban)
1972	Ahuja et al	New Delhi	2.3 (Urban)
1979	Johnson et al	Madurai	0.5 (Urban)
1979	Gupta et al	Multicentre	3.0 (Urban)
			1.3 (Rural)
1984	Murthy et al	Tenali	4.7 (Urban)
1986	Patel	Bhadran	3.8 (Rural)
1988	Ramachandran et at	Kudremukh	5.0 (Urban)
1989	Kodali et al	Gangavathi	2.2 (Rural)
1989	Rao et al	Eluru	1.6 (Rural)
1992	Ramachandran et al	Madras	8.2 (Urban)
			2.4 (Rural)

Ramaiya, Kodali, Alberti 1990[4]

Table 1: Prevalence of Diabetes in migrant Indians Compared to other Ethnic Groups

Year	Author	Country	Prevalence (%)						
			Europeans	Africans	Melanesians	Malays	Chinese	Creoles	Indians
1958	Wright et al	Trinidad		1.4					1.7
1986	Beckles et al	Trinidad	4.3 (M)	8.2 (M)					19.5 (M)
			10.2 (F)	14.8 (F)					21.6 (F)
1967	Cassidy	Fiji			0.6				5.7
1983	Zimmet et al	Fiji			3.5 7.1				12.9 (M)
					(M) (F)				11.0 (F)
1983	Marine et al	South Africa		3.6		6.6			10.4
1975	Chea et al	Singapore				2.4	1.6		6.1
1989	Simmons et al	Coventry,	2.8 (M)						11.2 (M)
		UK	4.3 (F)						8.9 (F)
1989	Dowse et al	Mauritius					11.5	10.4	12.4
1989	Swai et al	Tanzania		1.9					7.1

Ramaiya, Kodali, Alberti 1990[4]

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in Southall, London[7] and in Fiji,[8] increased to 10% and 9% respectively. These results suggest a rising

prevalence of the disease in India, probably related to the improving living condition and changing life pattern in the urbanised regions.

Population in rural areas, which constitute nearly 70% of the country, still have conventional living conditions and habits. Therefore, if environmental conditions have a significant role in unmasking diabetes, urban-rural differences are likely to be present in the prevalence rates within the same ethnic group. With this objectives in view, recently a survey of diabetes was conducted by the Diabetes Research Centre in Madras using the WHO criteria.[9] Two populations with considerable socio-economic differences, living in urban and rural areas, but belonging to the same ethnic group, namely Dravidians, were chosen for the study. The age-adjusted prevalence of diabetes in the urban population was 8.2% and 2.4% in the rural population. The study while showing a wide differences in the prevalence of diabetes in the urban and rural India, also highlighted the fact that its prevalence in urban India is as high as in migrant Indians. The prevalence was 8.4% and 7.9% respectively in urban men and women. Age, body mass index (BMI) and the waist:hip ratios showed positive association with diabetes in both populations. The mean values of BMI especially in the rural population were considerably lower than in the western population. Even so, upper body adiposity and BMI were positive risk factors in this relatively non-obese population.[9]

Impaired Glucose Tolerance (IGT)

Impaired Glucose Tolerance (IGT) was classified as an entity different from diabetes because long-term follow-up studies showed that a large proportion of them may remain as such or revert to normal tolerance. Moreover, the presence of microvascular complications such as retinopathy, a hall-mark of diabetes mellitus was negligible in subjects with IGT.[10]

The ratio of the prevalence of IGT/Diabetes varies in different populations[11] and usually is around one. One of the recent studies by Swai et al[12] in Tanzania showed a very high prevalence rate of 21.5% of IGT among the Indians in Tanzania. A study from Mauritius[13] also described a high prevalence of IGT in Indians and this was believed to be a reflection of the recent NIDDM epidemic.

An important observation made in the Madras Diabetes survey of diabetes was that although the prevalence of diabetes was 4 times lower in the rural population, the prevalence of IGT was almost similar in both populations (8.7% and 7.8% in the urban and rural areas respectively).[9]

The high prevalence of IGT in the population assumes great significance in view of our earlier observation that about 35% of the subjects with IGT becomes diabetic during a mean period of 5 years.[14] Recent clinical follow-up studies at the Diabetes Research Centre, Madras have convincingly shown that subjects with IGT and a positive family history of diabetes have a very high risk of developing diabetes. A similar observation has been made by Ohnede et al[15] in Japan. Furthermore, it has also been shown that subjects with IGT carry a high cardiovascular risk.[16-18] With increasing urbanisation, there would be a high conversion rate from IGT to diabetes and the prevalence of diabetes is expected to rise in India in future.

Risk factors for NIDDM

Obesity

Although varied observations have been reported examining the role of obesity in the pathogenesis of NIDDM,[19] it is generally agreed upon that obesity definitely contributes to the unmasking of the disease in a genetically prone individual. Recent studies have highlighted the association of regional distribution of body fat with disease such as diabetes and CVD.

When the body mass index (BMI) is considered as the index of obesity, sex differences are observed in its association with risk of NIDDM. A longitudinal study in Nauru showed BMI to be a strong predictive factor of NIDDM in women, but only of marginal predictive nature in men.[20] We have recorded a similar finding in urban south Indians, who are relatively non-obese.[9]

Diet

Undernutrition and overnutrition are shown to cause diabetes by different mechanisms. Diet may contribute to the development of diabetes in two ways; quantitatively, by supplying calories and in presence of low physical activity, by resultant obesity; and qualitatively, by the effect of specific foods.[21] Socio-cultural factors influence the diet pattern in any country and this is particularly applicable to a nation like India with varied cultural and socio-economic features within each region. West had shown that the prevalence of diabetes was inversely related to the consumption of complex carbohydrate, in different countries. Present data from rice-eating populations, however, do not corroborate the observation and this could probably be related to marked changes in the quality of the food consumed. The usefulness of a

calorie restricted, fibre rich diet in the management of diabetes has been unequivocally proved by the extensive studies of Viswanathan and colleagues.[22] This diet is similar to the diet of a common man in India and contaions high fibre content available from natural food sources and more of saturated fat are found to be detrimental.

Age

Age is found to be the most positively associated parameter with NIDDM in all populations.[1,4,9] In our study of the semi-urban population of Kudremukh and also in the urban-rural survey in Madras district of Tamil Nadu, we found a strong positive association of age with diabetes. Prevalence of diabetes was 21% in the age group of 40 years or above 30 years, the prevalence of diabetes was found to be 9.1% in Lucknow, 5.5% in Cuttack, 3.8% in Hyderabad and 1.4% in Madurai.[4] Gupta et al from Ahmedabad showed that maximum prevalence was seen above 50 years of age and 16.5% of the urban and 5.3% of the rural population of above 60 years were diabetics.[23] Omar et al[24] studding the South African Indians also found a positive correlation between plasma glucose and age. Similar observations were noted in the migrant Indians in the UK, Mauritius and Tanzania.[4] In Southall, UK, the Asians, aged 40-64 years, had five times higher prevalence of diabetes compared to the Europeans.[7]

Sex

Majority of the epidemiological surveys show a male preponderance among the Indian diabetics, both within the country and abroad. Studies of Campbell[25] and Omar et al[26] from South Africa and in our own studies at the Diabetes Research Centre, Madras, a slight female preponderance was noted which is probably related to increased obesity in women. In Mauritius,[13] the overall prevalence of age-standardised diabetes was similar in men (12.1%) and women (11.7%). However, male preponderance was present in Hindu and Chinese diabetics in Tanzania; the prevalence in both sexes were similar in Muslims.[12] Creole men had lower prevalence (7.7%) than women (13.0%). In our recent urban-rural survey of diabetes in Madras, we noted that sex did not have a statistically significant effect on the prevalence rate, although there was an apparently higher percentage of diabetic men in the urban area (10.3% of men vs 6.1% of women). In the rural area, 2.7% of men and 2.1% of women were diabetics.[9]

Genetic component in the etiology of NIDDM

Epidemiological evidences for a strong genetic component in the etiology of NIDDM are many and come from different sources.

Familial aggregation of diabetes

Asian Indians are shown to have increased familial aggregation of diabetes with higher prevalence of diabetes among the first degree relatives and vertical transmission through 2 or more generations.[27] Our study showed that 45% of the Indians compared to 38% of the Europeans had positive family history of diabetes. Viswanathan et al[28-30] have reported a high prevalence of NIDDM among the adult offspring of family history in the NIDDM patients attending the Diabetes Research Centre, Madras showed that positive family history was present in 62% and 53% had first degree relatives with diabetes.

Genetic susceptibility in ethnic groups

Certain ethnic populations show a high prevalence of NIDDM. Table 3 shows the degree of susceptibility to NIDDM in different populations. Asian Indians are considered as a high risk ethnic group for diabetes. There are wide differences in the prevalence of the disease in different ethnic groups living in the same geographic regions and environmental conditions. Indians in Fiji and Singapore[4] are shown to have higher prevalence of NIDDM compared to the host population; the Pima Indians, Mexican American and Hispanics are found to have higher rates compared to the Caucasoids in the USA.[4] This disparity in the prevalence of diabetes in different ethnic groups showing identical environmental influences points out their greater genetic susceptibility for NIDDM.

Table 3: Genetic susceptibility to NIDDM Ethnic groups

Low	Moderate	High
White	Africans	American Indians
Eskimos	Chinese	Micronesians
Others	Melanesians	Polynesians
	Japnese	Asian indians
		Mexican Americans
		Hispanics

Zimmet 1992[1]

Evidences from epidemiological studies described so far have clearly indicated that Indians as an ethnic group have a very high risk of developing diabetes. With increasing urbanisation and increased life expectancy in our population, a phenomenal increase like an epidemic of diabetes is foreseen in future in the Indian subcontinent which could pose a challenge to all concerned.

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Because NIDDM is more difficult to define and diagnose than IDDM, it is also much tougher to track. Only sketchy data exist concerning the incidence and prevalence of NIDDM in many countries, and most particularly, in developing nations. It is known, however, that NIDDM is very common among certain ethnic groups, such as the Australian Aborigines and Micronesian Polynesians from American and Western Samoa. NIDDM is also more common among obese people and among those who have emigrated from a rural to an industrial or westernized environment. In China, for example, the prevalence of NIDDM is about 1 percent. By contrast, the age-standardized rate for Chinese people in Mauritius, a small island off the east coast of Africa with a more modernized society is more than 20 percent, "If over the next 10 to 20 years, the people in mainland China become more modernized to a similar level to those in Mauritius, one could expect equally high diabetes rates".

Paul Zimmet