Primary Prevention of Type 2 Diabetes and Its Economic Implications

M MAIYA

Diabetes is the single most important metabolic disease which causes death and disability world-wide. Global presence of type 2 diabetics in the year 2000 is 171 million which is likely to be 366 million in the year 2030. India has the highest prevalence of diabetics in the world with 32 million and expected to increase to 80 million by 2030 accounting for almost 1/6th of world diabetic population[1]. Further several migrant studies have shown that South-Asians are more prone to diabetes compare to indigenous population[2].

The marked escalation in the growth of diabetes population is due to rapid changes in life style following urbanization, lack of physical exercise and nutrition transition. The ageing population may also be an additional factor.

Further to the epidemic proportion of diabetes in India there is a hidden population of pre-diabetics. Impaired glucose tolerance (IGT) with 2 hours post-prandial value of 140-199 mg/dl, and impaired fasting glucose(IPG) with value of 100-125 mg/dl are both considered to be pre- diabetics according to WHO and American Diabetic Association classification prediabetic subjects are for higher risk for diabetes and coronary heart disease. It occurs well before type- 2 diabetes and the conversion rate varies in different populations indicating ethnic differences[3-5]. The epidemiological studies conducted in urban India revealed the prevalence of IGT ranged between 10.6% and 16.8%[6]. In rural India it is about 7.18%[7]. In a prospective study followed up for 2-10 years of IGT subjects, 1/3 developed diabetes, 1/3 remained as IGT and 1/3 reverted to normal[8]. The interval period to develop diabetes from prediabetes gives an opportunity for preventive strategies.

PREVENTION

Management of diabetes and its complication involves enormous personal and public health burden anywhere in the world. Hence there is an increasing need to institute preventive strategies. Diabetes usually progress, from prediabetic stage, asymptomatic stage, clinical diabetes, and to the stage of complications. It provides adequate time and opportunity to undertake preventive measures. The various stages in the natural history of diabetes and appropriate preventive measures are mentioned in the Table 1 below.

Table 1: Prevention of diabetes

Primary prevention (Normal and pre-diabetes)	Secondary prevention (clinical DM)	Tertiary prevention (DM with complications)
1. Lifestyle changes through mass – education, group education	1. Early diagnosis	1. To limit complications and impairments
2. Pharmacological– Intervention	2. Adequate treatment to reverse the disease/ complication	2. Control suffering
		3. Rehabilitation

Primary Prevention

Burden of diabetes in the community will be reduced by primary preventive measures which delays or prevent the occurrence of diabetes. These measures essentially lies in life-style modifications targeting high risk population or entire population.

Table 2: Diabetes prevention

Study	Participants	Mean duration of follow up	Intervention and risk reduction
Non-pharmacological intervention			
Da Qing IGT and Diabetes Study[9]	577	6 years	Diet: 33% Exercise: 47% Diet plus exercise: 38%
Finnish Study[10]	522	3.2 years	Lifestyle: 58% reduction
Diabetes Prevention Programme[11]	3234	2.8 years	Lifestyle: 58% reduction
Indian Diabetes Prevention Programme[12]	531	2.6 years	Lifestyle: 28.5% reduction Metformin: 26.4% reduction Both lifestyle and Metformin: 28.2% reduction

High Risk Strategy

The high risk subjects in the population are, individuals, with family history of diabetes, prediabetes, obese, ageing and sedentary individuals and certain ethnic groups. The number of prospective studies conducted in subjects with IGT, have shown reduced progression or prevention of diabetes by lifestyle changes or pharmacological interventions. The results of preventive trials are tabulated (Table 2)[9-11]. The high risk approach, though efficient, but limited to small group, and does not alter the risk for the whole population.

Population Strategy

The population strategy involves at lowering the risk for the whole population. This strategy is more meaningful for India, as the entire population of India may be considered "high risk" for diabetes, hypertension and atherosclerotic heart diseases. By lowering the risk of whole population through increasing physical activity, improving the diet, reducing obesity there is a chance of preventing high risk individuals developing diabetes. Further, the programs reduce the chance of individuals with low risk, transferring into high risk[10].

Primary Prevention: Indian Scenario

India is facing an epidemic of diabetes and it is time to actively consider preventive measures. There are hardly any studies on preventive aspect of diabetes except 2 studies from Chennai – Chennai Urban Population Study (CUPS) and Chennai Urban – Rural Epidemiology Study (CURES).

Awareness and Education

The first step in the preventive program is awareness of diabetes. In CURES study only 75% of the Chennai residents knew the existence of the disease called diabetes, 25% felt the disease is preventable and only 12% were aware that obesity and physical inactivity could predispose to diabetes. The above data emphasizes the necessity for community oriented, mass scale education programs. Mass media, movie theatres pamphlets, posters, booklets and CD'S to be utilized freely both in urban and rural areas.

Screening for Diabetes

Early detection of prediabetes and diabetes is the cornerstone for prevention of diabetes and its complications. The Indian diabetic risk score (IDRS) helps in selective screening instead of universal screening of the population and thereby reduce the cost of screening. The screening system was developed using four simple parameters, like age, abdominal obesity and family history of diabetes and leisure time physical activity[14]. The IDRS is simple, safe, and cost effective especially with our explosive diabetes population and of which ½ are undiagnosed.

Intervention Programs

There is adequate evidence across the globe that diabetes can be prevented or delayed from prediabetic state by lifestyle modification (Table 3). The DPP[11] and Finnish[10] prevention studies illustrates the risk reduction by 58%. The Indian Diabetes Prevention Programme[12] shows the risk reduction by 28.5% by life style modification.

The pharmacological Intervention with metformin, acarbose[13], and triglitazone also causes risk reduction though to lesser extent than lifestyle modification.

Table 3: Diabetes prevention

Pharmacological intervention	Participants	Mean duration of follow up	Intervention and risk reduction
Diabetes Prevention Programme[11]	3234	2.8 years	Metformin: 31% reduction
Stop NIDDM Acarbose study[13]	1429	3.3 years	Acarbese : 25% reduction
Tripod study	236	2.5 years	Triglitazone: 55%

Economic Issues in Primary Prevention

The economic burden of diabetes and its complications is heavy all over the world. In Indian and other developing countries, health resources are limited and only 5% of gross domestic product (GDP) is spent on health care in India[15]. Further in developing countries, diabetes occurs at younger age and chronic complications occur in large proportion of diabetic patients during the most productive years, causing increasing economic burden.

The DPP[11] and the other studies[9,10,12] on primary prevention demonstrated that lifestyle modification and metformin intervention, reduced the incidence or delayed the occurrence of type 2 diabetes compared with placebo-intervention. But, from the perspective of a health system or society what is the value of delaying or preventing type 2 DM?

DPP has assessed the economics of prevention or delaying diabetes from health system and societal point of view. Health system perspective considers the direct medical costs only and societal perspective involves direct non-medical costs and indirect costs in addition to direct medical costs.

It is obvious, from the health system point of view the strategy prevents or delays direct medical costs, which includes costs of education, counseling, glucose monitoring, treatment and management of complications. From societal point of view delaying or preventing diabetes reduces medical costs, out of pocket costs, and time lost from work. It may also improve the quality and length of life.

The direct medical costs of treating diabetes is enormous. The costs increases with HbA1c level, and presence of complications and co- morbidities. The costs are 2.1 times higher in patients with new clinically diagnosed diabetes compared with individuals without diabetes. The results of within – trial cost- utility analysis of DPP suggest the value of lifestyle and metformin intervention is $ 9000- 29,000 for lifestyle intervention and $ 35,000 for metformin intervention for, QALY (quality adjusted life year) gained. The CDC cost-effective group estimates the intensive glycemic control in newly diagnosed type 2 diabetes in US costs approximately $ 41,000. Hence the cost per case of diabetes prevented seems to be cost-effective especially when implemented in a group format. The cost per QALY gained also tended to be lower.

There is no comprehensive, cost effective studies on life style and pharmacological interventions for primary prevention of type 2 diabetes from India. However, Rajappa PH, et al[16] estimated, the economic burden of diabetes (both direct and indirect) apportioned at individual, family and societal level. The total direct costs amounts to Rs 16, 765.50 and indirect cost to 35, 714.30 per anum per patient which includes expenses at all levels. In cost of diabetes in India study (CODI) the mean direct annual cost for out patient case for diabetes individual was Rs 4,724. The total indirect cost for non –earning diabetic patient is Rs 9,748. Whereas for earning member it is Rs 16831[17]. The cost of management of diabetes, apparently far higher than preventive strategies. However, the evidence on feasibility and effectiveness of applying preventive measures in the developing world is still missing[18].

CONCLUSION

There is a need for urgent preventive measures to prevent, and delay the onset of diabetes from pre-diabetic stage in India, in view of epidemic proportion of the disease. The economic benefits of such measures like lifestyle changes and pharmacological interventions are well established in the western world. Primary preventive measures, like reduction of obesity, diet and exercise will also benefit the co-morbid condition like hypertension and atherosclerative disease. Hence population-based rather than high risk intervention strategy is more beneficial in India and should be a public health prevention.

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