

Prevention of diabetes: How far have we gone?

Ambady Ramachandran, Chamukuttan Snehalatha

India Diabetes Research Foundation, Dr. A. Ramachandran's Diabetes Hospitals, Chennai, Tamil Nadu, India

Diabetes is ubiquitous, its prevalence is rising globally, and the social and economic burden caused is very huge. The highest healthcare and economic burden is on the developing countries which lodge more than 80% of the persons affected with the disease.^[1]

Optimal management of diabetes is of utmost importance to reduce the morbidity and mortality resulting from the disease and its associated vascular complications. The rising incidence of diabetes calls for urgent action to prevent the occurrence of new cases, that is, primary prevention is a major strategy to be adopted by every country. The number of adults with diabetes today is 382 million and is bound to increase to 592 million in 2035. The greatest number of people with diabetes is between 40 and 59 years of age. More than 80% of people with diabetes live in low- and middle-income countries.^[1]

Community-based randomized, controlled prevention trials, conducted in the past 2 decades have unequivocally shown that primary prevention of diabetes is possible in all ethnic groups by lifestyle modification (LSM) or by a few pharmacological agents.^[2] Extended trials such as the Chinese Da Qing study,^[3] the Diabetes Prevention Programme Outcomes Study (DPPOS) in USA,^[4] and the Finnish Diabetes Prevention Study^[5] have indicated that the benefits of LSM can last for periods, varying from 10 to 20 years.

Diabetes occurs from genetic and environmental interaction. Genetic factors do not change in a short period, hence the recent epidemic of the disease is mostly attributed

to the rapid changes occurring in the environmental risk factors. Lifestyle transition related to diet, physical activity, and stress factors have been the chief determinants of the rising prevalence of diabetes seen in the developing countries.^[6,7] These risk factors are mostly common for all noncommunicable diseases (NCDs).

Type 2 diabetes has a long asymptomatic stage, which when detected offers an opportunity to prevent the metabolic deterioration to diabetes. The nonmodifiable risk factors such as genetic factors, age, and ethnicity cannot be changed, however, behavior- and lifestyle-related factors such as obesity, physical inactivity, smoking, and excessive use of alcohol are the major modifiable factors. Prevalence of these is increasing phenomenally in developing countries. The prevalence of prediabetes consisting of impaired fasting glucose (IFG) and/or impaired glucose tolerance (IGT) is rising globally. Its prevalence currently is around 316 million and is likely to rise to 471 million in another 20 years.^[1] Levels of prevention in type 2 diabetes are primordial, primary, secondary, and tertiary. The ideal approach to primary prevention would be the upstream strategy, wherein the total population is targeted for prevention. This is not practical in majority of the countries, especially in large nations like India with different levels of educational, geographic, and cultural barriers.

The downstream strategy in which the high-risk populations are targeted for prevention have been used successfully in all the major programs.^[2,8] People with prediabetes and with a history of gestational diabetes mellitus have been chosen for these programs.^[8]

LSM using healthy diet, enhanced physical activity, and improved behavior have been used in the major prevention programs such as the China Da Qing study, the Finnish Diabetes Prevention Study, the DPP in the USA, the Indian Diabetes Prevention Programmes (IDPPs), and the Japanese Diabetes Prevention Study.^[2,9] In all these programs, subjects with IGT/IFG have been studied for periods varying from 3 to 20 years. The American and

Access this article online	
Quick Response Code:	Website: www.ijem.in
	DOI: 10.4103/2230-8210.131112

Corresponding Author: Prof. Ambady Ramachandran, India Diabetes Research Foundation and Chairman and Managing Director, Dr. A. Ramachandran's Diabetes Hospitals, 28, Marshalls Road, Egmore, Chennai - 600 008, Tamil Nadu, India. E-mail: ramachandran@vsnl.com

the Finnish programs targeted individuals with obesity and one of the major goals of prevention was to reduce the body weight by LSM. The Asian studies had relatively leaner populations and weight loss had not been a major contributor to the improved outcome of LSM, that is, a lower incidence of diabetes compared to the control group who only had standard care.

Obesity, elevated levels of fasting or 2-h glucose, insulin resistance, and beta cell secretory defects were found to be highly predictive of the conversion to diabetes. LSM reduced obesity levels, improved insulin sensitivity and beta cell function resulting in reduced incidence of diabetes during the study period in western populations.^[2] In the Asian studies, the beneficial effects were independent of the reduction in body weight. Importantly, Indians who had high rate of insulin resistance with lower body mass index (BMI) in comparison with the western population were also benefitted by LSM.^[2,9,10]

A few pharmacological agents such as metformin, rosiglitazone, pioglitazone, and acarbose were also studied for their efficacy in preventing type 2 diabetes in high-risk subjects. Among these, metformin has been recommended as the safe pharmacological agent if LSM cannot be successfully implemented.^[11]

Preventing diabetes is of enormous value for any nation particularly in the developing world because of the high cost of treating diabetes and its complications.^[12] In India, it is estimated that a diabetic person spends a median of Rs. 10,000/annum for medical treatment. If diabetes can be prevented or delayed by LSM, this would result in a net gain in healthcare investments. The need of the hour is to develop pragmatic, cost effective strategies for primary prevention to extend the benefits to the population at large. Recent studies using information technology such as mobile phone-based SMS are now being tested for this purpose. In a recent 2-year program in India, we have demonstrated the effectiveness of SMS in educating and motivating men with IGT to follow LSM and this was found to be highly effective with a relative risk reduction of 36% compared to the participants who had only standard care.^[13]

For large-scale implementation of preventive strategies, the future plan should focus on health education of the public, improving the national capacity to detect and manage NCD's and development of innovative, cost effective, and scalable methodologies. The national programs such as the Finnish DEKHO^[14] and the study in Singapore^[15] initiated by the government should be taken as model endeavors to formulate strategies to promote and implement community health programs.

REFERENCES

1. IDF Diabetes Atlas. 6th ed. International Diabetes Federation. Available from: <http://www.idf.org/diabetesatlas> [Last accessed on 2013].
2. Ramachandran A, Snehalatha C. Diabetes prevention programs. *Med Clin North Am* 2011;95:353-72.
3. Li G, Zhang P, Wang J, Gregg EW, Yang W, Gong Q, *et al.* The long-term effect of lifestyle interventions to prevent diabetes in the China Da Qing Diabetes Prevention Study: A 20-year follow-up study. *Lancet* 2008;371:1783-9.
4. Diabetes Prevention Program Research Group, Knowler WC, Fowler SE, Hamman RF, Christophi CA, Hoffman HJ, Brenneman AT, *et al.* 10-year follow-up of diabetes incidence and weight loss in the Diabetes Prevention Program Outcomes Study. *Lancet* 2009;374:1677-86.
5. Lindstrom J, Peltonen M, Eriksson JG, Ilanne-Parikka P, Aunola S, Keinänen-Kiukaanniemi S, *et al.*; Finnish Diabetes Prevention Study (DPS). Improved lifestyle and decreased diabetes risk over 13 years: Long-term follow-up of the randomized Finnish Diabetes Prevention Study (DPS). *Diabetologia* 2013;56:284-93.
6. Hu FB. Globalization of diabetes: The role of diet, lifestyle, and genes. *Diabetes Care* 2011;34:1249-57.
7. Ramachandran A, Ma RC, Snehalatha C. Diabetes in Asia. *Lancet* 2010;375:408-18.
8. Alberti KG, Zimmet P, Shaw J. International Diabetes Federation: A consensus on Type 2 diabetes prevention. *Diabet Med* 2007;24:451-63.
9. Baker MK, Simpson K, Lloyd B, Bauman AE, Fiatarone Singh MA. Behavioral strategies in diabetes prevention programs: A systematic review of randomized controlled trials. *Diabetes Res Clin Pract* 2011;91:1-12.
10. Snehalatha C, Mary S, Selvam S, Sathish Kumar CK, Shetty SB, Nanditha A, *et al.* Changes in Insulin secretion and insulin sensitivity in relation to the glycaemic outcomes in subjects with impaired glucose tolerance in the Indian Diabetes Prevention Programme -1 (IDPP-1). *Diabetes Care* 2009;32:1796-801.
11. Gillies, CL, Abrams KR, Lambert PC, Cooper NJ, Sutton AJ, Hsu RT, *et al.* Pharmacological and lifestyle interventions to prevent or delay type 2 diabetes in people with impaired glucose tolerance: Systematic review and meta-analysis. *BMJ* 2007;334:299.
12. Narayan KM, Zhang P, Kanya AM, Williams DE, Engelgau MM, Imperatore G, *et al.* Diabetes: The pandemic and potential solutions In: Jamison DT, Breman JG, Measham AR, Alleyne G, Claeson M, Evans DB, Jha P, Mill A, Musgrove P editors. Disease control priorities in developing countries. 2nd ed. New York: Oxford University Press; 2006. p. 591-603.
13. Ramachandran A, Snehalatha C, Ram J, Selvam S, Simon M, Nanditha A, *et al.* Effectiveness of mobile phone messaging in prevention of type 2 diabetes by lifestyle modification in men in India: A prospective, parallel-group, randomized controlled trial. *Lancet Diabetes Endocrinol* 2013;1:191-8.
14. Development programme for the prevention and care of diabetes. Dehko 2000-2010. Published by Finnish Diabetes Association. Edited by Leena Etu-Seppälä [Last accessed on 2008 Sep 26].
15. Ministry of Health. WHO Global Infobase: National Health Survey 2004, Singapore. World Health Organization Web site. Available from: <http://www.who.int/infobase/>. 2005 [Last accessed on 2009 Mar 31].

Cite this article as: Ramachandran A, Snehalatha C. Prevention of diabetes: How far have we gone?. *Indian J Endocr Metab* 2014;18:252-3.

Source of Support: Nil, **Conflict of Interest:** None declared