

Problem of diabetes in India :

Diabetes, which is already a huge global health problem (1), is now spreading rapidly to low and middle income countries like India. Earlier, many epidemiological studies have reported that migrant Asian Indians living in countries like UK, USA, Fiji, Singapore, Malaysia and Middle East countries have much higher prevalence rates of diabetes compared to native Indians within the Indian subcontinent (2). However, this has changed rapidly in the last 3 – 4 decades. According to the International Diabetes Federation (IDF), Diabetes Atlas, Seventh Edition (2015), India had 69.2 million people with diabetes in the year 2015 and this is expected to increase to 123.5 million by the year 2040 (1). The epidemic of diabetes in India is still spiraling upwards. However, the Indian Council of Medical Research, India Diabetes (ICMR–INDIAB) study, the largest epidemiological study on the prevalence of diabetes in Lancet Diabetes & Endocrinology showed wide variation in prevalence of diabetes within India (3). The prevalence of diabetes across all 15 states studies was 7.3%. When we looked at the Gross Domestic Product (GDP) of various states in relation to prevalence of diabetes, there was a fairly good correlation between diabetes prevalence and the GDP of the different states. The prevalence of the disease in urban India is twice that of rural India. Over 50% of people who participated in the study were unaware of their condition indicating low awareness about the disease. In most states, the rate of pre-diabetes exceeded the rate of diabetes, a forewarning that the epidemic is far from over. Thus, effective preventive programmes need to be urgently implemented to tackle the diabetes epidemic in our country.

Why the epidemic of diabetes in India ?

The first question is, why the pandemic of diabetes? - Is it due to genetic or environmental factors?. The most important gene implicated in type 2 diabetes is the TCF7L2 gene. Recently, our Genome Wide Association Studies (GWAS) done with UK collaborators in individuals of South Asian ancestry published in **NATURE GENETICS** identified six novel type 2 diabetes in South Asians (predominantly Indians) which were not seen among Europeans or other races (4). Our findings thus provide support for possible novel associations with type 2 diabetes in our population.

However, although genetic factors undoubtedly play a major role in the predisposition of diabetes in Indians, environmental factors contributes to over 50% of the risk and indeed the epidemic is driven by environmental factors as our genes did not change in 40 years.

In a paper published in British Journal of Nutrition, we showed that consumption of white rice was strongly linked into risk of type 2 diabetes in our south Indian population (5). A recent study from our centre has shown that replacing white rice with brown rice could improve 24 hour blood glucose and insulin levels (6). It is indeed true that rapid economic growth in India has resulted in rapid nutritional transition contributing to excess calories mainly from refined carbohydrates in both rural and urban population (high dietary glycemic load) (7,8) along with decreased physical activity which are the main driver of the diabetes epidemic. Therefore, it is logical to assume that adopting a diet that is rich in whole grains along with increasing physical activity could be a cost-effective, feasible and sustainable approach to diabetes prevention and control in India. However, our studies (9,10) revealed the challenges in doing so as due to the colour and texture of the cooked brown rice, it had low acceptability in society. Hence, we engaged in further research to look at white rice varieties with higher resistant starch and were able to **produce an innovative High Fibre White Rice** which has 5 times higher fibre content and lower glycemic index. This is a first of its kind among white rice varieties. Studies with this rice show that it has much lower glycemic index than conventional white rice (11).

Since the prevalence of prediabetes is even higher than that of diabetes, there is a golden window of opportunity to prevent diabetes. The big question is how do we take diabetes prevention to the masses. I want to share our success story of Asiad Colony experience. We had carried out the Chennai Urban

Population study (CUPS), in two urban residential colonies one representing the middle income group (Asiad colony in Tirumangalam) and the other representing the low income group (Bharathi Nagar in T.Nagar) in Chennai city, in southern India. The study was conducted from 1996 to 1998 and as expected, showed a significantly higher prevalence of diabetes in the middle income group (12.4%) compared to the lower income group (6.5%) (12). The results of the study were discussed with the residents of both colonies. After these awareness campaigns, the middle income residents realized the value of physical activity and built a beautiful park adjacent to their colony, by raising funds through their own resources thus increasing not just their physical activity but also people in the neighborhood. The question was did this help to reduce or at least slow down the rapidly escalating the diabetes rates. A follow up study was done after 10 years which showed that in the middle income group, the prevalence of diabetes increased from 12.4 to 15.4% (24% increase), while in the lower income group, it increased from 6.5 to 15.3% (135% increase) (13). This study is the first of its kind in India to introduce a “real-world” lifestyle intervention in prevention of diabetes through community empowerment.

Recently, we carried out a unique ten-year longitudinal follow-up of the Chennai Urban Rural Epidemiology Study (CURES). Our results show that more than 80% of cases of diabetes can be prevented in this Asian Indian population just by modifying five risk factors (14). Modifying diet and physical activity alone will reduce over half (52%) of the risk for diabetes (15).

This is the theory part. What about in practice? Can diabetes actually be prevented?

We recently published the results of the Diabetes Community Lifestyle Improvement Program (DCLIP) in people with prediabetes. We found that there is the reduction of incidence of diabetes by a third in community settings (16).

Large cohort studies, like the Prospective Urban Rural Epidemiologic (PURE) cohort study, reported higher rates of major cardiovascular events and the rates of death from any cause in rural communities than in urban communities in middle-income countries and low-income countries, suggesting that the health care systems (the access to and quality and affordability of health care) are likely to have a large impact on diabetes and cardiovascular disease outcomes (17). So, the next huge challenge is how to provide specialized diabetes care to rural India. Unfortunately, 72% of Indians live in rural areas whereas 80% of doctors practice in urban areas. Moreover, the most people in rural areas are extremely poor and cannot afford any treatment. Hence, we had to innovate and develop a rural diabetes model for the poor called as the “Chunampet Rural Diabetes Prevention Project (CRDPP)”. CRDPP was developed with the aim of not only providing diabetes health care, but also to take up diabetes prevention through the use of telemedicine. With the help of a telemedicine van, 27,014 individuals (86.5% of the adult population) were screened in 42 villages of Kancheepuram District in Tamil Nadu in south India. As a result of the follow up treatment given, the mean glycated haemoglobin levels among the diabetic subjects in the community decreased from $9.3 \pm 2.6\%$ to $8.5 \pm 2.4\%$ within a year (18). We also found that less than 5% of patients needed referral for further management to the tertiary diabetes hospital in Chennai. Thus, the CRDPP can be used as a model for diabetes prevention and health care delivery in underserved rural areas of developing countries like India (19). It is clear that to tackle the menace of the diabetes epidemic, we all have to work together and find local solutions.