

Diabetes Mellitus: Targetting School Children and Trigger Groups in Diabetes Prevention

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Diabetes Mellitus constitutes a major global challenge in this century, and the epidemic particularly afflicts India which has been termed the Diabetes capital of the world. 33 million subjects were afflicted in 2003 and this was projected to reach a figure of 57.2 million in 2025 and 80.9 million by 2030. By 2025 75% of the world's population would be from the developing countries. WHO estimated that Diabetes currently costs 2.5-15% of national health budgets and this was forecast to increase by 2025 in high prevalence countries to 40%.

Diabetes and related complications involve both direct costs (drugs, laboratory and hospital costs), indirect costs (production losses attributed to sickness, disability, premature retirement and death), and so called intangible costs (impaired quality of life due to pain, anxiety and stress). These costs are a formidable challenge even to Western countries (USA: \$44 billion per annum in 1997) and so far as India is concerned it would be a crippling burden, especially when considering the complications affecting the heart, kidneys, eyes and feet!

Diabetes Mellitus Type 2 which constitutes the major share of the Diabetes burden in India is today considered one part of the metabolic syndrome also termed Syndrome X or Reaven's syndrome. Other manifestations are obesity,

acanthosis nigricans, hypertension, coronary artery disease, hyperuricemia and the polycystic ovarian syndrome. Sleep disorders and nonalcoholic hepatic steatosis are also very likely related to the metabolic syndrome. Further interrelationships to inflammation markers, atherosclerosis (the so called inflammation of the blood), Cancer and to Age related Neuronal Degeneration, Age related Macular Degeneration, Alzheimer's Disease, and other disorders that imperil healthy ageing and even shorten life span are currently the focus of interest. Possible common threads are antioxidants and free radical stress as well as adipocytokines. Following the Barker hypothesis, Yajnik¹ from Pune has stressed the intrauterine environment in the genesis of the metabolic syndrome, and emphasized that apart from maternal malnutrition, the widespread administration of folic acid to pregnant mothers without balancing Vitamin B12 could also be playing a role. Insulin resistance, hyperinsulinemia conditioned leptin resistance (Lustig, 2007)² have been incriminated in causing obesity, and a faulty life style is another common thread between Coronary artery disease and Type 2 Diabetes (Hazra, 2005).³

Even considering that multiple or individual genes diversely predispose to the Metabolic syndrome or Diabetes, there is increasing evidence that cytokines such as TNF alpha and NKB may

play a role in enabling the expression of adverse genes, and many of these cytokines depend on environmental factors!

Despite controversies on the exact criteria to be used to define the metabolic syndrome or the exact metabolic syndrome, these common mechanisms and protean manifestations constitute a public health problem by reason of their additive/overlapping morbidity and mortality and therefore urgent preventive measures are mandatory.

Can we stop or arrest this Juggernaut? It is clear that preventive measures have been successful in preventing Diabetes in Impaired Glucose Tolerance. The STOP NIDDM study, the Da Quing study, the US Diabetes Prevention Study, and the Finnish Study have all demonstrated that life style intervention irrespective of pharmacological intervention can sharply decrease the transition from Impaired Glucose Tolerance to overt Diabetes Mellitus. (Whether such life style behavioral modification programs are successful in obese children is, however, moot: Ritchie et al, 2001, despite other reports of benefit, Epstein et al 2001).^{4,5}

Equally important, all primary prevention programs give the added benefit of early detection of a disease process, making it easier to limit damage and prevent complications, secondary and tertiary prevention.

The most important question in Diabetes prevention is the approach to be adopted. In theory the benefits of prevention should be applied to the general population, but it appears that successful modification of life style hinges around not only imparting advice, but also repeated reinforcement and followup so that the adoption of healthy life styles is not only monitored but also reemphasised. Effectively doing this for the general population is difficult, expensive and logistically impractical.

We therefore believe in a 3 pronged strategy, the prongs being addressed to (a) the high risk category, (b) the general population and (c) the trigger groups that can catalyse life style change,

irrespective of they themselves being at enhanced risk.

We describe some essential elements of each of these, along with a discussion of the role that school children can play in each of these. School children directed programs comprise inter alia, (i) Healthy life style education in schools (ii) school health assessment/care programs and (iii) attracting school children to diabetes education melas/camps/public lectures.

Finally we also discuss barriers to the life style modification approach, and some solutions to these barriers.

a. Intensive prevention strategies for high risk groups

Identifying high risk categories can be conceptualized in various ways. Glucose measurements to identify impaired fasting glucose or impaired glucose tolerance are relatively expensive on a large scale, and logistically difficult to implement. Serological or genetic markers assays for future diabetes are even more costly. A questionnaire approach, self administered and widely publicized to identify diabetes risk has therefore been advocated, and the American Diabetes Association and other groups have devised questionnaires for this purpose.

Type 2 Diabetes in particular and the Metabolic syndrome in general display a strong familial clustering. Over 75% Type 2 diabetics have a positive history of Diabetes amongst first degree relatives. With both parents having diabetes the risk of diabetes in the offspring approaches 70%; with one parent the risk is over 50% and with one sibling diabetic the risk is over 40%.

We have therefore at Agra embarked on a long term prospective preventive study, the Agra Preventive Intervention Diabetes Study (APIDS) directed at the offspring of diabetic couples. This usually constitutes a highly motivated group as the parents and very often some

sibs have already experienced the ravages of diabetes and its complications. Such families are registered in the Agra Diabetic Family Registry, derived from index cases encountered in outpatients, diabetic clinics, or in general practice referred to us. This high risk group is identified at zero cost without any serological or biochemical tests. Many of these offspring already show one or more manifestations of the metabolic syndrome or abnormal glucose tolerance patterns (Impaired fasting glucose, impaired glucose tolerance, diabetes mellitus) or alterations in Beta cell insulin secretion or Insulin resistance, as studied in various cross sectional analyses (Hazra, Gupta et al, 2000 and 2003^{6,7}). Effectively tracking these high risk families has involved (a) the Diabetes Clinic of the S N Medical College (b) the regular involvement of postgraduate students in medicine and related disciplines, many of whom are motivated to offer diabetes prevention/care subjects for their dissertations (c) the creation of the Agra Diabetes Forum, a group of physicians dedicated to, and enthusiastic about not only diabetes management but also prevention.

All the school children programs listed earlier can contribute to the high risk prevention strategy.

Efforts directed at school children and trigger groups such as teachers, often help in the identification of such diabetic families.

Anthropometric measurements in schools identify obese children who themselves obviously constitute a high risk group. Interaction with these children also reveal subjects with unhealthy dietary/television /physical exercise/ stress/pollution exposure patterns, who are also at risk. Nutritional and lifestyle counseling is offered to such children and their parents in an unobtrusive, confidential manner, so as to prevent peer ridicule of children categorized as obese.

Continuing interaction with school health physicians, physical education teachers, school nurses and school officials and teachers in general give further recruits to the high risk group, but such continued interaction is dependant on the availability of the diabetes health team for helping with other health problems, and the offering of preferential track medical access. To successfully offer this, integration with the state supported medical care system such as in teaching hospitals, medical colleges or the district hospitals is very desirable.

b. General population directed Strategy

The message for a healthy life style albeit using diabetes and heart disease as examples, must in our view nevertheless emphasise that the healthy life style is not only needed for prediabetics/diabetics but also enhances general health, longevity, cognitive function, looking good, and the prevention of high blood pressure, cancer, stress. This will avoid reactions such as “Mein kyon chini kam karoo? Mujhe diabetes to nahin hain!: Why should I reduce sugars? I’m not diabetic!”

The message re diet/exercise patterns/sleep patterns/avoiding tobacco and other addictions, particularly chews, dental powders containing tobacco or worse noxious agents, and stress avoidance must be skillfully integrated with what appeals to the Indian psyche and is culturally acceptable. Yoga, Pranayam, Prayer can all be interlinked with this message.

As indicated earlier, the message should include information about indicators of high risk, e.g. through a check list or questionnaire for self administration so that individuals at high risk report for assessment to their health care providers and are impelled to modify their life style.

Multimedia presentations and using television channels with stars/sportsmen can no doubt contribute to general population education,

thanks to our extensive satellite network, but these are expensive unless national publicly funded channels are used !

Local iconic figures such as physicians, teachers, sports champions utilizing local newspapers/news channels can inexpensively achieve the same purpose.

How can school children directed efforts contribute to this general population education?

School children and trigger group directed programs enhance the acceptability of the general population message, ensuring that the TV health message is not "switched off". The message honed and polished through school presentations is well adapted to use in general population presentations, e.g. the answers to commonly asked questions are included (Why do some people stay thin despite eating lots? Is not fruit juice good for health? Did not our ancestors take lots of fat and stay healthy? Are exercise and diet modification both needed? What are trans fats? Is not Safflower oil good for the heart? Cant one eat rice and stay healthy?). This has helped us improve the content and delivery of our general population programs. School directed programs have also helped our local speakers improve their communication, teaching and propaganda skills e.g. the effective use of attention getting openings/humour to get and hold the audience attention.

It is pertinent to point out that mass media presentations involving local schoolchildren (Our child on TV!): skits/plays/poetry/debates are popular in themselves, increasing the mass medium message audience.

c. Efforts directed at School Children and Trigger groups

Catching them young has been a time honoured strategy for education. Whether it is mathematical ability, artistic or musical skills or logical thought, the need to start early to fashion

plastic minds rather than attempt to change hardened habit sets appears logical. It is said that "Ideas have legs", and therefore societal life style change involves changing mind sets. The prevention of disease is a campaign akin to the prevention of war, and the declaration of the UNICEF charter at the end of World War II stated 'As wars begin in the minds of men, it is in the minds of men that the defences of peace must be constructed!'

School based health education programs have the advantage that the message delivered in the presence of the teacher is reinforced by the authority of the school. Children in turn affect parents, and both affect neighbours. What is sought is a thought revolution to effect life style change in society.

This is especially relevant when the forces of globalization, Westernisation, and multinational commerce seek to replace healthy food choices in the developing countries by empty calories, junk foods and fizzy drinks.

It must be admitted that some of the foreign assaults have permeated indigenous food styles over centuries. Sugar cane and the potato both were introduced in India and other colonies by giant companies such as the East India company which had access to these plants discovered in the Americas. 'Chini ka parantha', 'Aloo ka Samosa' and 'Makhan bati' exemplify junk food in the Indian cuisine!

The problem of high carbohydrate intake was compounded by an unwise change to hydrogenated fats and to n-6 unsaturated fats such as safflower oil, and target audiences for school programs have already received disinformation through advertisements.

Motorisation, television, computer games and spectator sports also have reduced physical activity, so that the high calorie intakes are not being balanced by physical activity.

The phenomena of increasing childhood obesity (Ogden, 2002)(8), childhood Type 2 diabetes reported from the United States encapsulated in Francine Kaufmann coining the term Diabesity⁹ are now being observed in India as well.

The message that we are imparting to school children stresses healthy food choices, physical activity, destressing and avoiding tobacco. We lay particular emphasis on deglamorising the television couch potato and the smoker using cartoons. We find the use of phrases such 'Smoking is the adult equivalent of thumb sucking!' and 'A cigarette is a stick with a fire at one end and a fool at the other!' to be effectively thought provoking.

After a decade of inviting school children to our Diabetes Melas from 1997, and innovatively utilizing folk theatre, skits and modified Kabir Ke Dohe to involve them in life style change, in 2007 thanks to a bold initiative by Prof Anoop Mishra and Diabetes Federation of India with World Diabetes Federation support, we joined hands with Delhi and Jaipur (Dr Rajiv Gupta) in starting **in school** educational programs in 10 schools each, under Project Marg. This was directed not only at the school children but also at the teachers and the parents. This involves didactic lectures, quizzes, cooking and tiffin competitions, debates, poster competitions, apart from anthropological measurements particularly height, weight and waist circumference. The success of the program is being measured by Knowledge, Attitude and Practices surveys, and in another dimension by seeing whether food practices, exercise patterns, and weights change. The results of this project will, it is hoped, be extremely interesting in designing further programs.

School teachers, pari passu, themselves are a powerful trigger group with a powerful potential for encouraging healthy life styles.

Other trigger groups that can be utilized are **religious leaders, defence personnel (including exservicemen), sports champions, television and screen stars**. The success of Baba Ramdeva in enthusing millions of people to incorporate some physical or breath exercise in the daily routine in hitherto completely sedentary routines has been witnessed by numerous physicians. Many obese individuals with severe osteoarthritis of the knees have been persuaded to at least exercise the trunk and upper limbs. So also did the phenomenal success of the movie blockbuster Chak De by Shah Rukh Khan awaken many to hockey!

Social welfare groups such as Bharat Vikas Parishad, Round Table, Lions and Rotarians are being involved both as trigger groups themselves but also to aid the education of other trigger groups, during the activities of our Agra Diabetic Forum.

Last but by no means the least, we must reiterate the role of doctors, as opinion leaders and trigger groups. Every health care professional-be it doctor, nurse, technician or pharmacist, must deliver a life style message both by exhortation and by example! Medical students are the Doctors of tomorrow, and therefore we have for the last 10 years been utilizing medical students in presenting health messages at our Diabetes Melas utilizing folk theatre, Kabir ke Dohe and the like. We hope that they will continue to spread the life style revolution in their respective towns where they will practice! We believe that Physicians must interweave the preventive health messages of healthy diet, physical exercise, avoiding stressors such as tobacco etc, and combating pollution to patients and their families with their therapy of all ailments, irrespective of whether the presenting disorders are directly linked to these ! The patient who comes for treatment is in a very receptive mind frame where preventive health indoctrination can be more easily imparted!

Barriers to preventive strategies especially in children, and possible solutions

Pathophysiological barriers

Promoting physical activity is an uphill task when the obesity leads to easy tiring, breathlessness and painful joints during unaccustomed exercise. Gradual and selective exercise patterns can overcome this: one can also emphasise that Fat active is better than Fat inactive! Some tennis players are highly motivated and successful despite being obese.

Peer ridicule of the fat child last in the race is also a very real problem: individual activity such as skipping, dancing or long walks, swimming, exercise cycles or Yoga are possible ways out.

Lustig, 2006,² in an excellent review has emphasized that biological susceptibility and societal accountability must be acknowledged and personal responsibility and guilt deemphasized.

The concept of "Personal responsibility" permits governments and business interests the luxury and absolution of abdicating their responsibility. To quote him "The concept of personal responsibility" is, however, not tenable in children. No child chooses to be obese. Obese children are ostracized by their peers, and their quality of life, as measured by self reported distress, is comparable to those receiving cancer chemotherapy. Young children among whom obesity is rampant are not responsible for their food choices and are incapable of accepting personal responsibility" The society that permits the sale, promotion and availability of junk foods must change its laws and attitudes. How does one can react to purveyors of pornography to children or for that matter tobacco advertisements to the vulnerable? Why not then a similar attitude to the promotion of junk food!

Further, Lustig reviews the central nervous system mechanisms underlying weight gain. Hyperinsulinemia promotes leptin resistance, insulin interfering with leptin signal transduction

being an endogenous antagonist. Ordinarily elevated leptin should lead to increased sympathetic (SNS) and decreased vagal outflow, with increased resting energy expenditure (REE), lipolysis and decreased food intake. Hyperinsulinaemia induced leptin resistance should decrease SNS activity to reduce REE and increase vagal activity to promote energy storage. The hypothetical hypothalamic set point being dysfunctional in obesity, a higher level of leptin is required to signal the hypothalamus to maintain a normal REE. Reductions in REE are associated with fatigue, malaise, decreased quality of life and decreased physical activity. The obese subject therefore increases calorie intake to raise leptin concentration above the level at which leptin resistance occurs, so as to maintain normal energy expenditure and quality of life. Work on pharmacological interruption of these vicious cycles such as SOCS 3 inhibitors is in progress, but even when developed these are likely to be inexpensive.

Hyperinsulinemia also decreases dopamine clearance and uptake in the hedonic pathway—the Nucleus Accumbens and Ventral Tegmental Area. The latter is known for initiating feeding behavior on the basis of palatability rather than energy need. The dopamine changes promote an increased pleasure reward of food that causes further food intake, as eating becomes more pleasurable!

The induced obesity induces further hyperinsulinaemia, thus constituting both these mechanisms as vicious cycles!

Thus biologically hyperinsulinemia and insulin resistance predispose to excessive eating and decreased energy expenditure!

Treating and preventing childhood obesity must therefore address the causes of hyperinsulinemia.

Causes of Hyperinsulinemia

Altered insulin dynamics, including increased secretion exist in certain ethnic groups even prior to obesity (Arslanian et al, 2002, Preyasombat C, 2005).^{10,11} We have described these in the

offspring of diabetic couples in the APIDS study.^{6,7} Hyperinsulinemia and insulin resistance have been described in both small for gestational age and large for gestational age subjects as well as in preterm infants (Stocker, 2005; Yajnik, 2002 and Hofman, 2004).¹²⁻¹⁴ Can this be corrected by proper maternal nutrition?

The typical Western diet has been categorized as highly insulinogenic (high energy density, glycemic index, fructose content and low fiber and dietary content)(Isganaitis and Lustig, 2005), and we have noted the sad westernization threatening the traditional Indian life style.³

Apart from these, the increasing frequency of diabetes despite the unaltered genetic pool could also be due to pancreatotoxic factors: viruses, pollutants and perhaps unknown agents. (Hazra, 2007)¹⁵

Logistic difficulties in effecting life style changes in children

Physical activity

Unfortunately, there are few schools which have good areas for physical exercise activities (Sujatha, 2007),¹⁶ even in the capital of economically affluent states such as Tamil Nadu. To quote this, “..there are quite a few schools in Chennai that do not have a playground. What students get in these schools is an apology of a playground and utilities. Such schools lease out a neighbouring vacant plot or use the neighbouring Corporation playground. Often schools carry on with rudimentary equipment that is not replaced until they wear out completely.”

There are many areas devoid even of safe public play areas. It is a wonder that determined children use even streets and lanes to play cricket or badminton.

Until physical activity is included in the subjects that earn marks in the school leaving examinations, and given credit in the selection criteria for professional courses, students will continue to remain sedentary bookworms moving from tutorial

to tutorial with no time for physical activity either in the school or at home.

Diet

Many of the health promoting foods:fruits,dairy products, pulses, salad vegetables are relatively expensive as compared to the empty calorie starch and sweet foods. The midday meal school program run by various schools gives an opportunity to effectively supplement these but unfortunately many of these programs are plagued by corruption and/or inefficiency. An alert public opinion is needed to monitor and correct these.

Conclusion

The task of disease prevention is difficult, the path long, and the work unglamorous, but changing mind sets we believe is worthwhile. Education for Life style changes must however go hand in hand with overcoming the logistic and pathophysiological barriers to behavioural change referred to above. As we strive for these, let us remember the exhortation:

“Awake, Arise and Stop not, until the Goal is reached”

Swami Vivekananda

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