Asian J. Exp. Sci., Vol. 23, No. 1, 2009; 261-268 **Review**

Diabetes mellitus: The Pandemic of 21st Century!

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Abstract : Diabetes mellitus is a major global metabolic disorder of 21st century. This is due to its broad spectrum of associated complications with risks, like cardiac and renal disorders. The rapid growth of diabetes is becoming a major burden upon healthcare facilities in all affected countries. Due to lack of definitive preventative measures of diabetes, we must be aware of this pandemic and follow a disciplined lifestyle to limit it. In this communication, recent advances in diabetes management and current preventative measures have been concluded.

Key words : Diabetes mellitus, Body mass index, Diet, Lifestyle management, Traditional medicinal plants.

Introduction

Diabetes mellitus is a major global metabolic disorder of current century. This pandemic is characterized by excessive sugar in the blood (hyperglycemia) due to deficiency in production of insulin by the pancreas or by the ineffectiveness of the insulin produced. Diabetes affects almost every cell in the body and essential biochemical processes that cause severe effects on health (Gupta, 2007).

The hereditary background, aging, obesity, dietary imprudence, endocrine imbalance, psychic stress, reduction in physical labour and discriminated social structure are the important factors, that have exploded the prevalence of diabetes in India and other affected countries (Popkin *et al.*, 2001; Boyle *et al.*, 2001; Gupta *et al.*, 2008). It is estimated that in year 2000 about 171 million people were affected with diabetes worldwide and this is expected to double by the year 2030 (Boon *et al.*, 2006). In India more than 35 million people suffering from diabetes. It is likely that these figures are a gross under estimation of the problem; particularly considering the fact that 50% of diabetics in India do not know that they suffer from diabetes (Agarwal, 2007a). Due to lack of definitive symptoms in early stage of diabetes its prevention in early stage is also a challenge. Diabetic patients have a considerable risk for cardiovascular disorder which further compounds the medical and public health challenges. Up to 80% death within this high risk population are due to associated cardiovascular disease (Harris *et al.*, 1987; Taubert *et al.*, 2003). The health care burden of diabetes is enormous, and effective steps to combat the indiscriminate rise in the global incidence and prevalence of diabetes are urgently needed (Popkin *et al.*, 2001; Eschwege *et al.*, 1997; Ramsey *et al.*, 2002).

Who is in danger zone of diabetes?

Over the next few decades the most anticipated increase in diabetes cases will come from developing countries. India is the number one danger zone of diabetes in the world (Gupta, 2007). It is estimated that by the year 2030 there will be 79.4 million diabetic patients

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in India. Mean while, China and US rank second and third in the world with 42.3 million and 30.0 million respectively (WHO, 2004). In the developing countries, it is the younger age groups which are affected whereas in industrialized countries increase in the number of cases of diabetes occurs among elderly people (Sinclair, 2003).

Over 13% adults in urban India suffer from diabetes whereas 5% in the countryside (Ramachandran *et al.*, 2001; Zimmet *et al.*, 1997). In India, roughly 43% of all diabetic cases were found to be up to 40 years of age (Agarwal, 2007a). Aging population and elderly are disproportionately affected by diabetes. For example currently, worldwide over 80 million people of age group 45-64 years are suffering from diabetes (Boon *et al.*, 2006). Women are reported to have more difficulty in maintaining normal blood sugar in comparison to men especially around the time of their menses, and are more susceptible to diabetes (Lunt and Brown, 1996; Trout and Teff, 2004).

It has been found that diabetes tends to transfer through genes in families having diabetic history. Sedentary life, decreased physical activity and increase in obesity optimize the risk of diabetes incidence, not only in adults but also in children. As population switch from their native diet to more commercial and refined fast foods high in carbohydrate, and fat the incidence of diabetes increase (Meyer *et al.*, 2001; Salmeron *et al.*, 1997; Van Dam *et al.*, 2002).

Root of Diabetes

Physiological construction of human body is one of the most complicated wonders of the nature. Carbohydrate is the active fuel of the body and main source of energy for cells. In normal digestion food sugars and starches (carbohydrates) are changed in to sugar glucose. Excess blood glucose stored in form of glycogen (animal starch) in liver and muscles. When blood sugar goes below normal, the stored glycogen reconverted in to glucose.

The normal blood sugar in the body is regulated mainly by the hormones insulin and glucagon. Growth hormone, cortisol and catecholmines (epinephrine and nor-epinephrine) are other hormones also influence blood sugar levels. The pancreas is a gland situated in upper abdominal region is scattered with hormone producing tissue called the islets of Langerhans. It contains alpha- and beta-cells responsible for production of glucagon and insulin respectively. In healthy individuals when blood sugar rises after meal, the beta-cells release insulin that helps glucose entry in body cells, lowering blood sugar to normal range. However, in fasting condition when the blood sugar level drops below normal range the insulin release suppresses and it signals alpha-cells to secrete glucagon. Glucagon signals the liver to release stored glycogen and convert in glucose, it raising blood sugar to normal level.

In case of disturbed metabolism insulin fails to maintain normal glucose level in body that results in abnormal accumulation of sugar in blood stream causes diabetic condition.

Types of Diabetes

On the basis of nature and causing factors, diabetes can be divided in to following types:

Type-1 Diabetes

It usually occur in young generation, near about 5% of whole diabetic population have type 1 diabetes. It is a slowly progressive autoimmune disease mediated through T-cells. In this the immune system attacks the insulin producing beta-cells and destroys them as a result hyperglycemia (high blood sugar level) occurs. The classical symptoms of type 1 diabetes appear when 70-80% of beta-cells have been destroyed. Therefore, profound insulin deficiency is requires insulin replacement therapy (Gupta, 2007; Eschwege *et al.*, 1997).

Type-2 Diabetes

This is most prevalent in aging and elderly population, representing more than 90% of all cases of the diabetes (Day, 1998). In type 2 diabetes body cells lose their ability to properly respond to signals given by insulin. However, pancreatic beta-cells producing the insulin 2-3 time the normal amount. Therefore, it is an 'insulin resistance' condition and can usually be treated without insulin replacement therapy.

Malnutrition Related Diabetes Mellitus (MRDM)

Recently this type of diabetes has been categorized as a separate class. This type of diabetes is mainly seen in some tropical countries like India, Bangladesh, and Africa etc. where poor people consuming carbohydrate rich diet. It occurs in young people between 15-30 years of age. People with MRDM are lean and undernourished. In this type of diabetes, the pancreas fails to produce adequate insulin. Therefore, these diabetics require insulin therapy (Raghuram *et al.*, 2003).

Gestational Diabetes

It occurs in about 2-5% of pregnant women. During normal pregnancy, insulin sensitivity is reduced due to the action of placental hormones and this affects glucose tolerance. In normal women prominent insulin resistance develops, mostly by second half of pregnancy. Repeated pregnancy may increase the risk of developing irreversible diabetes, particularly in obese women (Gupta, 2007; Raghuram *et al.*, 2003).

Diagnosis

When diabetes is suspected, it may be easily confirmed by determining blood sugar levels, urine sugar concentration and glycosylated haemoglobin content. According to WHO (1999) Fasting plasma glucose (FPG) more than 126mg/dl (7.0mmol/L) and 2 hour post load plasma glucose (PPG) more than 200mg/dl (11.1mmol/L) are the diagnostic criteria for diabetes (WHO, 1999). When the blood sugar level elevates beyond renal threshold (180mg/dl), the glucose is excreted in the urine, this conditioned is called glycosuria. This indicates diabetes and could also be monitored by diastex or Benedict's test. As blood sugar (glucose) increases, more of it gets binds to haemoglobin, this combined molecule is estimated as glycosylated haemoglobin. In normal population concentration varies from 4-7% while in diabetes, it ranges 8-18%, depending on blood sugar level (Gupta, 2007).

Complication of Diabetes

Among acute complications hypoglycemia and ketoacidosis are the most important. The patients using excessive insulin or oral drugs develop rapid and severe lowering of blood sugar below certain critical limits (below 45-55mg/dl) resulting hypoglycemia that may cause coma (Murata *et al.*, 2005). When body can not use carbohydrate as fuel for energy, it utilizes large amount of fats and proteins. This results in over production of metabolic product ketones. The increase amount of ketones in blood stream cause ketoacidosis and patients may enter into coma (Boon *et al.*, 2006).

Diabetic patients who have high blood sugar levels are at increased risk of formation of blood clots. This is due to their stickier platelet cells which cause several abnormalities (Agarwal, 2007b). In patients with long standing diabetes impaired vision, cataract, renal failure, sensory loss, gastrointestinal problems, foot ulcers, hardening of blood vessels, stroke would be recognized as chronic complication (Day, 1998; Raghuram *et al.*, 2003).

Current Preventative and Management Strategies

Current measures for diabetes management are diet, disciplined lifestyle and

drugs. Modification in life style and diet, ideal body weight and regular physical activity have been shown to be effective for prevention or delaying the risk of diabetes up to 60% (Knowler *et al.*, 2002; Tuomilehto *et al.*, 2001; Pan *et al.*, 1997). Diet and lifestyle are two most important factors that can cure the diabetes as well as resist the healthy people. Diet is the foundation of diabetes control. Dietary measures are required in treatment of all kind of diabetes. About 50% of new cases of diabetes can be controlled by diet alone. Normal Indian diet, generally high in carbohydrate (60-65%) and low in fat, and rest is derived from proteins (15-25%), is ideal in diabetes (Raghuram *et al.*, 2003). Intake of high-fibre complex carbohydrate food is protective against diabetes. The healthy and diabetic people should consume low calorie and reduced saturated fat containing diet. Alcohol must be avoided especially in diabetes as it is high in calories. Consumption of several traditional medicinal plant materials which are components of a normal diet do indeed not only compensate our nutritional requirement but also exert anti-diabetic activity by improving various parameters of glucose metabolism. Onion, garlic, fenugreek, karela, jamun, tejpat, elephant apple and sugar apple are good examples (Saxena *et al.*, 2006; Gupta *et al.*, 2008). About 20-30% new cases of diabetes need oral anti-diabetic drugs including metformin (Pan *et al.*, 1997), acarbose (Chiasson *et al.*, 2002), ramipril and captopil (Yusuf *et al.*, 2001; Hanson *et al.*, 1999), troglitazone (Buchanan *et al.*, 2002) and losarton (Daholf *et al.*, 2002), and 20-30% require insulin to manage their diabetes. The diabetics must use insulin or oral drugs only under observation of qualified practitioners. One can easily remain fit and can avoid diabetes risk by monitoring their Body Mass Index (BMI) and calorie consumption.

A. Body Mass Index chart

BMI is a relationship between weight and height that is associated with body fat and health risk. The BMI between 20 and 25 is considered ideal body weight range for sound health. If your BMI is between 25 and 30, it means you are overweight. The obesity is taken to start at BMI of 30. BMI below 20 is considered as underweight. To determine your BMI, locate your height (in Foot'Inch") on Body Mass Index chart (Table-1) and follow that column downward until you reach the row with the weight (in Kg.) nearest yours. The reading that cross height column and weight row is your BMI. The standards are same for men and women.

B. Calorie Requirements

The ideal calorie requirements for both men and women depending on their activity level must be checked (Table-2). One can easily calculate their calorie requirement by following method used the factors like height, weight, age and sex to determine Basal Metabolic Rate (BMR), using which you can determine your calorie requirements.

Men: BMR = 66 + (13.7 × wt. in kg) + (5 × ht. in cm) – (6.8 × age in years)

Women: BMR = 655 + (9.6 × wt. in kg) + (1.8 × ht. in cm) – (4.7 × age in years)

Now, multiply your BMR by your Physical Activity Ratio from criteria given below to estimate your calorie requirements-

Sedentary = BMR × 1.2

Moderate activity = BMR × 1.55

Heavy activity = BMR × 1.725

Conclusion

Definitive and safe preventative measure that can be taken against diabetes is yet to be developed at this time, except dietary and exercise guidelines. However, researches are in progress to prepare a safe and inhaled form of insulin (Hermansen, 2004). Research on the use of isolated pancreatic islets by

Table 1: Body Mass Index (BMI) chart

Weight (Kg)	Height (Foot' Inch'')																		
	4' 10''	4' 11''	5' 0''	5' 1''	5' 2''	5' 3''	5' 4''	5' 5''	5' 6''	5' 7''	5' 8''	5' 9''	5' 10''	5' 11''	6' 0''	6' 1''	6' 2''	6' 3''	6' 4''
	BMI (kg/m^2)																		
47	21	20	20	19	18	18	17	17	16	16	15	15	14	14	14	13	13	13	12
48	22	21	21	20	19	19	18	18	17	16	16	16	15	15	14	14	14	13	13
50	23	22	22	21	20	20	19	18	18	17	17	16	16	15	15	15	14	14	13
52	24	23	23	22	21	20	20	19	19	18	18	17	17	16	16	15	15	14	14
54	25	24	23	23	22	21	21	20	19	19	18	18	17	17	16	16	15	15	15
57	26	25	24	24	23	22	22	21	20	20	19	18	18	17	17	17	16	16	15
59	27	26	25	25	24	23	22	22	21	20	20	19	19	18	18	17	17	16	16
61	28	27	26	26	25	24	23	23	22	21	21	20	19	19	18	18	17	17	16
64	29	28	27	27	26	25	24	23	23	22	21	21	20	20	19	19	18	18	17
66	30	29	28	27	27	26	25	24	23	23	22	21	21	20	20	19	19	18	18
68	31	30	29	28	27	27	26	25	24	24	23	22	22	21	20	20	19	19	18
70	32	31	30	29	28	28	27	26	25	24	24	23	22	22	21	20	20	19	19
73	34	32	31	30	29	28	28	27	26	25	24	24	23	22	22	21	21	20	20
75	35	33	32	31	30	29	28	28	27	26	25	24	24	23	22	22	21	21	20
77	36	34	33	32	31	30	29	28	27	27	26	25	24	24	23	22	22	21	21
79	37	35	34	33	32	31	30	29	28	27	27	26	25	24	24	23	23	22	21
82	38	36	35	34	33	32	31	30	29	28	27	27	26	25	24	24	23	23	22
84	39	37	36	35	34	33	32	31	30	29	28	27	27	26	25	24	24	23	23
86	40	38	37	36	35	34	33	32	31	30	29	28	27	27	26	25	24	24	23
88	41	39	38	37	36	35	34	33	32	31	30	29	28	27	27	26	25	24	24
91	42	40	39	38	37	36	34	33	32	31	30	30	29	28	27	26	26	25	24
93	43	41	40	39	38	36	35	34	33	32	31	30	29	29	28	27	26	26	25
95	44	43	41	40	38	37	36	35	34	33	32	31	30	29	29	28	27	26	26
98	45	44	42	41	39	38	37	36	35	34	33	32	31	30	29	28	28	27	26
100	46	45	43	42	40	39	38	37	36	35	34	33	32	31	30	29	28	28	27
102	47	46	44	43	41	40	39	38	36	35	34	33	32	31	31	30	29	28	27
104	48	47	45	44	42	41	40	38	37	36	35	34	33	32	31	30	30	29	28
107	49	48	46	44	43	42	40	39	38	37	36	35	34	33	32	31	30	29	29
109	50	49	47	45	44	43	41	40	39	38	37	36	35	34	33	32	31	30	29
111	51	50	48	46	45	43	42	41	40	38	37	36	35	34	33	32	32	31	30
113	52	51	49	47	46	44	43	42	40	39	38	37	36	35	34	33	32	31	30
116	53	52	50	48	47	45	44	43	41	40	39	38	37	36	35	34	33	32	31
118	54	53	51	49	48	46	45	43	42	41	40	38	37	36	35	34	33	33	32
120	56	54	52	50	49	47	46	44	43	42	40	39	38	37	36	35	34	33	32
122	57	55	53	51	49	48	47	45	44	42	41	40	39	38	37	36	35	34	33

transplantation in human is also in progress to cure type 1 diabetes. A recent research has shown that cells from a number of body tissues can be induced to produce process and store insulin, release it in response to physiological signals and replace beta-cell functions in rodents, as a cure for diabetes (Efrat, 2004). Therefore, it is recommended that we must be

Table 2: Calorie requirements chart

Sex	Activity Level	Calories Required
Male	Sedentary	2400
	Moderate	2800
	Heavy	3800
Female	Sedentary	1900
	Moderate	2100
	Heavy	3000

aware of different aspects of diabetes. It could be prevented simply by lifestyle modification including natural diet, maintaining ideal body weight and physical activity prescription rather than be a diabetic.

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