INTRODUCTION

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1. DEFINITION OF DIABETES MELLITUS

The term diabetes mellitus describes a metabolic disorder of multiple aetiology characterized by chronic hyperglycaemia with a disturbances of carbohydrate, fat and protein metabolism resulting from defects in insulin secretion, insulin action or both.

Diabetes is a disorder of metabolism—the way the body uses digested food for growth and energy. Most of the food, people eat is broken down into glucose, the form of sugar in the blood. Glucose is the main source of fuel for the body. After digestion, glucose passes into the bloodstream, where it is used by cells for growth and energy. For glucose to get into cells, insulin must be present. Insulin is a hormone produced by the pancreas, a large gland behind the stomach.

When people eat, the pancreas automatically produces the right amount of insulin to move glucose from blood into the cells. In people with diabetes, however, the pancreas either produces little or no insulin, or the cells do not respond appropriately to the insulin that is produced. Glucose builds up in the blood, overflows into the urine, and passes out of the body in the urine. Thus, the body loses its main source of fuel even though the blood contains large amounts of glucose.

2. CLASSIFICATION OF DIABETES MELLITUS

2.1. Type 1 diabetes mellitus (insulin-dependent diabetes mellitus – IDDM)

This form of diabetes, which accounts for only 5–10% of those with diabetes, previously encompassed by the terms insulin dependent diabetes, type 1 diabetes, or juvenile-onset diabetes, results from a cellular-mediated autoimmune destruction of the b-cells of the pancreas. Type 1 diabetes mellitus is characterized by an absolute lack of insulin. Secretion of endogenous insulin is almost or completely absent, and the patients are vitally dependent on injections of exogenous insulin. The patients are prone to ketoacidosis. The disease is caused by an auto immune-induced selective destruction of insulin producing b-cells in the pancreatic Langerhans islets in genetically predisposed individuals. Viral infections or contact with other exogenous or endogenous agents may trigger the auto-immune reaction.

2.2 Type 2 diabetes mellitus (non-insulin-dependent diabetes mellitus −NIDDM)

The first stage in the development of type 2 diabetes mellitus is often insulin resistance, requiring increasing amounts of insulin to be produced by the pancreas to control blood glucose levels. Initially, the pancreas responds by producing more insulin, but after several years, insulin production may decrease and diabetes develops. Type 2 diabetes usually develops slowly and insidiously in children.

Some patients with type 2 diabetes may show no symptoms at all. In others, symptoms may be similar to those of type 1 diabetes. A patient may feel very tired, thirsty, or nauseated and have to urinate often. Other symptoms may include weight loss, blurred vision, frequent infections, and slow healing of wounds or sores. Some patients may present with vaginal yeast infection or burning on urination due to yeast infection. Some may have extreme elevation of the blood glucose level associated with severe dehydration and coma. Because symptoms are varied, it is important for health care providers to identify and test populations who are at high risk for the disease.

Physical signs of insulin resistance include acanthosis nigricans, where the skin around the neck or in the armpits appears dark and thick, and feels velvety. Women can have polycystic ovary syndrome with infrequent or absent periods, and excess hair and acne. Microalbuminuria and cardiovascular risk factors such as abnormal cholesterol and high blood pressure may be present at the time of diagnosis.

Type 2 is the prevailing form of diabetes mellitus. The patients are not vitally dependent on exogenous insulin because production of their own insulin usually is not decreased. The cause of this disease lies in disorder of action of insulin. Decreased cellular effects of insulin on the target organs are referred to as insulin resistance, due to a disorder at the level of insulin receptor or transduction of signal from the receptor inside the target cell. Initially, due to insulin resistance the absolute values of insulin are higher than normal. Later, however the disorder of insulin secretion also appears as the b-cells gradually lose their ability to respond to hyperglycemias with increased insulin production. Type 2 diabetes used to occur mainly in adults who were overweight and older than 40 years. Now, as more children and adolescents in the India become overweight or obese and inactive, type 2 diabetes mellitus is occurring more often in young people aged 10 or older. Most children and adolescents

diagnosed with type 2 diabetes are also insulin resistant, and have a family history of type 2 diabetes.

Onset of Type 2 diabetes mellitus is usually in adulthood, typically in age above 40. Unlike the Type 1 the patients are not prone to ketoacidosis. 60-90 % the patients of DMT2 are obese.

2.3. Gestational diabetes mellitus

Gestational diabetes mellitus (GDM) is a form of diabetes that is diagnosed during pregnancy. Reported rates of GDM range from 2 percent to 10 percent of pregnancies. GDM is more common among obese women, women with a family history of diabetes. During pregnancy, GDM must be treated to normalize maternal blood glucose levels to lower risk of adverse maternal, fetal, and neonatal outcomes. GDM imparts a lifetime risk for diabetes. Immediately after pregnancy, 5 percent to 10 percent of women with gestational diabetes are found to have diabetes, usually type 2. Women who have had gestational diabetes have a 35 percent to 60 percent chance of developing diabetes in the next 10 to 20 years. (Centres for Disease Control and Prevention, 2011). At 10 years postpartum, the risk of developing diabetes is 70 percent higher than in a comparable group of women without GDM. Overweight women with a history of GDM can take steps to reduce their risk for diabetes by losing at least 5 to 7 percent of their body weight and increasing their physical activity.

Children born to pregnancies complicated by diabetes may be at increased risk for obesity and diabetes.

For many years, GDM has been defined as any degree of glucose intolerance with onset or first recognition during pregnancy. Although most cases resolve with delivery, the definition applied whether or not the condition persisted after pregnancy and did not exclude the possibility that unrecognized glucose intolerance may have antedated or begun concomitantly with the pregnancy. This definition facilitated a uniform strategy for detection and classification of GDM, but its limitations were recognized for many years. As the ongoing epidemic of obesity and diabetes has led to more type 2 diabetes mellitus in women of childbearing ages, the number of pregnant women with undiagnosed type 2 diabetes has increased.

2.4 Other specific types of diabetes mellitus

(1) Genetic defects of beta-cell function

Several forms of diabetes are associated with monogenetic defects in b-cell function. These forms of diabetes are frequently characterized by onset of hyperglycaemia at an early age (generally before age 25 years). They are referred to as maturity onset diabetes of the young (MODY) and are characterized by impaired insulin secretion with minimal or no defects in insulin action. (ADA, 2011)

Examples-Chromosome 20, HNF4a (MODY1)

Chromosome 7, glucokinase (MODY2)

Chromosome 12, HNF1a (MODY3)

Chromosome 13, IPF-1 (MODY4)

Mitochondrial DNA 3243 mutation

(2) Genetic defects in insulin action

There are unusual causes of diabetes that result from genetically determined abnormalities of insulin action. The metabolic abnormalities associated with mutations of the insulin receptor may range from hyperinsulinemia and modest hyperglycaemia to severe diabetes. (ADA, 2011)

Example-Type A insulin resistance

Leprechaunism

Rabson-Mendenhall syndrome

Lipoatrophic diabetes

(3) Diseases of the exocrine pancreas

Any process that diffusely injures the pancreas can cause diabetes. Acquired processes include pancreatitis, trauma, infection, pancreatectomy, and pancreatic carcinoma.

With the exception of that caused by cancer, damage to the pancreas must be extensive for diabetes to occur; adrenocarcinomas that involve only a small portion of the pancreas have been associated with diabetes.

(4) Endocrinopathies

Several hormones (e.g., growth hormone, cortisol, glucagon, epinephrine) antagonize insulin action.Excess amounts of these hormones (e.g.,acromegaly, Cushing's syndrome, glucagonoma, pheochromocytoma, respectively) can cause diabetes. This generally occurs in individuals with pre-existing defects in insulin secretion, and hyperglycemia typically resolves when the hormone excess is resolved.

(5) Drug- or chemical-induced

Many drugs can impair insulin secretion. These drugs may not cause diabetes by themselves, but they may precipitate diabetes in individuals with insulin resistance.

(6) Infections

Certain viruses have been associated with b-cell destruction. Diabetes occurs in patients with congenital rubella, have HLA and immune markers characteristic of type 1 diabetes.

(7) Uncommon forms of immune-mediated diabetes

Anti-insulin receptor antibodies can cause diabetes by binding to the insulin receptor, thereby blocking the binding of insulin to its receptor in target tissues.

(8) Other genetic syndromes

Many genetic syndromes are accompanied by an increased incidence of diabetes.
These includes Down's syndrome, Friedreich's ataxia, Huntington's chorea, Klinefelter's syndrome, Lawrence-Moon-Biedel syndrome, Myotonic dystrophy, Porphyria, Prader-Willi syndrome, Turner's syndrome, Wolfram's syndrome.

(9) Borderline disorders of glucose regulation

1. Impaired fasting glucose (IFG)
2. Impaired glucose tolerance (IGT)

Impaired glucose regulation refers to a metabolic state intermediate between normal glucose homeostasis and diabetes. It includes impaired fasting glycemia (IFG) and impaired glucose tolerance (IGT). IFG refers to fasting glucose concentrations that are lower than those required to diagnose diabetes mellitus but higher than the non-diabetic (normal) reference value. IGT is an asymptomatic state diagnosed on the basis of the response of blood glucose to the glucose load.

3. THE RISK FACTORS OF DIABETES MELLITUS TYPE-2 IN INDIA

A. Acquired risk factor

1) Age

2) Family History

B. Environmental risk factor

1) Body mass index (BMI)
2) Central obesity
3) Insulin Resistance and Metabolic syndrome
4) Physical Inactivity and Sedentary occupation
5) Faulty dietary habit
6) Stress
7) Urbanisation
8) Cardiovascular problems and stroke
9) Gestational Diabetes
10) Thyroid disorders

The important risk factors for the high prevalence of diabetes include: (1) High familial aggregation, (2) Obesity especially central obesity, (3) Insulin resistance and metabolic syndrome, (4) Life style changes due to urbanization (Ramachandran A, 2008) (5) Gestational diabetes.

The cause of Diabetes Mellitus is poorly understood. Changes in diet and life style due to rapid economic development are fore most among the principle drives of diabetes in developing and developed countries. Barring the environmental impact, genetic component plays a vital role for the development of diabetes (Mohan, 2004). This form of diabetes is most often associated with older age, obesity, family history of diabetes, previous history of gestational diabetes, physical inactivity and certain ethnicities. About 80% of people with T2D are overweight. Diabetes is associated with long-term complications that affect almost every organ of the body. The disease often leads to blindness, heart and blood vessel disease, stroke, kidney failures, amputations and nerve damage. Uncontrolled diabetes can complicate pregnancy and birth defects are more common in babies born to women with diabetes. National and International members and partners, the American Diabetes Association (ADA)

recommends screening for type 2 diabetes in all overweight adults [body mass index (BMI) ≥25 kg/m2] who have one or more of the following risk factors: physical inactivity; a first-degree relative with diabetes; members of a high-risk ethnic population; women who developed gestational diabetes or had a baby weighing 9 pounds or more; hypertension; low concentrations of high-density lipoprotein cholesterol or high concentrations of triglyceride in blood; polycystic ovarian syndrome; IGT or IFG on a previous test; other clinical conditions associated with insulin resistance; and a medical history of cardiovascular disease. In the absence of these risk factors, the ADA recommends that testing for diabetes should begin at age 45 years. If results are normal, the test should be repeated after 3 years or sooner, depending on risk status (American Diabetes Association, 2009).

[1] Age

Until recently, type 2 diabetes was typically regarded as a disease of the middle-aged and elderly. Though this age-group maintains a higher risk than younger adults, evidence is accumulating that even children and adolescents aged less than 30 years are now becoming caught up in the diabetes epidemic, which has mainly been attributed to the high level of obesity in these groups.

As the age increases from 40 years onward, the risk of developing DMT2 is increases. Subjects having a family history of diabetes were at the highest risk in their productive years of life (Sethi S *et al*, 2011).

[2] Family History as a Risk Factor for Diabetes

Probabilistically, a disease such as diabetes with a demonstrated genetic component is expected to cluster among relatives. Family history is a reflection of this fact with the added value that it also reflects the environment, cultural practices, and behaviours shared to some extent by close relatives. It has been amply documented that having one or more first-degree relatives with T2DM increases the odds of having the disease compared with someone without such relatives. The estimations vary, but the odds usually range from two to six times more likely (Harrison TA *et al*, 2003). Also, a long-term study reported that the cumulative prevalence of T2DM at age 60 years is about 3.5 times higher (38% vs. 11%) for people with a first-degree relative with T2DM compared to people without any affected relative(Köbberling J *et al*, *1982*). Several studies in India and abroad have shown that nearly 75% of the T2DM patients

have first degree family history of diabetes; this indicates a strong familial aggregation in the Indian diabetic patient. Insulin resistance has been demonstrated to be a characteristic feature of Asian Indians *(*Ramachandran A, 2007).
Type 2 diabetes results from the interaction between a genetic predisposition and behavioural and environmental risk factors (Neel JV, 1962).

[3] Central obesity

The world health organization has described obesity as one of today's most neglected public health problems affecting every region of the globe (Pednekar MS, 2008).

The incidence of diabetes is on the rise, both in the developed and developing countries. One factor that is fuelling this increase is the increasing incidence of obesity in the community.

Increasing general obesity or central obesity is known to predispose individuals for insulin resistance. The prevalence of diabetes is 2.9 times higher in over weight (BMI 27.8 in males and 27.3 in women) than in normal weight subjects of 20 to 75 years of age (Burton BT *et al*, 1985). Abdominal fat deposition is hormonally controlled by secretion of adipokinase which may impair glucose tolerance. Abdominal obesity, measured by an elevated WHR is shown to be a strong risk factor for Diabetes Mellitus Type 2 (Bray GA *et al*, 2008, Lahti-Koski M *et al*, 2000, Miljkovic-Gacic I *et al*, 2008). It has also been noted that for a given BMI, Asian Indian have higher fat percentage compared with Caucasian subjects (Banerji MA *et al*, 1999). High proportion of upper-body fat or abdominal fat independent of overall obesity is recognized as an important component in the insulin resistance linked to obesity and Diabetes Mellitus Type 2 (Goodpaster BH *et al*, 2000).

Obesity continues to influence on individual's health after the development of type-2 diabetes and heightens the risk of cardiovascular disease and polyneuropathy (Ziegler D *et al*, *2008*), non-alcoholic fatty liver disease, (Ong & younossi *et al*, 2007*)* sleep disordered breathing (Shaw JE *et al*,2008) and end stage kidney disease.(Hus C *et al*, 2006) .Thus the degree of obesity in an individual with type-2 diabetes is an important modifiable risk factor for long term health.

Central adiposity indicates deposition of large quantities of abdominal fat, which consists of visceral fat and subcutaneous fat. Visceral fat increases the risk of diabetes

and hyperlipidaemia by favouring insulin resistance. Though, obesity is a leading risk factor for late onset of diabetes, life style habits play a vital role to become obese (Gupta R *et al*, 2009). Obesity results from an imbalance between energy expenditure and intake which is modulated by genetic predisposition. International Diabetes Congress in Helsinki, Finland reported that obesity is the most preventable and important risk factor for Diabetes Mellitus Type 2 (WCPD 2008). In fact, the synchrony of obesity and type 2 diabetes is so obvious that a term 'diabesity' has been coined that suggests a striking interrelationship between the two diseases (Berger M, 1992).

[4] Body mass index

WHO has recommended classifications of bodyweight that include degrees of underweight and gradations of excess weight or overweight that are associated with increased risk of some non-communicable diseases (WHO, 1995). These classifications are based on body-mass index (BMI), calculated as weight in kilograms divided by height in metres squared (kg/m2). As a measure of relative weight, BMI is easy to obtain. It is an acceptable proxy for thinness and fatness, and has been directly related to health risks and death rates in many populations.

[5] Insulin Resistance and Metabolic syndrome

Metabolic syndrome is defined as the presence of any three of the following conditions:

1. Waist measurement of 40 inches or more for men and 35 inches or more for women.

2. Triglyceride levels of 150 milligrams per deciliter (mg/dL) or above, or taking medication for elevated triglyceride levels.

3. HDL, or "good," cholesterol level below 40 mg/dL for men and below 50 mg/dL for women, or taking medication for low HDL levels.

4. Blood pressure levels of 130/85 or above or taking medication for elevated blood pressure levels.

5. Fasting blood glucose levels of 100 mg/dL or above, or taking medication for elevated blood glucose levels (Grundy SM *et al,* 2005).

People with metabolic syndrome have a fivefold greater risk of developing type 2 diabetes (Stern MP *et al*, 2004).

Insulin resistance is a condition in which the body produces insulin but does not use it properly. When people are insulin resistant, their muscle, fat, and liver cells do not respond properly to insulin. As a result, their bodies need more insulin to help glucose enter cells. The pancreas tries to keep up with this increased demand for insulin by producing more. Eventually, the pancreas fails to keep up with the body's need for insulin. Excess glucose builds up in the bloodstream, setting the stage for diabetes. Many people with insulin resistance have high levels of both glucose and insulin circulating in their blood. Scientists have identified specific genes that make people more likely to develop insulin resistance and diabetes. Excess weight and lack of physical activity also contribute to insulin resistance.

Many people with insulin resistance and high blood glucose have other conditions that increase the risk of developing type 2 diabetes mellitus and damage to the heart and blood vessels, also called cardiovascular disease. These conditions include having excess weight around the waist, high blood pressure, and abnormal levels of cholesterol and triglycerides in the blood. Having several of these problems is called metabolic syndrome or insulin resistance syndrome, formerly called syndrome X.

Insulin resistance and prediabetes usually have no symptoms. People may have one or both conditions for several years without noticing anything. People with a severe form of insulin resistance may have dark patches of skin, usually on the back of the neck. Sometimes people have a dark ring around their neck. Other possible sites for dark patches include elbows, knees, knuckles, and armpits. This condition is called acanthosis nigricans.

Converging points of evidence from population based studies suggests that Indians are apparently genetically more prone to diabetes and insulin resistance. Moreover, Asian Indians are more susceptible to developing truncal obesity, which might account for their tendency to insulin resistance referred to as "Asian Indian

phenotype" (Banerji MA *et al*, 1999, Chandalia M *et al*, 1999, Raji A *et al*, 2001, Ramachandran A *et al*, 2001,Mohan V *et al*, 2006).

[6] Physical Inactivity and Sedentary occupation

Physical inactivity has emerged in epidemiological studies as independent risk factor for type 2 diabetes. Observational studies and intervention trials have shown a beneficial effect of regular exercise on both insulin resistance and glucose intolerance (Burchfiel CM *et al*, 1995). A sedentary lifestyle (defined as hours of television watching and or having a sedentary occupation) was associated with a higher risk of type 2 diabetes in the people. (Hu FB *et al*, 2001).

[7] Stress

It's hard to dispute that most of us live life at breakneck speed. It's the nature of a fast-paced society, where numerous family, social, and work obligations can easily overpower precious time and resources. But for people with diabetes both physical and emotional stress can take a greater toll on health. Stress is a feeling that's created when one reacts to particular events. It's the body's way of rising to a challenge and preparing to meet a tough situation with focus, strength, stamina, and heightened alertness. Stress results when something causes the body to behave as if it were under attack. The events that provoke stress are called stressors, and they cover a whole range of situations like physical, injury or illness. Or they can be mental, like problems in marriage, job, health, or finances (Meadows-Oliver *et al*, 2007).

There is no evidence that stress causes diabetes. However, stress may sometimes unmask diabetes, by causing blood glucose levels to rise (Kahn CR *et al*, 1996). In people who have diabetes, stress can alter blood sugar levels. It does this in two ways. First, people under stress may not take good care of themselves. People who are anxious are under pressures and may lose appetite and skimp on eating, or reach for not-so healthy quick fixes like candy or chips and sometimes seek refuge in food and drink. This can take the form of chocolates, sweets and crisps, often in between meals. The intake of alcohol may be increased. Many people who are under stress turn to food as a source of 'comfort'. This pattern of 'comfort eating' can often play havoc with blood sugar level. Further anxiety leads to less exercise. The results can be disastrous for people with diabetes. They may forget, or not have time, to check their

sugar levels or plan good meals. Second, stress hormones may also alter blood sugar levels directly as it antagonizes the action of insulin. While in most people glucose levels go up with mental stress, while in others can go down.

[8] Urbanisation

The population increase during 2000-2030 is expected to take place mostly in urban areas of developing countries whose population is likely to rise from about 2 billion in 2000 to about 4 billion in 2030, averaging 2.4 percent per year. It is expected that rural-urban migration and the transformation of rural settlements into cities are the major determinants of a rapid population growth in urban areas of developing countries including India in the next thirty years. These changes will lead to the eventual decline in rural population of developing countries. Consequently, the growth rate of rural population in developing countries will become negative for the first time during 2025-2030. The migration of people from rural to urban areas, or rural-urban migration, is mainly in search of better jobs, education and living conditions. It has both negative and positive effects on the survival and well-being of peoples.

There is considerable evidence of the increased risk of type-2-diabetes and other NCD risk factors (including obesity, hypertension, glucose intolerance, high triglyceride levels and CHD or cardiovascular disease), following migration and the consequent environmental changes, especially among South Asians who migrated to different parts of the world (McKeigue PM, 1997, Deedwania P *et al*, 2005). It is suggested that the variation in NCD risks between migrant populations and native residents or indigenous. A population is largely a manifestation of environmental influences that may be contributed by genetic predisposition (Shetty P, 2002). Similar observation is made on the variation in the prevalence of NCDs between rural and urban populations within a country or region, especially following rural-urban migration.

Several studies in India have revealed that the prevalence of type 2 diabetes and CHD risk factors is higher in urban than in rural areas (Chadha SL *et al*, 1997, Singh *et al*, 1997, Ramachandran, 1998, Copalan C, 1997,Shetty, 2002, Lubree HG *et al*, 2002). It has been suggested that rural-urban migration, which is associated with changing dietary patterns and lifestyles, is linked to increased risk of chronic diseases in India.

Epidemiological studies have revealed that the prevalence of CHD is much lower in adult rural (3 to 5%) than urban (7 to 10%) populations (Gupta, 2005).

Table 1: Top ten states for rural-urban and urban-rural migration based on last residence with duration 0-9 years (census 2011).

Rural to urban		Urban to rural	
State	Percentage	State	Percentage
Mizoram	39.1	Goa	26.7
Meghalaya	27.4	Kerala	13.3
Nagaland	26.8	Nagaland	13.2
Arunachal Pradesh	26.1	Sikkim	11.8
Gujarat	25.9	Tamil nadu	11.5
Tamil nadu	23.3	Meghalaya	11.0
Haryana	21.9	Mizoram	8.5
Maharashtra	21.2	Andhra Pradesh	8.4
Karnataka	21.2	Maharashtra	8.2
Jammu and Kashmir	21.1	Karnataka	7.4

In Gujarat rural to urban migration is 25.9% as per census 2011, which is very high. And as per census of India 2011, 6.8 million people migrated from urban to rural parts of Gujarat. (table 1).

Therefore, increasing urbanisation, changes in standards of living, dietary patterns and occupational-work patterns are risk factors of the high prevalence of NCDs. As a result, although under-nutrition remains a major health problem in many developing countries, over-nutrition is also emerging with the improvement in socio-economic condition and increasing urbanisation (Khongsdier R, 2006). Consequently, the double burden of under- and over-nutrition is likely to exert considerable impact on the economy and health system in many developing countries (Popkin BM, 1998, 2002).

[9] Cardiovascular problems and stroke

As type 2 diabetes is in common with coronary artery disease (CAD), Diabetic subjects are known to have a two to four times increased CAD risk, and CAD has been reported to occur two to three decades earlier in diabetic subjects as opposed to their non diabetic counterparts (Haffner SM *et al*, 1998).

The life expectancy of people with diabetes is reduced by nearly eight years due to increased mortality (Fuller JH *et al*, 1983).

Coronary artery disease accounts for more than 80% of all deaths and 75% of all hospitalizations in diabetic subjects (Malmberg K *et al*, 2000). It is also reported that plaques are more vulnerable to rupture among patients with diabetes. (Moreno PR *et al*, 2000). The association between CAD and diabetes is strong despite the fact that there are wide ethnic and geographic variations in their prevalence. The protective female gender effect is lost in diabetic subjects, and indeed, women with diabetes are possibly more prone to develop CAD than men with diabetes. (Gu K *et al*, 1999).

[10] Gestational Diabetes

The "fetal origin of adult disease" hypothesis proposes that gestational programming may critically influence adult health and disease (Barker DJ, 1995). Gestational programming is a process whereby stimuli or stresses occurring at critical or sensitive periods of fetal development, permanently change structure, physiology, and metabolism, which predisposes individuals to disease in adult life (Lucas A, 1991). If the stimulus happens to be glucose intolerance in pregnancy, it predisposes the offspring to an increased risk of developing glucose intolerance in the future.

GDM women are at increased risk of future diabetes as are their children and following generations. Prevalence of GDM varies from one region to another region in the same country. Compared with selective screening, Universal screening for GDM detects more cases and improves maternal and offspring prognosis. Asian women are ethnically more prone to develop glucose intolerance compared to other ethnic groups.

4. SYMPTOM OF DIABETES MELLITUS TYPE 2

Some patients with type 2 diabetes may show no symptoms at all. In others, symptoms may be similar to those of type 1 diabetes. A patient may feel very tired, thirsty, or nauseated and have to urinate often. Other symptoms may include weight loss, blurred vision, frequent infections, and slow healing of wounds or sores. Some patients may present with vaginal yeast infection or burning on urination due to yeast infection. Some may have extreme elevation of the blood glucose level associated with severe dehydration and coma. Because symptoms are varied, it is important for health care providers to identify and test youth who are at high risk for the disease.
Diabetes mellitus type 2 may present with characteristic symptoms such as thirst, polyuria, blurring of vision, and weight loss. Often symptoms are not severe, or may be absent, and consequently hyperglycaemia sufficient to cause pathological and functional changes may be present for a long time before the diagnosis is made.

5. EFFECT OF DIABETES MELLITUS TYPE 2

The effects of diabetes mellitus include long–term damage, dysfunction and failure of various organs. The long–term effects of diabetes mellitus include progressive development of the specific complications of retinopathy with potential blindness, nephropathy that may lead to renal failure, and/or neuropathy with risk of foot ulcers, amputation, Charcot joints, and features of autonomic dysfunction, including sexual dysfunction. People with diabetes are at increased risk of cardiovascular, peripheral vascular and cerebrovascular disease.

6. COMPLICATION OF DIABETES MELLITUS TYPE 2

Asian Indian diabetic subjects may be at greater lifetime risk for these complications due to the earlier onset of their disease (Bjork S *et al*, 2003).Unfortunately nearly half of the individuals with diabetes in the community remain undiagnosed.

Type 2 diabetes is a complex metabolic disease, primarily characterised by insulin resistance, relative insulin deficiency and hyperglycemia (Kraegen EW *et al*, 2008) and leading to micro vascular diseases, blindness, nerve damage, arthrosclerosis and renal complications (McAlpine RR *et al*, 2005, Van dieren *et al*, 2010).

The burden of diabetes is to a large extent the consequence of macro vascular (coronary artery disease, peripheral vascular disease, and atherosclerosis) and micro vascular (like retinopathy, neuropathy, and nephropathy) complications of the disease (Permutt MA *et al*, 2005)

The impacts of T2DM are considerable: as a lifelong disease, it increases morbidity and mortality and decreases the quality of life. (Hoskote *et al*, 2008). At the same time, the disease and its complications cause a heavy economic burden for diabetic patients themselves, their families and society. A better understanding about the cause of a predisposition of Indians to get T2DM is necessary for future planning of healthcare, policy and delivery in order to ensure that the burdens of disease are addressed (Hoskote *et al*, 2008).

7. EPIDEMIOLOGY OF DIABETES MELLITUS TYPE 2 IN THE WORLD

Epidemiology is an essential part of any widespread disease. It is meant to assess the frequency of the disorder in a population along with studies on its aetiology. The data emerging from study of epidemiology is most valuable for setting up a programme for prevention.

The impact of the worldwide explosion of type 2 diabetes mellitus (which accounts for approximately 85 to 95% of all cases of diabetes) will remain centred in the developing countries, since by the year 2025, 75% of all people with diabetes will be in the developing countries as compared with 62% in 1995- a majority in the Indian subcontinent 59% (King H *et al*, 1998). By 2025 there will be a 42% increase from 51-72 million in the developed countries and 170% increase from 84-228 million in the developing countries (King H *et al*, 1998). India already faces a graves problem with the largest number of subjects with diabetes (approx 33 million in 2003) an it is expected to escalate further with the number increasing to 57.2 million in the year 2030 it may be 80.9 million (Bjork S *et al*, 2003). The prevalence estimate by the International Diabetes Federation (IDF) reported the worldwide prevalence to be increasing from 5.1-6.3% between 2003-2025 (Sicree R *et al*, 2003).

The prevalence of type 2 diabetes mellitus has been increasing rapidly worldwide (Zimmet P, 2000).As there is no available cure at the moment for type 2 diabetes, primary prevention is of great importance. (Hu FB *et al*, 2001)

Diabetes is fast becoming the epidemic of the 21st century. Type 2 diabetes mellitus, which is more prevalent (more than 90% of all diabetes cases) and the main driver of the diabetes epidemic, now affects 5.9% of the world's adult population with almost 80% of the total in developing countries (Sicree R *et al*, 2006).

Diabetes has become a common global health problem that affects >170 million people worldwide. It is one of the leading causes of death and disability. It is estimated that by 2030, the number will rise to 366 million (WHO). Diabetes mellitus (DM) ranked as the fourth leading cause of death by disease globally (Kowluru RA *et al*, 2007) has become one of the most challenging problems of the 21th century. The disease affects more than 230 million people worldwide and this number is expected to reach 350 in 2025. In developing countries, the majority of diabetes patients are in the age range of 45-64 years whereas in the developed countries are aged >65 years (Ramachandran A, 2007).

8. EPIDEMIOLOGY OF DIABETES MELLITUS IN THE INDIA

The World Health Organization (WHO) reports show that 32 million people had diabetes in the year 2000 (Wild S *et al*, 2004). The International Diabetes Federation (IDF) estimates the total number of diabetic subjects to be around 40.9 million in India and this is further set to rise to 69.9 million by the year 2025 (Sicree R *et al*, 2006).

India is currently experiencing a rapid epidemiological transition from communicable to non communicable diseases viz. diabetes mellitus, hypertension and ischemic heart disease. Rapid industrialisation and urbanisation with subsequent rise in standards of living, obesity, stress, sedentary life style, addictions etc. are posing a growing threat to the health of the nation. Number of people with diabetes in India currently around 40.9 million is expected to rise to 69.9 million by 2025 unless urgent preventive steps are taken (Sicree R *et al*, 2006). Recent studies (Mohan V *et al*, 2007) from India showed increasing prevalence of type 2 diabetes in all the regions like 19.5% in

Kerala (ADEPS), 15.5% in Chennai (CURES), 13.5% Chennai, 12.4% Bangalore, 16.6% Hyderabad, 11.7% Kolkata and 9.3% Mumbai (NUDS).

India, like many other developing countries, has witnessed a rapid epidemiological transition in the last two decades. Coupled with this, there has been a dramatic improvement of the Indian economy in terms of per-capita income. These dramatic changes have had a great impact on urbanization and lifestyle of the Indians. As a result, diabetes mellitus has become the main public-health problem and amenable to change through early recognition at the individual level and surveillance at the population level. Results of studies showed that India is facing three-fold rise in the prevalence of diabetes in urban (5-15%) and in rural (2-6%) areas (Ebrahim S *et al*, 2010). India tops in the world with the largest number of diabetic subjects (31.7 million cases of T2DM) (Deepa M *et al*, 2005). This is further compounded by the epidemic of obesity and doubling the cost of diabetes management (Ramachandran A e*t al*, 2007).

The recent World Health Organization report suggests that over 19% of the world's diabetic population currently resides in India (Wild S *et al*, 2004).This translates to over 35 million diabetic subjects, and these numbers are projected to increase to nearly 80 million by 2030. This rising trend predicts a significant health burden due to diabetes in India (Ramachandran A *et al*, 1997). Unfortunately more than 50% of the diabetic subjects in India remain unaware of their diabetes status, which adds to the disease burden (Deepa M *et al*, 2005).The prevalence of known diabetes was 1.9% whereas the prevalence of undiagnosed diabetes was 4.3%, which was more than double that of diagnosed cases (Zargar AH *et al*, 2000).This underscores the need for mass awareness and screening programmes to identify and overcome the burden due to diabetes in India. The Government of India has already initiated a National Diabetes Control Programme and is planning to start a diabetes prevention programme shortly. For such programmes to be successful, it is necessary to determine cost effective methods for identifying undiagnosed diabetic subjects in our country.

9. EPIDEMIOLOGY OF DIABETES MELLITUS TYPE 2 IN GUJARAT

The population of Gujarat is 60,596,992 as per the census in the region. The number holds true on 1st March 2010. The population of Gujarat is diverse. Hindus form the majority among the Gujarat state population. Muslims and Jains make up the minorities in the state.

Gujarat, Punjab and south India are known as capital cities of Diabetes. Rapid urbanisation and industrialisation have produced advancement on the social and economic front in developing state such as Gujarat which has resulted in dramatic lifestyle changes leading to lifestyle related diseases. The transition from a traditional to modern lifestyle, consumption of diets rich in fat and calories combined with a high level of mental stress has compounded the problem further. There are several studies from various parts of Gujarat which reveal a rising trend in the prevalence of type- 2 diabetes mellitus in the urban areas. There are several studies shows that most people have type -2 diabetes mellitus. Among all patients, 90% patients are of type-2 diabetes mellitus. It is quite evident from the above observation that diabetes has become a major health problem in Gujarat in order to assess the magnitude of the problem and its impact on health and economy of the state we must have all information about the prevalence of type-2 Diabetes in Gujarat. But we still have not authorised data about the prevalence of Diabetes in Gujarat. The scattered data on the prevalence of type-2 Diabetes in Gujarat needs to be compiled and analysed. In this study, we want to establish a database of all the data which we will get during study period.

10. HEALTH PROGRAM FOR DIABETES MELLITUS TYPE 2

10.1 Government health program

Pilot phase of the National Programme for Prevention and Control of Diabetes, Cardiovascular Diseases and Stroke (NPDCS)

This program started in 2008. This has the objective of risk reduction for prevention of non-communicable chronic diseases (Diabetes, CVD and Stroke) and early diagnosis and appropriate management of Diabetes, Cardiovascular diseases and Stroke. The expected outcomes for the pilot phase are awareness generated on healthy life styles; Health promotion at School, Community & work places; Decrease in the

incidence of Non –Communicable Diseases particularly, Diabetes, Cardiovascular Diseases and Stroke.

One district in each of the following states is covered under pilot Phase.

	State	District
1.	Assam	Kamrup
2.	Punjab	Jalandhar
3.	Rajasthan	Bhilwara
4.	Karnataka	Shimoga
5.	Tamilnadu	Kancheepuram
6.	Kerala	Thiruvanathapuram
7.	Andhra Pradesh	Nellore
8.	Madhya Pradesh	Jabalpur
9.	Sikkim	East Sikkim
10.	Gujarat	Gandhinagar

In the Gujarat following Six Districts have been selected under NPDCS Programme.

District	Headquater
1. Gandhinagar	Gandhinagar
2. Sabarkantha	Himmatnagar
3. Surendranagar	Surendranagar
4. Junagadh	Junagadh
5. Panchamahal	Godhara
6. Kheda	Nadiad