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TYPE II DIABETES - A COMMON LIFESTYLE DISEASE

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ABSTRACT

Lifestyle diseases are diseases that appear to increase in frequency as countries become more industrialized and people live longer. Type 2 diabetes, formerly known as adult onset diabetes, is among one of the major prevalent lifestyle diseases. According to International Diabetes Federation, in 2013, an estimated 381 million people had diabetes. Lifestyle related causes of diabetes include obesity, inactivity, smoking, and poor dietary habits. Diet is a basic part of management in every case. Treatment cannot be effective unless adequate attention is given to ensuring appropriate nutrition. Core focus in diabetes care revolves around three basic principles of nutrition therapy which include, total energy balance, nutrient balance and food distribution balance. But diet, while critical to prevention, is just one risk factor. Physical inactivity is now recognized as an increasingly important determinant of health, is the result of a progressive shift of lifestyle towards more sedentary patterns. Stress management and treatment of anxiety or depression are also very important lifestyle related aspects associated with diabetes. Oftentimes they are overlooked because focus is so much on the food, exercise and medications. This shift in the pattern of disease is taking place at an accelerating rate in developing countries than it did in the industrialized regions of the world. This rapid rate of change, together with the increasing burden of disease, is creating a major public health threat which demands immediate and effective action.

Keywords: lifestyle disease, type 2 diabetes, nutrition therapy.

INTRODUCTION

Lifestyle diseases, also sometimes called diseases of longevity or diseases of civilization interchangeably are diseases that appear to increase in frequency as countries become more industrialized and people live longer. These diseases do not develop suddenly. They are caused by an inappropriate relationship of people with their environment. The onset of these lifestyle diseases is insidious, they take years to develop, and once encountered do not lend themselves easily to cure. Lifestyle diseases are different from other diseases because they are potentially preventable, and can be lowered with changes in diet, lifestyle and environment.

Peoples' diet has changed substantially in the second half of the twentieth century, generally with increases in consumption of processed foods. Other aspects of lifestyle also changed, notably, large reductions in physical activity and large increases in the prevalence of obesity (Key *et a,l* 2002). Lifestyle diseases are known as silent killers. Due to industrialization there was advancement in the life of the people according to that lifestyles changed, they started consuming junk food and did a very little physical activity. In the long run it started creating problems. Prior to 1940's the main causes of deaths were Malaria, typhoid but after that due to changes in lifestyle more and more deaths occurred due to the cancer, heart attacks, diabetes. Diet and nutrition are important factors in the promotion and maintenance of good health throughout the entire life course. The lifestyle diseases that are related to diet and nutrition present the greatest public health burden. These include diseases like cardiovascular diseases, cancer, osteoporosis, alzheimers disease and diabetes.

NATURE OF DIABETES

Glucose is the primary and preferred source of energy for the body. Carbohydrate foods break down during digestion in the gastrointestinal tract and are absorbed into the blood stream mainly as glucose. Glucose is then transported throughout the body to be used by the cells in the body, it first has to be taken out of the blood and transported into the cells. For this purpose to process to happen in most cells, the hormone must be present (David *et al,* 2011). Insulin is produced by the beta cells of pancreas that attaches to insulin receptors on cell membranes and allows absorption of glucose into cell. Individuals with diabetes either do not produce insulin or cannot effectively use the insulin produced. Without

insulin, glucose accumulates in the bloodstream. The expert committee on the diagnosis and classification of diabetes mellitus defines diabetes as a group of metabolic diseases characterized by hyperglycemia resulting from defects in insulin secretion, insulin action or both (Nix, 2009).

Of the various subtypes of diabetes, type 2 diabetes has the greatest impact on health worldwide. (Mc Carty and Zimmet, 2010) It displays a clear association with obesity, hypertension, dyslipidaemia and macrovascular disease within individuals and families, indicates that reduced sensitivity to the peripheral actions of insulin (i.e. insulin resistance) plays a key role in disease pathogenesis (Zawalich and Kelley 1995).

CLASSIFICATION

The first worldwide accepted classification scheme for diabetes mellitus was published in 1979 by the National Diabetes Data Group (NDDG) and classified diabetes mellitus based on the pharmacologic therapy applied into two major groups: Insulin dependent diabetes mellitus (IDDM) and noninsulin dependent diabetes mellitus (NIDDM). The terms coined by the NDDG became popular during the 1980s and 1990s, but with time, the misclassification of patients became evident. Since the correct classification of DM allows a more adequate treatment, the new classification proposed by the American Diabetes Association in 1997 was based in the pathogenesis of the disease and comprises four categories: Type 1 diabetes mellitus, Type 2 diabetes mellitus, other types and gestational diabetes.

TYPE I DIABETES

It accounts for 5-10% of all cases of diabetes, previously called as juvenile-onset diabetes or insulin dependent diabetes. It is usually caused by an auto-immune reaction where the body's defense system attacks the beta cells of pancreas that produce insulin. Four different autoantibodies have been identified as the cause of destruction and these are islet cell antibodies, autoantibodies to insulin, autoantibodies to glutamic acid decarboxylase and autoantibodies to the tyrosine phosphatases IA-2 and IA- 2beta (Hoet *et al*, 1996). People with type 1 diabetes produce very little or no insulin. The disease may affect people of any age, but usually develops in children or young adults. People with this form of diabetes need injections of insulin every day in order to control the levels of glucose in their blood and these people are usually underweight and at higher risk for acidosis at the time of diagnosis.

TYPE II DIABETES

It is called non-insulin dependent diabetes or adult-onset diabetes, and accounts for at least 90% of all cases of diabetes. It is characterized by insulin resistance and relative insulin deficiency, either or both of which may be present at the time diabetes is diagnosed. The diagnosis of type 2 diabetes can occur at any age. It is often, but not always, associated with overweight or obesity, which itself can cause insulin resistance and lead to high blood glucose level (Umpierrez *et al*, 1995). This form of diabetes frequently goes undiagnosed for many years because the hyperglycemia develops gradually and at earlier stages is often not severe enough for the patient to notice any of the classic symptoms of diabetes. Such patients are at increased risk of developing macrovascular and microvascular complications (Mykknen *et al*, 2005) People with type 2 diabetes can often initially manage their condition through exercise and diet and over time most people require oral drugs and or insulin.

Gestational diabetes (GDM) is a form of diabetes consisting of high blood glucose levels during pregnancy. It develops in one in 25 pregnancies worldwide and is associated with complications to both mother and baby. GDM usually disappears after pregnancy but women with GDM and their children are at an increased risk of developing type 2 diabetes later in life. Approximately half of women with a history of GDM go on to develop type 2 diabetes within five to ten years after delivery (Figure I).

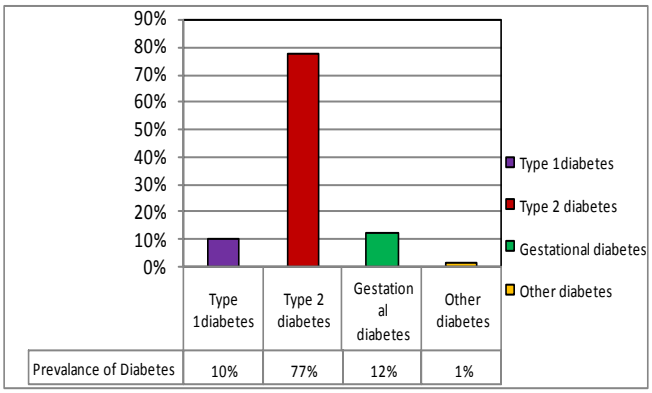

Figure I: Prevalence of different types of diabetes
Source:
http://www.somersetintelligence.org.uk/diabetes.html

SIGNS AND SYMPTOMS

People with type 2 diabetes may not have symptoms for many years. Early symptoms of diabetes may include, Bladder, kidney, skin, or other infections that are more frequent or heal slowly, fatigue, hunger, increased thirst. The first symptom may also be, blurred vision, Pain or numbness in the feet or hands (American Diabetes Association, 2013).

The classic symptoms of untreated diabetes are loss of weight, polyuria, polydipsia and polyphagia(Cooke and Plotnick, 2008). Symptoms may develop rapidly (weeks or months) in type 1 diabetes, while they usually develop much more slowly and may be subtle or absent in type 2 diabetes.

PREVALENCE OF DIABETES

Globally, as of 2010, an estimated 285 million people had diabetes, with type 2 making up about 90% of

the cases. In 2013 an estimated 381 million people had diabetes (International Diabetes Federation, 2013). The number of patients with type 2 diabetes is increasing rapidly in both developed and developing countries around the world. The emerging pandemic is combined effects of rising levels of obesity and inactivity, (Ramachandran *et al*, 2010) unlike in the West, where older populations are most affected, and the burden of diabetes in Asian countries is disproportionately high in young to middle-aged adults.

Diabetes is a major global cause of premature mortality that is widely underestimated, because only a minority of persons with diabetes dies from a cause uniquely related to the condition. Approximately one half of patients with type 2 diabetes die prematurely of a cardiovascular cause and approximately 10% die of renal failure. Global excess mortality attributable to diabetes in adults was estimated to be 3.8 million deaths. It is projected that by 2025 there will be 380 million people with type 2 diabetes and 418 million people with impaired glucose tolerance (Ramachandran and Snehalatha, 2009) (Table 1).

Table I: Top ten countries for estimated numbers of adults with diabetes 2010 and 2030

	Country / Territory	2010 (millions)	Country / Territory	2030 (millions)
Rank				
1	India	50.8	India	87.0
2	China	43.2	China	62.6
3	U.S.	26.8	U.S.	36.0
4	Russian Federation	9.6	Pakistan	13.8
5	Brazil	7.6	Brazil	12.7
6	Germany	7.5	Indonesia	12.0
7	Pakistan	7.1	Mexico	11.9
8	Japan	7.1	Bangladesh	10.4
9	Indonesia	7.0	Russian Federation	10.3
10	Mexico	6.8	Egypt	8.6

Source: Das, *et al,* 2011.

LIFE STYLE FACTORS CAUSING TYPE II DIABETES

OBESITY/OVERWEIGHT

Obesity has been found to contribute to approximately 55% of cases of type 2 diabetes, Chronic obesity leads to increased insulin resistance that can develop into type 2 diabetes, most likely because adipose tissue (especially that in the abdomen around internal organs) is a source of several chemical signals, hormones and cytokines, to other tissues (Salmerón *et al,* 2001).Gene expression promoted by a diet of fat and glucose, as well as high levels of inflammation related cytokines found in the obese, can result in cells that produce fewer and smaller mitochondria than is normal, and are thus prone to insulin resistance. Fat tissue has also been shown to be involved in managing much of the body's response to insulin and control of uptake of sugar. It secretes retinol binding protein 4(RBP4) which increases insulin resistance by blocking the action of insulin in muscle and liver. Fat cells also secrete adiponectin which acts in an opposite way to RBP4 by improving the action of insulin, however, engorged fat cells secrete it in lower amount than normal fat cells. The obese therefore may have higher level of RBP4 but lower level of adiponectin, both of which increase the risk of developing diabetes (Christian and Christine, 2010).

INACTIVITY

Lack of activity or exercise contributes to type II diabetes suggesting that inactivity may play a key role in impairing glycemic control. Physical activity lowers blood sugar. Aerobic activities such as walking, swimming are helpful. Strength training also helps to lower blood sugar. Exercising for at least 30 minutes per day is considered good (Catherine *et al*, 2011). Now there is evidence that physical activity is an important part of the daily maintenance of glucose levels. Even in the short term, reducing daily activity and ceasing regular exercise causes acute changes in the body associated with diabetes that can occur before weight gain and the development of obesity.

POOR DIET / POOR DIETARY HABITS

Dietary habits have long been associated with the management and/or prevention of various metabolic disorders like type 2 diabetes. In particular, the adoption of a dietary pattern characterized by a high intake of refined grain products, snacks, sweets and fried foods, is believed to contribute to the increased prevalence of type 2 diabetes worldwide In contrast, the adoption of a dietary pattern that is characterized by a high consumption of non-refined cereals, fruits and vegetables, a moderate intake of dairy produce, poultry and fish, is believed to reduce the prevalence of type 2 diabetes (Steyn *et al,* 2004). Our food habits affect our overall health. An ideal diet should constitute 65 % carbohydrate, 15% protein and only 20% of fat. Over the past 50 years, dietary patterns have been drastically changed. A high intake processed foods high in sugar and saturated fats have become common phenomenon. In urban communities, a typical diet consists of 28 % carbohydrate, 40% fat, 12% protein and 20% sugar which leads to fatty buildup in the arteries and finally the occurrence of lifestyle diseases including type 2 diabetes. It is not necessary to eat a strict "diabetic" diet; any healthy diet rich in whole grains, vegetables, and fruit in low to moderate portions, may prevent or reverse the development of diabetes (Sacks et al, 2001).

SMOKING

It is now evident that smoking causes type II diabetes. In fact, smokers are 30–40% more likely to develop type 2 diabetes than nonsmokers. People with diabetes who smoke are more likely than nonsmokers to have trouble with insulin dosing and with controlling their

disease. The more cigarettes one smoke, the higher your risk for type 2 diabetes. Smokers with diabetes have higher risks for serious complications, including, heart and kidney disease, Poor blood flow in the legs and feet that can lead to infections, ulcers, and possible amputation (removal of a body part by surgery, such as toes or feet), retinopathy (an eye disease that can cause blindness), peripheral neuropathy (damaged nerves to the arms and legs that causes numbness, pain, weakness, and poor coordination) (National Institute of Diabetes and Digestive and Kidney Disease, 2014)

Analysis of the data indicated that active smokers have a 44 percent increased risk of developing type 2 diabetes compared with non-smokers. Further analyses suggested a dose-response relationship between smoking and diabetes, with the association stronger for heavy smokers (20 or more cigarettes/day; 61 percent increased risk) compared with lighter smokers (29 percent increased risk). The association also was weaker for former smokers (23 percent increased risk) than it was for active smokers. Cigarette smoking and diabetes mellitus provide evidence of a positive association from a large prospective cohort study (Julie *et al*, 2001).

ALCOHOL

In recent years, increasing attention has been paid to the role of alcohol in the etiology of type 2 diabetes. A number of studies have investigated this issue, but with contradictory results. Some studies report an increased risk in high consumers and some studies report a protective effect primarily at moderate levels of consumption. Most of the studies conclude that moderate alcohol consumption may reduce the risk of type 2 diabetes but alcohol consumption may increase the risk of type 2 diabetes in women (Nakanishi *et al* 2003).

Heavy drinking can reduce the body's sensitivity to insulin, which trigger type 2 diabetes. and diabetes is a common side effect of chronic pancreatitis, which is caused by heavy drinking. Alcohol contains a huge amount of calories, so drinking can also increase chance of becoming overweight and risk of developing type II diabetes (Kopper *et al*, 2005).

STRESS

Many studies reported that permanent stress had a 45 percent higher risk of developing diabetes, compared with people who reported to have no or periodic stress. The link between stress and diabetes has been statistically significant (Novak *et al*, 2013). There are two reasons why stress could lead to a spike in blood sugar levels in people with type 2 diabetes. One reason is that people under stress may stop taking care of their diabetes. They may neglect to check their blood sugar levels, or they may stray from their diet and eat or drink too much. Another reason is that stress increases the body's demand for energy. To get that energy, our body releases hormones that raise blood sugar. Raised levels of these hormones stimulate the body to release stored glucose into the bloodstream. In non-diabetic condition body respond to the higher blood glucose levels by increasing the insulin levels. The end effect of this is that more energy (in the form of glucose) will be available to body cells. But in diabetes, this response can cause problems. As blood glucose increases, body may not have enough insulin to move this glucose into cells. This can result in blood glucose levels becoming high (Tuomilehto *et al*, 2001).

LONG TERM COMPLICATIONS

Type 2 diabetes can be easy to ignore, especially in the early stages when person feel fine. But diabetes affects many major organs, including heart, blood vessels, nerves, eyes and kidneys. Controlling blood sugar levels can help prevent these complications. Although long-term complications of diabetes develop gradually, they can eventually be disabling or even life-threatening. Some of the potential complications of diabetes include:

CARDIOVASCULAR DISEASE

Diabetes dramatically increases the risk of various cardiovascular problems, including coronary artery disease with chest pain (angina), heart attack, stroke, narrowing of arteries (atherosclerosis) and high blood pressure. The risk of stroke is two to four times higher for people with diabetes, and the death rate from heart disease is two to four times higher for people with diabetes than for people without the disease (American Heart Association, 2004). A large epidemiological and pathological data documents that diabetes is an independent risk factor for CVD in both men and women. Women with diabetes lose most of their inherent protection against developing CVD.CVDs are listed as the cause of death in 65% of persons with diabetes. It acts as an independent risk factor for several forms of CVD. Prospective studies document an increased likelihood of sudden cardiac death and unrecognized myocardial infarctions in patients with diabetes. Moreover, acute ischemic syndromes, peripheral arterial disease, and advanced CVD complications occur more commonly in patients with diabetes than in those without (Le Roith *et al*, 1996).

RETINOPATHY

Retinopathy involves small hemorrhages from broken arteries in the retina, with yellow, waxy yellow, waxy discharge or retinal detachment. Diabetic retinopathy is the leading cause of new cases of blindness in adults ages 20 to 74 years (Centers for disease control and prevention, 2007). The risk of retinopathy significantly increases with incessant hyperglycemia (fasting blood glucose ≥120mg/dl). Retinopathy has few warning signs, however nearly all patients with type 1 diabetes develop some degree of retinopathy, and up to 21% of patients with type 2 diabetes have retinopathy at the time of diagnosis (Fong, 2003). American diabetic association position statement on diabetic retinopathy recommends individuals

with type 1 diabetes go for examination within 3-5 years after diagnosis and those with type 2 diabetes have their first time eye examination shortly after diagnosis. Studies indicate that strict control of blood glucose and intensive intervention can reduce retinopathy progression by 65% and decrease the development of severe diabetic retinopathy by 47% (Genuth, 2006). Retinopathy should not be confused with the blurry vision that sometimes occurs as one of the first signs of diabetes. Blurry vision is caused by the increased glucose concentration in the fluids of the eye, bringing brief changes in the curved, light refracting surface of the eye.

NEPHROPATHY

Diabetic nephropathy, is a progressive kidney disease It is due to longstanding diabetes mellitus. It is classified as a microvascular complication of diabetes. When the level of blood glucose rises beyond the kidney's capacity to reabsorb glucose from the renal ultrafiltrate, glucose remains diluted in the fluid, raising its osmotic pressure and causing more water to be carried out, thus, increasing the excreted urine volume. The increased volume dilutes the sodium chloride in the urine, signalling the macula densa to release more renin, causing vasoconstriction, a survival mechanism to retain water by passing less blood through the kidneys. Because the kidney is nurtured exclusively by the blood it filtrates, the vasoconstriction also reduces the nutrients supplied to it, causing infarct of its tissues and reduction of renal function (Berkman *et al*, 2003). Only some people who have diabetes get kidney damage. Certain things make one more likely to get diabetic nephropathy like high blood pressure or high cholesterol, smoking. Globally diabetes has become the most common single cause of end-stage renal disease. The earliest clinical evidence of nephropathy is the appearance of low but abnormal levels (≥ 30 mg/day or 20μg/min) of albumin in the urine, referred to as microalbuminuria. A higher proportion of individuals with type II diabetes are found to have microalbuminuria shortly after the diagnosis of their diabetes, because diabetes is actually present for many years before the diagnosis is made (American Diabetes Association, 2004).

NEUROPATHY

Diabetic neuropathies are a family of nerve disorders caused by diabetes. People with diabetes can, over time, develop nerve damage throughout the body. Some people with nerve damage have no symptoms. Others may have symptoms such as pain, tingling, or numbness (loss of feeling in the hands, arms, feet, and legs). Nerve problems can occur in every organ system, including the digestive tract, heart, and sex organs. About 60 to 70 percent of people with diabetes have some form of neuropathy. People with diabetes can develop nerve problems at any time, but risk rises with age and longer duration of diabetes. The highest rates of neuropathy are among people who have had diabetes for at least 25 years, males are more prone to neuropathy, Person having poor glucose control or have concurrent complications such as CVD, retinal and renal disease (Shread, 2011) Diabetic neuropathies also appear to be more common in people who have problems controlling their blood glucose as well as those with high levels of blood fat and blood pressure and those who are overweight. Approximately 50% of people with diabetes have mild to severe forms of nervous system damage. The loss of nerve reaction can lead to further tissue damage and infection from unfelt foot injuries such as bruises, burns. Amputations and foot ulcerations are the most common results of severe neuropathy (WHO, 2002).

OSTEOPOROSIS

Osteoporosis is a bone condition defined by low bone mass, increased fragility, decreased bone quality, and an increased fracture risk. Osteoporosis is not symptomatic until there is a fracture. Diabetes mellitus is a risk factor for osteoporotic fractures. Recent research suggests that patients with type 1 diabetes, the initial onset of the disease often occurs at a young age, when bone mass is still being formed. Thus, low bone mass would seem a likely complication of type 1 diabetes. Type 2 diabetes was previously believed to provide bone protection because of its associated normal to increased bone mass density. These reports were primarily based on the concept of bone mineral density alone (Hofbauer, *et al*, 2007).

When considering all of the risk factors patients with diabetes generally have an increased risk of falling because of peripheral neuropathy, possible hypoglycemia, nocturia, and visual impairment. Because many type 2 diabetic patients are obese and sedentary, coordination and balance factors that are protective in falls may be absent. Thus, patients with generally larger body size and relatively high bone mass may have higher fracture rates. Conversely, patient groups with low bone mass density, such as Asians, may have lower fracture rates when one considers all factors in a risk assessment (Chau and Edelman, 2002).

DIETARY MANAGEMENT OF DIABETES

Diet is a basic part of management in every case. Treatment cannot be effective unless adequate attention is given to ensuring appropriate nutrition.

DIETARY MANAGEMENT AIM

- Ensuring weight control
- Providing nutritional requirements
- Allowing good glycemic control with blood glucose levels as close to normal as possible i.e preprandial plasma glucose should be 70–130 mg/dl and postprandial plasma glucose should be less than 180 mg/dl.
- Correcting any associated blood lipid abnormalities

- Ensuring consistency and compatibility with other forms of treatment if used, for Example oral agents or insulin.

CARBOHYDRATE AND DIABETES

Studies in healthy subjects and those at risk for type 2 diabetes support the importance of including foods containing carbohydrate, particularly from whole grains, fruits, vegetables, and low-fat milk in the diet of people with diabetes. A number of factors influence glycemic responses to foods, including the amount of carbohydrate, type of sugar, nature of the starch, cooking and food processing, and food form, as well as other food components like fat and natural substances that slow digestion like lectins, phytates, tannins, and starch-protein and starch-lipid combinations (Tuomilehto *et al*, 2001). In persons with type 2 diabetes, on weight maintenance diets, replacing carbohydrate with monounsaturated fat reduces postprandial glycemia. However, there is concern that increased fat intake may promote weight gain. Therefore, the contributions of carbohydrate and monounsaturated fat to energy intake should be individualized based on nutrition assessment, metabolic profiles, and treatment goals. Carbohydrates should provide 50-60% of total caloric content of the diet. Although it has been traditionally recommended that carbohydrates should be complex and high in fibre, more emphasis should be placed on the total amount of carbohydrates consumed than the source of carbohydrate (American Diabetes Association, 2004).

FIBER

As for the general population, people with diabetes are encouraged to choose a variety of fiber-containing foods, such as whole grains, fruits, and vegetables, because they provide vitamins, minerals, fiber, and other substances important for good health. Early short-term studies using large amounts of fiber in small number of subjects with type 1 diabetes suggested a positive effect on glycemia Recent studies have reported mixed effects on glycemia and lipids. In subjects with type 2 diabetes, it appears that ingestion of very large amounts of fiber are necessary to confer metabolic benefits on glycemic control, hyperinsulinemia, and plasma lipids. It is not clear whether the palatability and the gastro-intestinal side effects of fiber in this amount would be acceptable to most people (Diabetes Prevention Program Research Group, 2003).

RESISTANT STARCH

It has been proposed that foods containing naturally occurring resistant starch or foods modified to contain more resistant starch may modify postprandial glycemic response, reduce hyperglycemia. However, there are no published long-term studies in subjects with diabetes to prove benefit from the use of resistant starch.

PROTEIN AND DIABETES

People with diabetes, abnormalities of protein metabolism were less affected by insulin deficiency and insulin resistance than glucose metabolism. However, in subjects with type 2 diabetes, it has been demonstrated that moderate hyperglycemia can contribute to an increased turnover of protein, which suggests an increased need for protein (Sacks *et al*, 2001). A number of studies in healthy subjects and in persons with controlled type 2 diabetes have demonstrated that glucose from ingested protein does not appear in the general circulation, and therefore protein does not increase plasma glucose concentrations. Furthermore, the peak glucose response to carbohydrate alone is similar to that of carbohydrate and protein, suggesting that protein does not slow the absorption of carbohydrate. Protein intake can range between 10-15% total energy (0.8-1 g/kg of desirable bodyweight). Requirements increase for children and during pregnancy. Protein should be derived from both animal and vegetable sources (WHO, 2002).

FATTY ACIDS, DIETARY CHOLESTEROL AND DIABETES

The primary dietary fat goal in persons with diabetes is to limit saturated fat and dietary cholesterol intake. Dietary fat should provide *25-35%* of total intake of calories but saturated fat intake should not exceed 10% of total energy. Cholesterol consumption should be restricted and limited to 300 mg or less daily. Saturated fat is the principal dietary determinant of plasma LDL cholesterol. Furthermore, persons with diabetes appear to be more sensitive to dietary cholesterol than the general public. In non diabetic persons, low saturated fat and cholesterol diets decrease plasma total cholesterol, LDL cholesterol, and triglycerides with mixed effects on HDL cholesterol. Positive correlations between dietary total and saturated fat and changes in plasma total cholesterol and LDL and HDL cholesterol are observed. Adding exercise results in greater decreases in plasma total and LDL cholesterol and triglycerides and prevents the decrease in HDL cholesterol associated with low-fat diets. However, studies in persons with diabetes demonstrating effects of specific percentages of dietary saturated fatty acids and specific amounts of dietary cholesterol are not available. Therefore, the goal for persons with diabetes remains the same as for the general population (Cryer *et al*, 2003).

FAT REPLACEMENTS

Dietary fat intake can be reduced by lowering the amount of high fat foods in the diet or by providing lower-fat or fat-free versions of food and beverages or by using fat replacers (ingredients that mimic the properties of fat but with significantly fewer calories) in food formulations (The American Diabetes Association,2004). The Food and Drug Administration provides assurance that current fat replacers/substitutes are safe to use in foods. Regular use of foods with fat replacers may help to

reduce dietary fat intake (including saturated fat and cholesterol), but may not reduce total energy intake or weight. Long-term studies are needed to assess the effects of foods containing fat replacers on energy intake and on the macronutrient content of the diets of people with diabetes.

MICRONUTRIENTS AND DIABETES

Persons with diabetes should be educated about the importance of consuming adequate amounts of vitamins and minerals from natural food sources as well as the potential toxicity of megadoses of vitamin and mineral supplements. In general, megadoses of dietary antioxidants—vitamin C, vitamin E, selenium, beta carotene, and other carotenoids—have not demonstrated protection against diabetes. The role of vitamins B1, B6, and B12 in the treatment of diabetic neuropathy has not been established and cannot be recommended as a routine therapeutic option. Deficiencies of certain minerals, such as potassium, magnesium, and possibly zinc and chromium, may aggravate carbohydrate intolerance (Franz *et al*, 2002). There is no clear evidence of benefit from vitamin or mineral supplementation in people with diabetes who do not have underlying deficiencies. Exceptions include folate for prevention of birth defects and calcium for prevention of bone disease (The American Diabetes Association, 2004).

CONCLUSION

The chronic disease problem is far from being limited to the developed regions of the world. Contrary to widely held beliefs, developing countries are increasingly suffering from high levels of public health problems related to chronic diseases. This shift in the pattern of disease is taking place at an accelerating rate; furthermore, it is occurring at a faster rate in developing countries than it did in the industrialized regions of the world half a century ago. This rapid rate of change, together with the increasing burden of disease, is creating a major public health threat which demands immediate and effective action.

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