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Diet for Indian Diabetics

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Abstract : India is undergoing rapid nutritional transition with an the average Indian diet tends to be high in carbohydrates, saturated fat, trans fat (mostly related to the widespread use of vanaspati), and low in protein and fibre The energy producing components of the diet are the macronutrients. Macronutrients are the chemical compounds consumed in the largest quantities and provide bulk energy. The three primary macronutrients include carbohydrates, proteins, and fats. Dietary transition and a sedentary lifestyle have led to an increase in obesity and diet-related non-communicable diseases (type 2 diabetes mellitus [T2DM], cardiovascular disease [CVD], etc.) predominantly in urban, but also in rural areas. Both, NIN and an expert group have developed some broad Indian guidelines which recommends reduction intake of carbohydrate, higher intake of fibre, lower intake of saturated fat , optimal ratio of essential fatty acids ,slightly higher protein intake, lower intake of salt and restricted intake of sugar.

Introduction

Diabetes is a major health care problem in India with an estimated 65 million persons with diabetes; this has been forecast to rise to almost 80 million people by 2030 – an absolute increase of 150%. India is one of the epicenters of the diabetes epidemic. According the World Bank, India has been classified as a country with a lower middle income, with per capita GNP of US $ 996-3945. Studies show that , among the Indian population, about 28% in the rural and 26% in the urban areas are estimated to be below the poverty line, which is defined as the expenditure needed to obtain, on an average, 2400 Kcal per capita per day in the rural areas and 2100 Kcal in urban areas. India is undergoing rapid nutritional transition, resulting in excess consumption of calories, saturated fats, trans fatty acids, simple sugars, salt and low intake of fiber. Such dietary transition and a sedentary lifestyle have led to an increase in obesity and diet-related non-communicable diseases (type 2 diabetes mellitus, cardiovascular disease, etc.) predominantly in urban, but also in rural areas. The energy producing components of the diet are the macronutrients. Macronutrients are the compounds consumed in the largest quantities and provide bulk energy. The three primary macronutrients include carbohydrates, fat and proteins.

Medical nutritional management is the corner stone in management of person with diabetes. Diet plays a major role in regulating carbohydrate, fat, protein, homeostasis in patient with diabetes. Further more proper dietary management is required for the safe and

effective use of insulin. Diabetes care is complex and requires that many issues beyond glycemic control be addressed. Medical Nutrition Therapy is an integral component of diabetes management and training. Diet plays a major role in regulating carbohydrate, fat, and protein homeostasis in patients with diabetes.

Calories

The primary nutrition goals for persons with type 2 diabetes are to achieve and maintain normal blood glucose and lipid levels. A number of strategies can be implemented to achieve these goals. Learning new life-style behaviors and attitudes are essential.

control in persons with type 2 diabetes, independent of any effects from weight loss.When calories are restricted, hyperglycemia improves more rapidly than with weight loss. Furthermore, when calories are increased after weight reduction, glucose levels increase despite no regain of weight. This suggests that caloric intake is more important than weight.

A genetic predisposition to obesity and possible impaired metabolic and appetite regulation make it difficult to lose and, more importantly, to maintain weight loss. Because of the psychological and physiologic impact of dieting,

Table. 1 Methods for Determining Caloric Requirements of Adults*

1. Caloric requirements of adults Obese or very inactive adults, chronic dieters (20 kcal/kg) Adults older than 55 years of age, active women, sedentary men (28 kcal/kg) Active men or very active women (30 kcal/kg) Thin or very active men (40 kcal/kg) 2. Harris-Benedict equation for determining caloric requirements of adults (Measure of Resting Energy Expenditure [REE]) Women: REE = 655 + 9.63 W (kg) + 1.83 H (cm) – 4.73 A (yr) Men: REE = 66 + 13.73 W (kg) + 5.3 H (cm) – 6.83 A (yr) Obese Adults: W = ([actual wt. – DBW] x 0.25) + DBW Activity factors: restricted, 1.1; sedentary, 1.2; aerobic activity = 3x/wk, 1.3; 5x/wk, 1.5; 7x/wk, 1.6; true athlete, 1.7 (REE x activity factor = total caloric requirements)
W, weight; H, height; A, age; DBW, desired body weight Adapted from Kraus, Mahan Nutrition Therapy for Diabetes Mellitus and Hypoglycemia of Non -Diabetic Sign, Food, Nutrition and Diet Therapy, 200; 34:771.
For Children 1000 kcal + Age x 100 kcal for girls 1000 kcal + Age x 125 kcal for boys (upto 12 years)
Adapted from Raghuram TC, Pasricha S, Sharma RD. Diet and Diabetes, NIN, 1991.

Weight loss appears to improve glucose uptake, increase insulin sensitivity, and normalize hepatic glucose production. Weight loss may be most beneficial soon after type 2 diabetes is diagnosed, when insulin secretion is still adequate.

A hypocaloric diet, however, has been shown to have an important regulatory effect on glucose

individuals should be encouraged to attain and maintain a reasonable body weight. Emphasis should be on blood glucose control, a nutritionally adequate intake, and moderate caloric restriction (250 to 500 kcal less than the average daily intake as calculated from nutrition assessment), rather than weight loss.

Carbohydrate

Carbohydrates are either simple or complex, that provide 4 Kcal/g of energy. Carbohydrates should provide 50-60% of energy intake. The simple carbohydrates, glucose and fructose, are found in fruits, vegetables and honey, sucrose in sugar and lactose in milk, while the complex polysaccharides are starches in cereals, millets, pulses and root vegetables and glycogen in animal foods. The other complex carbohydrates which are resistant to digestion in the human digestive tract are cellulose in vegetables and whole grains, and gums and pectin's in vegetables, fruits and cereals, which constitute the dietary fibre component. In India, 70-80% of total dietary calories are derived from carbohydrates present in plant foods such as cereals, millets and pulses. Recently published STARCH study shows that Indians consume high amount of carbohydrate in their diet compared to the western population. The comparison of macronutrients (ie, region-wise carbohydrate, fat and protein) revealed a similar pattern of dietary consumption, that is, high carbohydrate and a lower range of fat and protein. This study neutralizes the myth that only the south Indian population consumes high CHO in their diet (rice, idli and so on).

Both the quantity and type of carbohydrate have differential effects on postprandial glucose levels. The classification of carbohydrates based on their ability to raise blood glucose which is termed as 'Glycemic Index (GI)'. According to Jenkins et al, 1981 Glycemic Index (GI) can be defined as the incremental area under blood glucose response curve of a 50g carbohydrate from a reference food (white bread or glucose) taken by the same subject over a specified period of time. As per glycemic index foods are categorized as low (GI value < 55), medium (GI value 56-69) or high GI foods (> 70). The glycemic index of common Indian foods is given in Table no 2. Further, Glycemic load is a ranking system for carbohydrate content in a food portion based on their glycemic index and carbohydrate content of food. Asian Indians are known to have high triglycerides and low HDL and this may be due in part to the high carbohydrate intake or high glycemic load. Higher intake of carbohydrate is associated with higher fasting glucose, higher triglycerides (24mg/dl) and lower HDL (5mg/dl). Several prospective studies have associated diets high in glycemic index with risk of developing type 2 diabetes mellitus, coronary heart disease, and some cancers. The GI concept may thus be of particular benefits to Indians due to high prevalence of impaired glucose tolerance and diabetes.

Fibre

Dietary fibre is that part of food that is not digested by the gut and is considered as unavailable carbohydrate. Dietary fibre delays and retards absorption of carbohydrates and fats and increases the satiety value. The dietary fibre content of some common Indian foods is given in Table 3 .The recommended amount of dietary fibre is 14 g per 1000 calories, or 25 g per day for women and 38 g per day for men. Although 50% or more of Indians are vegetarian, fiber intake is low in this population. Diets containing 20 g/day of soluble fibres may be capable of modestly reducing fasting circulating total and LDL cholesterol when administered in conjunction with a diet containing at least 50% carbohydrate. However, long-term consumption of insoluble fibre also improves glucose tolerance. Unrefined carbohydrates, with natural fibre intact, have distinct advantages over highly refined versions because of their other benefits such as a lower glycemic index, greater satiety and cholesterol-lowering properties.

It remains possible that particular classes of food or individual foods can confer specific benefit. One such possible constituent is oats, a whole-grain cereal that is rich in soluble fibre.

Table 2. Glycemic Index of Common Foods

Item	Glycemic Index	Item	Glycemic Index
Cereal Products		**Fruits**	
Bread	70	Apple	39
Millets	71	Banana	69
Rice (White)	72	Orange	40
Wheat (Paratha)	70		
Breakfast Snacks		**Vegetables**	
Pongal	55	Brown beans	79
Pesarattu	60	Frozen beans	51
Upma	75	Potato	70
Idli	80	Sweet potato	48
Chole	65	Yam	51
Sprouted green gram	60	Beetroot	64
Sundal	80		
Dairy Products		**Dried Legumes**	
Milk	33	Soyabeans	43
Ice-cream	36	Rajmah	29
Curds	36	Bengal gram	47
		Green gram	48
Miscellaneous		Black gram	48
Groundnuts	13		
Potato chips	51		
Tomato soups	38	**Sugars**	
		Fructose	20
		Glucose	100
		Maltose	105
		Sucrose	59
		Honey	87

Source: Jenkins et al, 1981; Am J Clin Nutr 34:362, 1981
Raghuram et al, Diabetes Bull., 7:64, 1987
Dilwari et al, Diet, Digestion & Diabetes, 1987

The effects of oats on lipid metabolism are well documented, and there is a growing body of literature to suggest that oats also lower blood pressure or help prevent CVD. Population studies suggest that diets rich in oats or other foods containing soluble fibre are associated with lower levels of blood pressure or rates of coronary disease. Oat or oat fibre consumption has been shown to reduce postprandial glucose and insulin concentrations, and the reduction in insulin concentration may provide a mechanism by which blood pressure could be reduced in response to oats consumption. Oats also contain a varied range of phenolic compounds including ester linked glycerol conjugates ester linked alkyl conjugates ether and ester linked glycerides, anthranilic acids and avenanthramides. These compounds possess high level of antioxidant activity. Compared with other cereals (wheat, rice, barley, buckwheat, rice) , oats contain higher content of protein, and the composition of oat amino acid is more reasonable. Refer table 4. Moreover, the levels of crude fat, showing the nutritional and functional potential, in oat are much higher than that of other cereal grain, which leads oat to become an excellent source of functional food. Oat lipids are rich in polyunsaturated fatty acids, Vitamin E and plan sterols.

Table 3: Dietary Fibre Content of Some Common Indian Foods

Food	Dietary Fibre (g/100 g)
Cereals and Millets	
Rice	7.6
Wheat	17.6
Sorghum	14.3
Bajra	20.3
Ragi	18.6
Pulses and Legumes	
Green gram dhal	13.5
Black gram dhal	14.3
Red gram dhal	14.1
Bengal gram dhal	13.6
Nuts and Oilseeds	
Groundnut	6.1
Coconut dry (copra)	8.9
Roots and Tubers	
Sweet potato	7.3
Potato	4.0
Yam	5.3
Fruits	
Banana	2.5
Mango	2.3
Vegetables	
Amaranth	3.4
Palak	5.0
Brinjal	2.0
Ridge gourd	5.7
Snake gourd	1.8
Bottle gourd	2.8
Yellow pumpkin	0.5

Source : B.S. Narasinga Rao, Nutrition Foundation of India Bulletin, 9(4), 1988

Protein

Proteins are primary structural and functional components of every living cell, majorly present as muscle and the rest of it is in bone, cartilage and skin. Proteins are complex molecules composed of different amino acids. Certain amino acids which are termed “essential”, have to be obtained from proteins in the diet since they are not synthesized in the human body. Other nonessential amino acids can be synthesized in the body to build proteins. Proteins perform a wide range of functions and also provide energy (4 Kcal/g). Common sources of dietary protein include whole protein foods , both animal source and plant source. Dietary sources include milk , milk products, fish, lean meat such as poultry, eggs, beans, peas, soy products, nuts and seeds. Animal proteins are of high quality as they provide all the essential amino acids in right proportions, while plant or vegetable proteins are not of the same quality because of their low content of some of the essential amino acids. However, a combination of cereals, millets and pulses provides most of the amino acids, which complement each other to provide better quality proteins. The adult recommended dietary intake (RDI) of 0.8 g protein/kg body weight meets metabolic and nutritional needs. Indian diets derive almost 60 % of their protein from cereals with relatively low digestibility and quality. There have been several surveys of diets and protein intakes in India by the National Nutrition Monitoring Board (NNMB) over the last 25 years, in urban and rural, as well as in slum dwellers and tribal populations. Data of disadvantaged populations from slums, tribals and sedentary rural Indian populations show that the protein intake (mainly from cereals) is about 1 gm/kg/day. However, the protein intake looks less promising in terms of the protein digestibility corrected amino acid score (PDCAAS), using lysine as the first limiting amino acid, where all populations,

Table 4: Comparison of oats with other cereals

Characteristics	Oats	Other cereals
Crude fat	↑	→
PUFA	↑	→
Vitamin E	↑	→
Plant sterols	↑	→
Lipophilic properties	↑	→
Lipophobic properties	↑	→
Beta glucan	↑↑	→
Micronutrients	↑	→
Avenanthramide/antioxidant	Only cereal to posses	NA
Consumption form	Mostly consumed as a whole gain	Mostly as flour (except rice)
International health claim	Available	None

particularly rural and tribal, appear to have an inadequate quality to their protein intake. The protein: energy (PE) ratio is a measure of dietary quality, and has been used in the 2007 WHO/FAO/UNU report to define reference requirement values with which the adequacy of diets can be evaluated in terms of a protein quality corrected PE ratio. It is likely that about one third of this sedentary rural population is at risk of not meeting their requirements. These levels of risk of deficiency are in a population with relatively low BMI populations, whose diets are also inadequate in fruits and vegetables. Therefore, while the burden of enhancing the quality of protein intake in rural India exists, the quality of the diet, in general, represents a challenge that must be met.

Fat

Fats are a concentrated source of energy providing 9 Kcal/g, and are made up of fatty acids in different proportions. Fats serve as a vehicle for fat-soluble vitamins like vitamins A, D, E and K and carotenes and promote their absorption. Dietary fats are derived from two sources; the invisible fat present in plant and animal foods; and the visible or added fats and oils. Oils and fats such as butter, ghee and vanaspati constitute dietary visible fats. Irrespective of the way it has been classified structurally from the nutrition perspective the fatty acids are classified usually basis their unsaturation.

Saturated fatty acids: Saturated fatty acids do not have any double bonds between the individual carbon atoms of the fatty acid chain. The chain of carbon atoms is fully "saturated" with hydrogen atoms. Single bonds between carbon atoms are more stable than double bonds. The dietary sources of these fats include fat in milk, cream, butter, ghee, animal fat and among vegetarian sources coconut oil, palm oil etc.

Partially hydrogenated or trans fatty acids: These solid fats are made from unsaturated vegetable oils (liquids) to which have been added some hydrogen atoms, through the process called hydrogenation. During the hydrogenation process, some hydrogen atoms change their configuration from being on the same side (cis) of a carbon-carbon double bond to being on opposite sides (trans). If complete hydrogenation is achieved than no trans fats and saturated fats result. If only partial hydrogenation is obtained, some double bonds remain, and trans fats are produced. Naturally occurring trans fatty acids are found in smaller amounts in beef and lamb. In India,trans fats are commonly available as vanaspati and Dalda.

These are also present in margarines, shortenings, bakery food products, ready to eat and processed foods. Research has shown that consumption of trans fatty acid have been associated with coronary artery diseases, increase in LDL Cholesterol , decrease in HDL Cholesterol and increase in C reactive protein.

Unsaturated fatty acids: An unsaturated fatty acid has at least one double bond within the fatty acid chain. The fat molecule is monounsaturated if it contains one double bond and polyunsaturated if it contains more than one double bond.

Mono unsaturated fatty acids (MUFA): These have fatty acids containing one double bond. Foods containing higher amount of MUFA are shown to reduce LDL Cholesterol and increase HDL cholesterol. Dietary sources of MUFA are olive oil, ground nut oil, rice bran oil, mustard oil, soyabean oil ,canola oil. Nuts rich in MUFA are almonds, peanuts etc. Fruits like olives and avocados are rich sources of mono unsaturated fatty acids. Consumption of these oils result in lowering total cholesterol and LDL cholesterol levels in the blood.

Poly unsaturated fatty acids (PUFA): Polyunsaturated lipids are triacylglycerols in which the hydrocarbon tails of this ester constitutes PUFA (fatty acids possessing more than a single carbon–carbon double bond).Use of PUFA as fats is shown to reduce LDL cholesterol and improve insulin sensitivity. Oils such as sunflower oil, safflower oil, corn oil are polyunsaturated fats. Besides these, all invisible fats present in cereals and pulses are also polyunsaturated. These fats are known to lower cholesterol, however they are not preferred to be used as additional visible fats. This is due to their viability to oxidation in our body and also due to its invisible consumption in large amounts as cereals and pulses.

Overall , the excessive dietary fat intake contributes to obesity, insulin resistance, hypertension, and atherosclerotic cardiovascular disease. Epidemiologic evidence indicates that high-fat diets contribute to atherosclerosis. High-fat diets cause insulin resistance and impaired intracellular glucose metabolism. High-fat diets decrease the number of insulin receptors in several tissues, decreasing glucose transport into muscle and adipose tissue and decreasing activities of insulin-stimulated processes. There is considerable evidence to suggest that oxidative damage to LDL significantly increases LDL atherogenicity and therefore, oxidized LDL (oxLDL) promotes atherogenicity. Oxidized LDL may directly alter both the structure and function of the endothelial cells and thereby promotes atherogenecity. Elevated plasma cholesterol concentrations, particularly LDL-cholesterol, show a strong and consistent association with the incidence of CHD. However, there are limited data showing that dietary interventions to lower cholesterol intake improve patient outcomes.

Dietary fat intake should not exceed 30% of energy. The type of fat consumed in a given diet appears to be more important than the amount of total fat. Most importantly, saturated fats, because of their atherogenic potential, should not exceed maximum of 10% of energy needs e.g. ghee, butter, coconut and coconut oil. Polyunsaturated fatty acids, with their tendency to lower HDL-cholesterol values and their susceptibility to oxidation, should also be less than 10%. However, up to 35% of energy from fat can be used for non-obese individuals with acceptable serum triglyceride values if the additional fat comes from monounsaturated sources such as peanut or olive oils or rice bran oil. Cholesterol intake, though less influential than saturated fats on serum lipid values, should be held under 300 mg/day; recommended less than 200 mg/day. Trans fats contribute to coronary heart disease, while n-3 (and perhaps n-6) polyunsaturated fats are protective. Edible vegetable oil plays a vital role in determining the serum lipid levels and apoliporotein levels depending on its fatty acid composition. Several single seed oils like Rice Bran Oil (RBO), Safflower oil (SFO), Olive oil (OO), Groundnut Oil (GO), Coconut Oil (CO) are

popular in India as well as globally as cooking medium. It is known that many of these oils contain substantial amount of PUFA, the increase in the number of unsaturation in fatty acids increases its vulnerability to oxidation during storage and specially while cooking. However, none of these single edible oils meet the dietary fatty acid recommendation. Studies have shown that it is not a single fat source, but a combination or a blend of various fats having fatty acid compositions and additional minor components like tocotrienols, oryzanol tocotrienols and phytosterols along with a good balance of saturated and unsaturated fats that will bring about favorable serum lipid profiles with cardio protective beneficial effects. Hence, the National Institute of Nutrition, India (NIN) in their recent recommendations state that a correct combination or blend of two or more oils should be used to achieve all kinds of fatty acids in the diet.

The new concept in cooking oils of blending one or more vegetable oil serves the advantages like improve thermal stability, higher oxidative stability, and appropriate nutritional benefits . The blending of oils allows the optimization of fatty acid composition of mixed oil. A blend of two oils 70% RBO and 30% SFO with antioxidants is expected to be complementary in lowering dyslipidemia, and thereby to control known risk factors.

Recommendation for India

Diet is a difficult risk factor to compare among populations, because of considerable variation within and between different countries. In the CADI study, involving Indian physicians and their family members, the average energy intakes from carbohydrates, total fats, and saturated fats were 56%, 32%, and 8% respectively. High total fat intake was associated with obesity and high carbohydrate intake (>280grams per day) was associated with high triglyceride levels.

Both, NIN and expert group have developed some broad Indian guidelines.The broad principles of which are given in the table below (Table 5). A trans cultural algorithm for diabetes has also been developed.

Table 5: Indian Nutritional Guidelines**. Adapted from Misra A, et al. Consensus dietary guidelines for healthy living and prevention of obesity, the metabolic syndrome, diabetes, and related disorders in Asian Indians. *Diabetes Technol Thera*. 2011, Jun;13(6):683-94.**

Hypocaloric (weight loss) diet to achieve 250 - 500 Kcal/day deficit
–Recommended Target: decrease weight by 5% for overweight, 10% for obesity, 15% for severe obesity and maintenance for at least for 1 year
Recommended target - reduction of waist circumference
Small frequent meals at regular intervals (gap should be 3 – 4 hrs) is recommended,
–Carbohydrates (preferably low-glycemic index): 55%-60% daily energy intake and not <130 gm/day in patients on low caloric diet
–Protein: 10%-15% daily energy intake
–Total Dietary fat: 15-30% daily energy intake (encourage intake of Mono Unsaturated Fatty Acid)
–Use of cooking fat in moderation. Reheating of fat should be discouraged
–Use combination of oils
–Saturated fat: <7% daily energy intake
–Cholesterol: limit to 200 – 300 mg/day
–Fiber: 25-40 g/day,
–Trans-fats: <1% of total energy/day OR minimize or eliminate
Salt – 5 gm a day
Sugar – consumption of simple sugars should be restricted
Water – Adequate intake unless contraindicated
Alcohol: Alcohol is not a recommendation, it can be an allowance at discretion of physician

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