**IMPACT OF DIETARY INTERVENTIONS ON TYPE 2 DIABETES MELLITUS AND IT’S COMPLICATIONS**

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ABSTRACT

Type 2 diabetes mellitus (T2DM) constitutes one of among the most prevalent diseases in worldwide. T2DM is a complicated etiology that includes incurable risk factors including age, genetics, race, and ethnicity as well as irreversible variables like cigarette smoking, dietary habits, and exercise. This study aims to review previous research and investigate the connection among diverse dietary patterns, practices, and behaviour’s, as well as the difficulties associated with type 2 diabetes. The main reasons of the sharp rise in the prevalence of diabetes mellitus in developing nations are dietary practices and sedentary lifestyles. Raised HbA1c levels among people with Type 2 diabetes are now thought to be one of the primary risk factors for an increase of microvascular and macro vascular problems. Improvement in the elevated HbA1c level can be achieved through diet management; Thus, the patients could be prevented from developing the diabetes complications. Awareness about diabetes complications and consequent improvement in dietary Knowledge, attitude, and practices lead to better control of the disease. Health care providers, health centre’s, diabetes care organizations, and various other stakeholder have to teach patients about the role that diet plays in managing their condition, taking proper care of themselves, and living a better quality of life.

Keywords: Type 2 Diabetes Mellitus, Rapport, Knowledge, Practice, Complications, Diet, Weight, Mediterranean diet.

INTRODUCTION

Diabetes mellitus (DM) was first recognized as a disease Around 3000 years ago by the ancient Egyptians and Indians, İllustrating some clinical features very similar to what we Now know as diabetes.1 DM is a combination of two words, “diabetes” Greek word derivative, means siphon – to pass Through and the Latin word “mellitus” means honeyed or sweet. In 1776, excess sugar in blood and urine was first confirmed İn Great Britain. With the passage of time, a widespread Knowledge of diabetes along with detailed etiology and Pathogenesis has been achieved. DM is defined as “a metabolic Disorder characterized by hyperglycemia resulting from either The deficiency in insulin secretion or the action of insulin.” The poorly controlled DM can lead to damage various organs, Especially the eyes, kidney, nerves, and cardiovascular system.4 DM can be of three major types, based on etiology and clinical Features. They are Type 1 Diabetes Mellitus, Type 2 Diabetes Mellitus and Gestational Diabetes Mellitus. As a result of an autoimmune process mediated by cells, Type 1 DM patients have complete insulin insufficient amount, resulting in the death of beta cells in the pancreas. The resistance to insulin with relative insulin insufficiency are present in type 2 diabetes. Gestational diabetes mellitus is Any degree of glucose intolerance that is recognized during Pregnancy. DM can arise from other diseases or due to drugs Such as genetic syndromes, surgery, malnutrition, infections, And corticosteroids intake. Type 2 DM factors which can be irreversible such as age, genetic, Race, and ethnicity or revisable such as diet, physical activity And smoking.

GLOBAL HEALTH

WORLD

Diabetes Mellitus, commonly referred to as Diabetes is one of the leading chronic diseases characterized by the rise of blood sugar level. Due to lack of enough or any insulin production or effectiveness in utilization it fails to use insulin the body produces. The IDF global estimate of the diabetes prevalence in the 20-79 years old population was 151 million in the year 2000 almost equal to the WHO estimate at the time (150 million). WHO estimate (in 2014), 422 million number of the population had diabetes that is very near to IDF estimate of 415 million in 2015; increasing with more than threefold that of 2000; we now have 537 million (2021). It Is believed that about 573 million diabetic patients are adults aged between 20-79 years worldwide (10.5 % of all adult in this age group). By 2030 about 643 million adults 20-79 years of age are predicted to have the condition while in 2045 another 140 million would be living with diabetes from the projected 783 million adults 20-79 years of age. Therefore, although the world’s population is projected to grow by 20% over this Period, the number of diabetic patients is expected to Increased (Map 1.1) by Our forecasts see the rise in the actual of a 16% impress. Diabetes prevalence from the ageing population. Number wise the percentage of people with Type 2 diabetes mellitus in western Pacific and South East Asia was the highest, followed by Africa, Europe, Middle-East and North Africa, North America and Caribbean, South and Central America. Western Pacific is the highest number of diabetic adults which is equivalent to 206 million adults (20–79) years or 1 in 8 adults. In the Western Pacific region more than a third (38%) of adults living with diabetes come from this region. The third highest prevalence of diabetes is found in the Western Pacific region of the world and registered at number of 11.9 %. In the World, one living adult among 4 suffers from diabetes and ¼ of these cases are reported in China. More than half (53%) of all adults with diabetes are undiagnosed. In 2021, 2.3 million deaths were attributed to diabetes- the greatest number of all IDF region. In South East Asia region about 1 in 11 adults have diabetes- 90 million. There are approximately 14% of the worlds adult population living with diabetes in India with 1 in every 7 being one of these persons. The amount of people suffering from diabetes is forecasted to raise by 69% to 152 million in 2045. Diabetes is among the leading killers accounting for 747,000 deaths in 2021.

Map 1.1: Estimated Total Number of Adults (20-79) with Diabetes in 2021.

NATURAL HISTORY

EPIDEMIOLOGICAL DETERMINANTS

Diabetes mellitus is a syndrome of multiple etiologies characterized by chronic Hyperglycemia with disturbances of carbohydrate, fat and protein metabolism Resulting from defects in insulin secretion, insulin action or both. This disorder is often Associated with long term complications, involving organs like eyes, kidneys, nerves, Heart and blood vessels.

SYMPTOMS OF DIABETES: Osmotic symptoms- polyuria, polydipsia, Weight loss in spite of polyphagia, Tiredness, weakness, Generalized pruritus, Recurrent urogenital infections, Delayed healing of wounds. More than half of all patients with diabetes will have no symptoms at all

RISK FACTORS: Modifiable risk factors are weight management, Blood pressure, Total-C (Total cholesterol) to HDL (High density Lipoprotein) ratio, Smoking, Diet , Alcohol, Stress and well being, Sleep. Non- Modifiable risk factors -Family history, race-ethnic background, age -gestational diabetes

COMPLICATIONS: Diabetes leading cause of cardiovascular diseases (CVD), Diabetic nephrology, Diabetic retinopathy, Non-Alcoholic fatty liver diseases (NAFLD/NASH) , peripheral neuropathy, periodontitis, foot ulceration, Peripheral artery diseases.

PREVENTION AND MANAGEMENT:

Whom and when to screen?

Screening should be performed in all individuals >30 years of age. It should be carried Out at an earlier age in adults who have one or more of the following risk factors:

* Family history of diabetes
* Overweight/obese (BMI ≥23 kg/m2) or have increased waist circumference (>90 cm males, >80 cm females)
* History of hypertension (≥130/80 mmHg) or on treatment for hypertension
* History of dyslipidemia
* Sedentary physical activity
* History of gestational diabetes or macrosomia (birth weight > 3.5 kg)
* History of CVD (ischemic heart disease, cerebrovascular disease)
* History of polycystic ovarian syndrome and/or acanthosis nigricans

Methods of diabetes Diagnosis are as follows OGTT (oral glucose tolerance test) , FBG (fasting or blood glucose), HBA1C (Glycosylated Hemoglobin) , Self- reported diabetes, medical record or clinical Diagnosis.

Table 1.1: Diagnostic Criteria for Diabetes and Prediabetes.

\*Individuals with random plasma glucose between 140-199mg/dl are recommended to undergo OGTT WHO – World Health Organization; ADA-American Diabetes Association; IFG – Impaired Fasting Glucose; IGT – Impaired Glucose tolerance; FPG – Fasting Plasma Glucose; 2-h PG-2 hour post load Glucose test (oral glucose tolerance test) plasma glucose; HbA1c – Glycosylated Haemoglobin.

Diagnostic Criteria for Diabetes

* Symptoms of diabetes plus casual or random plasma
* Glucose ≥ 200 mg/dl (Casual means without regard to time of last meal)
* Fasting plasma glucose ≥ 126 mg/dl\*
* 2 hour post 75 g glucose ≥ 200 mg/dl (as part of OGTT)\*
* Glycated Haemoglobin ≥ 6.5%\*

\*Diabetes diagnosed using any of these criteria should be confirmed with another Test subsequently.

Primary prevention such as lifestyle modification like Healthy diet, Don’t smoke, Regular check-ups, Secondary prevention such as Have a personal stake and an Action plan, monitor, medications, and personal action. Pharmacological therapies are multiple which are best maximized when used in combination, ideally matched to stage of T2DM(reverse Pathophysiology of T2DM). Such medications are Metformin (tab), Insulin-secretagogues, Insulin sensitizers, Incretin based treatments, SGLT2-inhibitors; GLT1 agonists.

RAPPORT BETWEEN DIET AND TYPE 2 DIABETES MELLITUS

The relationship between nutrition & type 2 diabetes mellitus (T2DM) is complex and important while nutrition affects Type 2 diabetes. Risk, treatment, and prevention. A thorough assessment of systematic reviews of prospectively observational studies has demonstrated many dietary components associated to a reduced risk of type 2 diabetes (T2DM): Increased consumption of chocolate, yoghurt, olive oil, cereal fiber, and entire grains Moderate use of alcohol overall Optimal eating regimens, such the DASH and Mediterranean diets. Several dietary variables have been linked to an increased risk of type 2 diabetes: Increased consumption of processed meat, bacon, red meat, and drinks with added sugar Unhealthy eating habits, such the diets seen in the West and the South. To validate the causal effects of nutrition on type 2 diabetes, additional carefully performed research is required as the quality and validity of the data supporting these connections differ. Furthermore, based on individual variables like age, sex, ethnicity, genetics, and comorbidities, there may be differences in the ideal diet for those with type 2 diabetes. Consequently, for individualized nutritional advice and assistance, it is recommended that you speak with a licensed nutritionist or dietician.

RECOGNITION OF DIETARY KNOWLEDGE of TYPE 2 DIABETES MELLITUS

Knowing how different foods and nutrients affect the blood glucose levels and insulin sensitivity and metabolic health of people with T2DM is referred to as dietary knowledge of T2DM. Through nutrition, people with T2DM can avoid complications, achieve weight management and maintain glycemic control. Macronutrient like Carbohydrates fats, Proteins composition of foods is only one approach to choosing diabetes-friendly meals. How these macronutrients affect insulin responsiveness and blood glucose levels sit near the top of the list of the most important diet-related things they need to understand. The more of a food people with diabetes at a single meal, the more important the Glycemic index and Glycemic load numbers become, since they put the others into context. They give good ideas as to the effects of equal quantifies of different foods on blood glucose. It is a concept that becomes very important when transitioning from the diet’s weighing and measuring phase to its eyeballing phase, where they stop using a scale and measuring cups, and learn to estimate portion sizes base on their size, shape and texture Eating A Balanced, Varied Diet That Meets Nutritional Needs And Your Preferences A healthy diet for type 2 diabetes should include: Ample foods are Vegetables, Fruit, Whole grains, Legumes ,Nuts, seeds , Protein from lean sources, Healthful fats , The diet should also be low Added It should be limit ate – Sugars, Refined grains, Processed meats, Saturated fats, Trans fats, Sodium. There is no one-size-fits-all diet for diabetes, and different dietary patterns can be balanced and healthful, such as Mediterranean, DASH, Low-carbohydrate Show as long as It the is individual individualized to his or her goals, personal and, medical conditions. The merits of maintaining regular and adequate meal timing, portion control, and reading food labels to manage blood sugar levels and weight. Eating at intervals helps to eliminate fluctuations in blood glucose level and also to stave off hunger. Controlling the portion size of foods is one way to reduce your kilojoule Intake and help lose weight, plus keep it off. Heart-healthy Eating Reading food labels can tell you how many grams of carbohydrates, sugar or fibers; what is their fat content and so forth. It is a handy shortcut for steering clear not only of that rich, gooey chocolate cake but also all kinds of packaged snacks, beverages or desserts.

MINDSET OF PRACTICES OF TYPE 2 DIABETES MELLITUS

The way people, with type 2 diabetes mellitus (T2DM) view and interact with foods and dietary patterns which can impact their blood glucose levels and overall health is known as the attitude of T2DM towards food. This attitude plays a role in their food choices adherence to guidelines, satisfaction levels well as their ability to manage blood sugar levels effectively quality of life and risk of complications. Various factors such as knowledge, beliefs, preferences, culture, religion, education level, income level and social support can influence the attitude of individuals with T2DM towards food. Research suggests that there are themes that emerge from these studies; Many individuals with T2DM tend to have an outlook on food. They perceive it as restrictive and depriving while feeling tempted by it. Additionally they may experience guilt or frustration associated with giving up their foods or following a diet plan. Social gatherings centered around food can also pose challenges for them. Emotional eating episodes or cravings may further impact their blood glucose levels and weight management. On the hand some individuals with T2DM have a perspective, on food. They view it as a source of enjoyment and satisfaction while empowering them to make choices for their well being. They might believe that they can still relish a range of options maintain a versatile and well rounded eating routine and engage in social gatherings centered around food. Other people with T2DM have a facilitator attitude towards food, seeing it as enjoyable, satisfying, empowering and health providing and wanting to achieve positive outcomes, where despite dietary changes such as restriction and change in identity with food, they are still manage to enjoy a wide variety and flexibility with food, go out and eat with friends. People with very high understanding about the nutritional content, portion size and glycaemic impact of food and use a range of strategies such as psychological, substitution, moderation, skill enhancement and self-monitored to regulate their blood glucose levels and weight. Some individuals with T2DM have a mixed or ambivalent food attitude where it can be a source of both pleasure and pain. They may have conflicts between needing to eat what they like versus needing to eat what they should. These individuals may also have inconsistencies or inaccuracies in their knowledge of the effects of food and meals, in general, on blood glucose and health outcomes. Additionally, barriers to choosing appropriate foods include cost, availability, accessibility and acceptability of healthy foods. Improving the food attitude of individuals with T2DM requires patient-centered education, counselling and support that addresses the cognitive, emotional and behavioral aspects of food and diet. The objective is for persons with T2DM to develop, over time, healthier, sustainable and consistent food patterns in their everyday lives. The registered dietitian (RD) and diabetes care and education specialist can provide up-to-date, sustainable services to meet the needs of people with diabetes at any stage in life. One component of these services is teaching people with diabetes how to adapt to lifestyles focusing on the nutritional changes central to good diabetes care and limitations on key nutrients that can lessen the risk of diabetes complications. The optimal goal of a sound nutrition therapy plan for diabetes is to develop a positive and realistic attitude towards food, that enables the people with diabetes to enjoy food life while maintaining good glycemic control and preventing diabetes complications.

COMPLICATIONS OF TYPE 2 DIABETES MELLITUS

Diabetes Mellitus is fourth among the leading cause of global death due to complications. Worldwide this disease, weight down on health system and also on patient and their families who have to face too many financial, social and emotional strains. Diabetes Mellitus affects several organ systems of the body and over time it is associated with some grave complications. Diabetes mellitus type 2 complications include microvascular and macrovascular complications.

Microvascular complications damages to small blood vessels and capillaries is common. Destruction of small blood vessels. Contributes to kidney damage, blindness and various neuropathies. Micro vascular injury is directly related to the degree and duration of hyperglycemia. Microvascular complications include Diabetic retinopathy, Diabetic nephrology, Diabetic neuropathy, Diabetic foot ulcer.

Diabetic retinopathy a microangiopathic disorder that affects all small vessels of the eye, including arterioles , capillaries and venules is characterized by increased vascular permeability ocular hemorrhages lipid exudates due to vessel closure mediated through development neovascularization on the retina surface posterior vitreous.

Diabetic nephropathy is a chronic complication that presents increased urinary albumin excretion (Proteinuria) or reduced kidney glomerular filtration rate in both forms of diabetes mellitus type 1 patients and diabetes Mellitus. In about 30% cases of type1 DM the presence of proteinuria was observed and in almost 40%cases for Type2DM. It is also the leading cause of end-stage renal diseases worldwide, contributing to about 40% of new cases requiring renal replacement therapies.

Oxidative stress, activation of the polyol pathway, early end product glycation development and protein kinase C activation are some molecular mechanisms associated with functional nerve impairment.

Diabetic foot ulcer are laceration usually seen in the Diabetes patients due to peripheral neuropathy or peripheral artery diseases on all skin layer, necrosis or inflammation. 15% to 25% diabetes patients will grow foot ulcers during their lives.

Macrovascular complications includes coronary artery diseases, cerebrovascular diseases (Stroke), peripheral artery diseases, congestive heart failure (6% to 10% of individuals 65 years or older), Myocardial infarction (20.2%) prevalence in the diabetes mellitus type 2 patients. Peripheral vascular diseases may lead to bruises or injuries that do not heal, gangrene and ultimately amputation.

Another types of Diabetes Mellitus complications includes periodontitis, tuberculosis, diabetic myonecrosis, diabetes cardiomyopathies, dental caries, diabetes gastroenteropathy (involving heartburn, abdominal pain, nausea, vomiting, constipation, diarrhea & fecal incontinence)

The prevalence reported from studies conducted worldwide on the complications of type 2 diabetes mellitus showed varying rates. The prevalence of cataracts was (26-62%), retinopathy (17-50%), blindness (3%) , nephropathy(17-18%) , cardiovascular complications (10-22%) , stroke (6-12%), neuropathy (19-42%) . Mortality from all causes was reported between(14%) and (40 %) .

In India, the reported incidence of retinopathy ranged from (4.8 to 21.7%), diabetic nephropathy ranging between (0.9% to 62.3%) in Indian population studies The prevalence of diabetes neuropathy in India ranged from (10.5% to 44.9%) studies conducted in the country showed that poor glycemic control and long standing diabetes were significantly associated with incident onset or progression of diabetic neuropathy

In Saudi Arabia the prevalence rate of diabetic retinopathy was 30%, Sri Lanka (31.3 %), Brazil (35.4%), South Africa it was (40 %), Pakistan (26.l%), Malaysia(14.9%).

AIMS OF DIETARY MANAGEMENT

* Achieve good glycemic control.
* Reduce hyperglycemia and avoid hypoglycemia assist with weight management.
	+ Weight maintenance for type 1 diabetes and non obese type 2 diabetes.
	+ Weight loss for overweight and obese type 2 diabetes.
* Reduce the risk of microvascular and macro vascular complications.
* Ensure adequate nutritional intake.
* Avoid ‘atherogenic’ diet or those that aggravate complications. Example- high protein intake in nephropathy.

Dietary constituents and recommendations % of energy intake :

* Carbohydrates: 50% : sucrose up to 10%

Fat(Total): <35% :n-6 Polyunsaturated: <10%, n-3 Polyunsaturated: eat 1 portion (140 g) oily fish once or twice weekly,

Monounsaturated: 10-20% ,

 Saturated: <10%

* Protein: 10-15% (do not exceed 1 g/kg body weight/day)
* Fruits/Vegetables: 5 portions daily.

WHO recommended population macronutrient goals.

(obesity, type 2 diabetes, coronary heart diseases, diverticulosis, cancers). The requirements during and after illness may be different, and pre-term infants have particular needs.

Energy: Sufficient to attain or maintain a reasonable body weight for adults, normal growth And development for children and adolescents, to meet the increased needs during Pregnancy and lactation and recovery from illness. Daily physical activity and exercise Needs to be considered. Ideal Body Weight (IBW) = (Height in cm – 100) \* 0.9. Approximately, 25 kcals/kg ideal body weight/day can be given to a moderately Active patient with diabetes. The change in the daily calorie should be a gradual Process, and not more than 500 calories/day.

HEALTHY EATING

Nutrition advice should be tailored to individual and take account of their age, Lifestyle, culture and personal circumstances. Between 80% to 90% of people with Type 2 DM are overweight and so the majority require dietary advice for achieving weight loss, to include calorie restriction. In generally, high fat intake ( especially saturated fats ) is associated with a raised HbA1c but it is unclear. How the type and amount of fat influence post- prandial glucose control. Reduction of calorie intake and weight loss should be the major goals.

Some evidence for the Mediterranean diet, low carbohydrates diets and meal management replacement is emerging. Weight loss is overweight and obese individuals with diabetes markedly improves glycaemic control and show diabetes progression.

DIETARY RECOMMENDATIONS

MACRONUTRIENTS

1.CARBOHYDRATES

While it is recognized that the total amount of carbohydrates is the major determinants of postprandial glucose. Current U.K government Food Standards Agency Recommendations are that the total carbohydrates intake should be no. >50% of energy, and of this non milk extrinsic sugar ( example : table sugar honey, sugar, fructose sugars ) should not be more than 11%. Low glycaemic index ( G.I. ) diets have shown to improve HbA1c but the literature concerning glycaemic index and glycaemic control mixed. The G.I. of a carbohydrates containing foods is a measure of the change in blood glucose observed following a liquid oral glucose tolerance test ( OGTT ).

Low G.I. foods such as starchy foods (Example: Basmati rice, spaghetti, porridge, noodles, granary bread, beans and lentils ) may reduced post-prandial glucose excursion.

Low carbohydrates diets may lead to significant reduction in body weight and improved Low carbohydrates diets may lead to significant reduction in body weight and improved glycaemic control in the short term, although high dropout rates and poor adherence have limited widespread application of their approach.

Emphasis on eating high protein foods (e.g., meat, fish, poultry, eggs, hard Cheese, and nuts). Preference of low-carbohydrate vegetables (e.g., green salad, asparagus, Broccoli, etc.) Limited consumption of fruits. Best Choices could be berries, grapefruit, And melon. Unrestricted consumption of fats (e.g., Butter, oils, mayonnaise, lard, fried Food). Avoiding starchy carbohydrate foods (bread, pasta, rice, oats, potatoes, etc.).Restricted consumption of dairy Products. Total exclusion of refined carbohydrate (e.g., sweets, biscuits, desserts, Chocolate, etc.).

2. FATS

Current U.K. government Food Standards Agency Recommendations are that intake of total fats should be not more than 35% of energy intake of which not more than 11% should consist polyunsaturated fats. Mediterranean diet rich in monounsaturated fats appears more beneficial. The influence of dietary fats on plasma lipid profile and cardiovascular diseases. In people with Type 2 diabetes mellitus, monounsaturated fatty acids ( MUFA ) rich cooking oil and nuts in moderation may benefits glycaemic control and CVD risk factor. MUFA rich oils like mustard, rice bran, peanut( groundnut ) and gingelly are good option.

Oils rich in n6 Polyunsaturated Fatty Acids ( PUFA ) like sunflower, safflower, cotton seeds should be mixed with oil in n3 like soya and mustard to maintain n6:n3 ratio 5-10% use of mixed oils or alternating of oils is recommended.

According to ICMR 2018 guidelines, Fat quality:

* Polyunsaturated Fatty Acids ( PUFA ) equal or more than 10% energy, n6: 3-7% energy, n3: > 1% energy, n6:n3 ratio 5-10% .
* Saturated Fats 10% energy and 7% in those with raised blood lipid levels.
* Monounsaturated Fatty Acids ( MUFA ) 10-15% energy with any calories left from the carbohydrates portion
* Trans Fats < 1% energy preferably totally avoided.

Foods containing high amounts of SFAs, TFAs, sugars, And salt are limited. Low-energy dense foods such as starchy carbohydrates (e.g., whole grains), fruits and vegetables are Recommended. But in practice it often includes high Amounts of low-fat processed foods. Preference for lean proteins and low-fat dairy products To reduce energy intake. Limited use of food high in fat and sugar (e.g., potato Chips, biscuits, oils, spreads, chocolate, etc.).

3. PROTEINS

There is no evidence that that adjusting the daily level of protein intake ( typically 1-1.5 g/kg body weight/day or 15-20% of total calories ) will improves health and research is Inconclusive regarding the ideal amount of dietary protein to optimize either glycaemic management or CVD risk.

Some research has found successful management of type 2 diabetes mellitus with meal plans including slightly higher level of protein ( 20-30%), which may contribute to Increased satiety.

Low protein eating plans were advised for individuals with diabetic kidney diseases ( DKD ) with albuminuria and reduced estimates glomerular filtration rate. Reducing the amount of dietary protein below the recommended daily allowance of 0.8 g/kg is not recommended because it does not alter glycaemic measures. Cardiovascular risk measures or the rate at which glomerular filtration rate declines and may increase risk for malnutrition.

Strong evidence suggest higher plant protein intake and replacement of animals protein with plant protein is associated with lower risk of all causes.

A meta-analysis of 13 RCT showing replacing animals with plant proteins leads to small improvement in HbA1c and fasting glucose and lower in saturated fats and support planetary health.

4. SALTS

People with diabetes should follow the advice given to the general population: namely, adults should limit their sodium intake to no more than 6 g daily. For person with hypertension and diabetes the intake should be reduced to less than 3 g/day. In hypertensive patients or oedematous patients with nephropathy, Sodium restriction is required. All preserved and processed foods such as pickles, chutneys, packaged namkeen/savouries, sauces should be restricted.

MICRONUTRIENT AND SUPPLEMENTS

Despite lack of evidence of benefits from dietary supplements, consumes continue to take them. Routine antioxidant supplementation ( such as vitamin C and E ) is not recommended Due to lack of evidence of efficacy and concern related to long term safety. Beta- carotene was associated with increased lung cancer and cardiovascular mortality risk. In addition, there is insufficient evidence to support the routine use herbal supplements and Micronutrients such cinnamon, curcumin, vitamin D, aloe Vera or chromium to improve glycaemic in people with diabetes.

ALCOHOL

The usage of alcohol is both welcomed as an effective substance in CVD patients and rejected for it caused harm in the same group of patients. Moderate alcohol intake with food does not influence long term blood glucose management in people with diabetes due to the fact that food helps absorb the alcohol into the metabolism more smoothly. People living with diabetes can adhere to the dietary recommendations for all healthy individuals as given in Dietary Guidelines for Americans 2020-2025. For alcohol consumption, risk includes hypoglycemia and delayed hypoglycemia, particularly in those who use insulin or insulin secretagogue therapy ,weight gain and hyperglycemia is a risk for those who consume too much alcohol. Cuts risks of alcohol related harms via drinking moderately exceeding 2 drinks a day for men or 1 drink a day for women ( one drink, for each man, is equal to 12-oz beer, 5-oz glass of wine, or 1.5oz of distilled spirit ). Research indicates that there may be a psychoeducation intervention which is aimed at increasing the knowledge of alcohol use and diabetes among the youth with Type 1 DM, thus leading to the perception of risk and in the end reduction of alcohol consumption.

FIBRES

Fibers recommendation for general population is 40 g/day ( 2000 kcals ), traditionally Indian diet that includes whole grains along with whole pulses like grams, soy, green leafy vegetables and some fruits is the recommendation. All fruits juices are best avoided.

WEIGHT MANAGEMENT AND DIETARY PATTERN

In patients with diabetes, weight management is important, as a high percentage of people with Type 2 diabetes are overweight or obese, and many antidiabetic drugs, including insulin, encourage weight gain. Obesity, particularly central Obesity with increased wait circumference, also predict insulin resistance and cardiovascular risk.

Weight loss can be achieved through a reduction in energy intake and an increase in energy expenditure through physical activity. Lifestyle Interventions or pharmacotherapy for Obesity, when associated with weight reduction, have beneficial effects on HbA1c, but long-term benefits in terms of glycaemic control and microvascular disease have not been adequately assessed. More recently, bariatric surgery has been shown to induce marked weight loss in obese individuals with type 2 diabetes and this is often associated with significant improvement in HbA1c and withdrawal of or reduction in diabetes medication.

Classification of the World Healthy Organization (WHO) and International Obesity Task Force. Reference range of BMI( weight in kg/height m sq.) is 18.5-24.9. The Western Pacific Region Office of WHO recommends that, among Asians, BMI >23.0 is overweight and >25.0 is obese. Lower cut- off for waist circumference have also been proposed for Asians but have not been validated. When BMI is >35 kg/m Sq., waist circumference does not add to the increased risk.

Mediterranean diet Rich in Monounsaturated Fatty Acids (MUFAs) and Polyunsaturated Fatty Acids (PUFAs), low in Saturated Fatty Acids (SFAs). Consistent evidence showing associations with reduced Coronary heart diseases, improved Cardiovascular risk factors, and inverse Relationships with the incidence of various chronic Non communicable diseases and all-cause mortality. Similar weight-loss compared to low-fat and low-Carbohydrate diets. Long-term adherence more possible due to the fact that It is varied, tasty, and with many flavor’s. In non-Mediterranean countries the consumption of Olive oil and wine is not usual.



CONCLUSION

Type 2 diabetes (T2DM) is a major metabolic disease that is largely influenced by insulin resistance and abnormal insulin secretion, where the dysfunction in the signaling induced from the insulin receptor in glucose metabolism is a major mechanism contributing to T2DM. Some of the molecules associated with the insulin-signaling pathway are targets for the prevention and intervention of T2DM. Growing evidence suggests an integrated role of nutrition in the development of T2DM, and the mechanisms of its actions can be explained, namely, from the viewpoints of five major nutrients: protein, carbohydrates, fat, vitamins, and minerals. The previous suggestions for the management of T2DM made from average of population; however, in the era of precision medicine, precision nutrition is increasingly important and relevant to T2DM. Both genetic predisposition and diet have a specific role in an individual’s risk of developing T2DM. Through modification of gene expression, epigenetic features, and gut microbiota, and thus differentiating an individual’s response to prevention and treatment, through adjusting dietary patterns. Nevertheless, precision nutrition remains at its early stages, and studies have not been comprehensive or are sometimes with contradictive conclusion, possibly due to the limited sample size, varied population, and unstandardized study design. In sum, nutrition takes big part in the prevention and intervention of T2DM, and precision nutrition offers promising future therapeutic strategies. Nonetheless, the optimal diet for T2DM is likely to vary between individual and may also depend on individual characteristics and preferences, and therefore personalized dietary advice and guidance is recommended.

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