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Role of Mediterranean Diet in Risk Reduction of Diabetes Mellitus and Associated Complications

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ABSTRACT

Diabetes is one of the prevalent diseases affecting around 540 million people which is expected to reach 783 million by 2045. Dietary factors play a major role in the prevention and management of diabetes and associated complications. Currently it is observed that increased HbA1c level increases the risk of diabetes and associated complications. It is found that proper diet management can improve elevated HbA1c level. High intake of soft drinks, fried foods, red meat, sweets, and white rice are directly correlated with increased risk of diabetes mellitus and associated complications whereas intake of vegetable and fruits highly rich in fiber and nutrients is associated with reduce risk of diabetes. So, Mediterranean dietary pattern can help diabetics as it is composed of fruits, vegetables, legumes, nuts, olive oil, MUFA, whole grains, fish, adequate consumption of red wine & fat dairy products and low intake of red meat, sugary beverages, butter & cream. Mediterranean dietary pattern has been studied by various researchers and they reported that Mediterranean diet could reduce the risk of diabetes by improving glycemic control, HbA1C, triglycerides and insulin resistance. According to various diabetes guidelines, diet management has paramount importance simultaneously with pharmacotherapy, but patients are not properly counselled by medical practitioners for nutritional interventions, and they are not aware about the importance of diet management in treatment of diabetes leading to increased risk of associated complications. There is a thrust need of awareness among the world's population for diet management. So, various government agencies, healthcare providers, and health facilities should take steps to aware population about diet related health consequences.

INTRODUCTION:

Diabetes mellitus (DM) is a combination of Greek word 'diabetes' and Latin word 'mellitus, means 'to pass through' and 'sweet' respectively. It is signalized by hyperglycemia. Type 2 diabetes mellitus (T2DM) is one of the most prevalent form of DM characterized by ineffective utilization of insulin. T2DM results from other diseases or due to drug intake and may lead to various associated complications. Among other diabetic complications, cardiovascular disorders (CVD) are the major cause of high mortality in diabetics [Einarson et al., 2018].

It is well known that diet holds a paramount importance in management of T2DM but till date most of the diabetic patient are not following diet regimen. Medical practitioners are not trained in

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nutritional interventions, so they fail to counsel the patient. Health practitioners, health care providers, agencies involved in diabetes care etc. should make the patient aware of the consequences of T2DM and the importance of diet. Moreover, there is no definite consensus revealing the most appropriate diet for the management of T2DM by controlling weight and hyperglycemia [Sami et al., 2017]. In this chapter, ongoing controversy over the dietary guidelines to manage T2DM and associated CVD with importance of diet regimen and patient awareness of T2DM complications will be discussed.

Epidemiology:

According to the International Diabetes Federation, globally 540 million people in the age group of 20-79 are affected with DM which is predicted to reach 643 and 783 million by the year 2030 and 2045 respectively. T2DM is one of the most prevalent types of DM. Studies have reported that T2DM are specifically more prominent in Navajo, Canadian First Nation people, Pima, Asian and Afro-Americans. In 2021, it is reported that prevalence of diabetes is higher in urban region than rural region as 360 million and 176.6 million individuals suffered from diabetes in urban and rural region respectively. Additionally, Prevalence of T2DM is driven by economic development and urbanization as these changes in the society promotes sedentary lifestyle, unhealthy eating resulting into obesity. Moreover, obesity increases the risk of T2DM in children and young people. Current statistic report of IDF revealed that around 6.7 million adults in the age group of 20-79 have died due to DM and associated complications [IDF diabetes atlas, 2021; IDF annual report, 2022].

Diabetes Associated Complications:

Diabetes leads to various life-threatening complications like vasculopathy, retinopathy, neuropathy, and nephropathy. High blood glucose damages the vascular system and affects the various vital organs like heart, kidney, and endothelium [DeFronzo et al., 2015]. Microvascular and macrovascular complications are the major associated complications of diabetes at chronic level. Acute complications are common in Type 1 Diabetes Mellitus (T1DM) but found rarely in T2DM. The sub-optimal control of blood glucose level leads to building up of ketone bodies resulting into a condition called diabetic ketoacidosis (DKA). People with diabetes may suffer with diabetic eye complications including diabetic macular oedema (DMO), diabetic retinopathy (DR), cataract and glaucoma. Despite being preventable and treatable it is found that DR is the leading cause of blindness in most of the countries. Diabetes or other associated conditions may also lead to chronic kidney disease (CKD). Globally, it is found that 80% of cases of end

stage renal disease (ESRD) attributed to diabetes or diabetes associated hypertension or hypertension. Moreover, diabetes whole solely responsible for 10-67% of ESRD. Prevention of diabetes or early diagnosis of CKD may reduce its impact and possible to treat. Diabetic neuropathy is another major fatal complication which results to nerve damage and impairment in autonomic, sensory, and motor functions. In addition, peripheral neuropathy is most common diabetic neuropathy affecting distal nerves of the limbs. Neuropathic patients experience lack of sensation allowing injuries neglected resulting into ulceration (diabetic foot), serious infection even sometimes amputation. It is estimated that lower limb amputation is 10-20 times more common in diabetic compared to non-diabetic [IDF diabetes atlas, 2021]. In addition, diabetic patients lose their lower limb to amputation every 30 second. According to the reports, annually 2% of global diabetic population suffer from foot ulceration and amputation [Zhang et al., 2017]. Cardiovascular disorder (CVD) is the most prevalent diabetes associated disorder. Type 2 diabetic patients are at four times higher risk of developing cardiovascular disorder than non- diabetic [IDF diabetes atlas, 2017]. Most frequently occurring diabetes associated CVD are peripheral artery disease, coronary heart disease, congestive heart failure and cerebrovascular disease. Hyperglycemia increases the risk of CVD through insulin resistance, endothelial dysfunction, inflammation and harmful effect of glucose on microvasculature [IDF diabetes atlas, 2021]. Approach towards awareness for intake of healthy diet can prevent and manage the T2DM. Thus, reducing the risk of diabetes associated with CVD.

Nutrition Transition: A driving force for towering prevalence of diabetes:

The world has experienced notable shift in dietary pattern, body composition, physical activity and incidence of diabetes and complications. Nutrition transition is one of the contributors for these shifts and is associated with change in lifestyle and dietary behavior [Popkin, 2015]. Asian countries, South America, sub-Saharan Africa experiencing rapid nutrition transition characterized by high intake of fast foods, refined food and sugar and thus resulting into high prevalence of T2DM [Forouhi et al., 2018; Zheng et al., 2018].

Critical factors that brought drastic change in lifestyle and dietary pattern are: the *first* is technology, introduction of labor-saving equipment in the market led to the promotion of sedentary lifestyle resulting in high prevalence of obesity. Equipment for household work like grinders and microwaves also increases the ease of household with reduced physical activity. Technologies

including wheels, trains, radio, mobile phones, robotics, etc. promotes sedentary lifestyle and dietary behavior. The second one is *urbanization*, notably urbanization is increasing exponentially from few past decades, and it increased the availability of variety of foods. Global urbanization and environmental changes lead to the increased accessibility to the unhealthy food. Exponentially growing fast food restaurant have led to drastic changes in the dietary pattern and increased consumption of processed meat, high calorie food, sugary beverages, unhealthy fats and highly refined carbohydrates. The third one is *increased income per capita*, this increment ease the accessibility of fast food to population and they tend to spend small proportion of income on variety of processed food. Globally, packaged food has becoming more popular day by day and thus promoting incidence of diabetes. The fourth one is remarkable *expansion of global trade* results into the introduction of modern technologies and services.

Another characteristic of nutrition transition is epidemiological transition, United Nations Food and Agriculture Organization stats that mostly Asian countries are affected by epidemiological transition have experienced livestock revolution resulting into increased consumption of pork, beef, dairy products, poultry and egg. Refinement of whole grains such as refined wheat flour and white rice by milling and processing reduces its nutritional components [Ley et al., 2014; Popkin, 2015]. Nutrition transition has led to increased body weight among the global population thus increasing prevalence of diabetes and complications.

Importance of diet management in T2DM and associated complications:

It is well known that diabetes and associated complications are rising at alarming rate despite of available oral hypoglycemic agent and insulin therapy. There is a thrust need to manage the T2DM with lifestyle changes and diet to prevent T2DM associated complications. Diet act as the cornerstone in the prevention and treatment of T2DM and complications [Sami et al, 2017]. As study involving 188 countries stats that unhealthy diet is a major contributor to morbidity and mortality [Forouhi et al, 2018].

According to the studies it is found that nutrition transition and sedentary lifestyle lead to increased body mass index (BMI) and waist circumference. Additionally, higher waist circumference holds slightly stronger risk to develop diabetes as compare to BMI. Obesity is independent risk factor for T2DM and associated cardiovascular disorders. Lifestyle modification with calorie restriction and increased physical activity led to reduced risk of developing

diabetes in high-risk patient with impaired glycemic control by 58% [Knowler, 2002]. Several studies suggested the lifestyle changes and nutritional intervention for the preliminary treatment of dyslipidemia [Sami et al, 2017].

Mahoney SE, suggested that consumption of flavonoid enrich vegetables and fruits like apples, berries, citrus fruits and leafy green can improve blood glucose level, reduce inflammation and probability of diabetic retinopathy [Mahoney et al., 2014]. American Diabetes Association (ADA) suggested that specific diet might not prevent diabetes but different dietary pattern would moderately manage it [Maiorino et al., 2017]. Healthy dietary pattern includes mainly plant-based food components rather than processed food. Moreover, it is well known that intake of healthy diet along with proper dietary pattern reduces the risk of obesity thus reducing the possibility of T2DM and associated complications.

Different types of diet recommendation in diabetes: from ancient to modern times:

Diet management holds a paramount importance in management of diabetes. So, from ancient times dietary recommendations is provided to diabetes patients. Aretaus, ancient Greek physician described the diabetes as “the melting down of flesh and limbs into urine”. The word diabetes originated from Greek word ‘diabaino’ that means ‘to go’ or ‘to run through’ as one of the symptoms of diabetes is polyuria [Laios et al., 2012]. The first dietary treatment was found by Ebers Papyrus in 1550 BC. It recommended the intake of food rich in carbohydrates including grapes, berries, honey, wheat and grains [Wheeler, 2000]. Galen (AD 128–200), used to treat the diabetes by a diet made from ‘sundried membrane of young roosters’ abdomen’ or drinks that is a combination of dry acorn, mountain copper, honey of roses, flower of wild pomegranate, oak gall and cold water [Christopoulou-Aletra et al., 2008]. At the time of Avicenna, a Persian physician, diabetes was thought as a kidney disease so most of its remedies targeted to reduce water loss through urine. Therefore, Avicenna recommended an intake of diet rich in zedoary, lupin and fenugreek these were considered to reduce the excretion of sugar through urine [Lasker et al., 2010]. In the 17th century Thomas Willis, advocated a diet including milk and water boiled barley with bread [Dukan, 2011]. In 1799, John Rollo assigned 1500 calorie diet to two of his diabetic patients. This diet contains rancid meat and blood pudding that was high in protein, fat and low in carbohydrates. Therefore, he became the first person to establish the association between low calorie intake and reduced diabetes symptom [Day & Bailey, 2012].

In the 20th century, Frederick Madison Allen recommended a very low-calorie diet and it was called as starvation diet. Starvation diet was low in carbohydrates and high in protein & fat for the diabetes [Gale, 2001]. However, later it was observed that starvation diet resulting into hypoglycemia, lack of energy and retarded children growth. After the discovery of insulin, doctors started to recommend diets without restriction on carbohydrate content. After some years, a higher mortality rate in children was observed due to cardiovascular and metabolic complications [Sawyer & Gale, 2009]. In 1940, ADA suggested to reduce the intake of carbohydrate content to 40% in a diet to maintain glycemic control [Kim, 2011]. In 1970, ADA recommended the intake of individualized diet, and this endorsement was amended in 1980. This amendment by ADA suggested the addition of refined sugar and low amount of sucrose in diet [Khazrai et al., 2014]. Now, almost all the dietary guidelines for diabetes recommend prevention of sedentary lifestyle and weight gain.

Trending diets for the management of diabetes

Low carbohydrates and ketogenic diet:

A ketogenic diet is comprised of very low carbohydrates, moderate protein, and high fats. Low carbohydrate and ketogenic diet are always controversial among the doctors and researchers because of low carbohydrates. Carbohydrates is a macronutrient, and it elevates blood glucose level however low carbohydrate diet in diabetic patients might lead to hypoglycemia especially in those who are administered with insulin therefore modification in treatment is required prior to low carbohydrate and ketogenic diet [Gupta et al., 2017]. According to ADA 45% of total calories ought to come from carbohydrates which means one person should consume 30-60g of carbohydrates per meal and 15-30g carbohydrates from snacks [ADA, 2009]. Consumption of low carbohydrate diet within a recommended range showed to improve diabetes. Clinical trials showed that low carbohydrate diet has significantly reduced excess body weight and improved lipid profile (high density lipoprotein (HDL), triglycerides, cholesterol) but not low-density lipoprotein (LDL) and glucose metabolism. These findings came during a time when the generally accepted beliefs about the negative effects of fat intake are beginning to shift. However, these findings supported the fact that intake of dietary fats are not alone responsible for any type of health condition, but it also depends on other types of diet [Mansoor, et., 2016, Meng et al., 2017, Nielsen et al., 2008]. Feinman and his colleagues found twelve different strong evidence proving that intake of low carbohydrate diet could be a first line treatment for diabetes. These results were supported by scientific

explanations, and authors has also claimed that effects of low carbs can be seen even without weight reduction as they have personally observed during their clinical practice [Feinman et al., 2015]. Usage of low carbohydrate diet in patients who are on several medications/ insulin or have co-morbidities should be guided by specialist dietician and experienced health care professionals. Restriction of carbohydrates in diet initiates a state in body known as ketogenesis. As a result, ketone bodies will be produced that can be used as an alternative fuel source. The more you restrict the carbohydrate in diet the more ketone bodies will be produce. However, intake of more than 50 gms of carbohydrates in a day is not sufficient to trigger significant ketone bodies production in most people. Low carbohydrate and ketogenic diet in general are not exact same term but they overlap sometime. Low carbohydrate diet means a reduction in carbohydrate intake compared to a standard diet. While ketogenic diet is a specific type of diet in which reduced intake of carbohydrate leads to ketogenesis in which body will use generated ketone for energy instead of carbohydrates. Therefore, all ketogenic diets are low carbohydrate diet, but all low carbohydrate diets are not ketogenic in nature [Hallberg et al., 2019]. Ketogenic diet leads to production of ketone bodies mainly acetoacetate, acetone and β -hydroxybutyrate and regulates blood glucose level. Therefore, mitochondria of cells can fulfil their energy demand through ketone bodies including muscle and brain [Paoli, 2014]. Furthermore, scientific studies suggests that β -hydroxybutyrate, functions as a signalling molecule and could potentially contribute to appetite suppression [Adam-Perrot, 2006]. Study involving T2DM patients showed that ketogenic diet has significantly improved blood glucose level and HbA1C. However, it is advisable to diabetic patients that they should consult health care professionals prior switching to low carbs and ketogenic diet [Hussain et al., 2012].

Vegan (plant based) diet:

A vegan diet consists of plant-based foods such as vegetables, legumes, nuts, whole grains, and fruits. It excludes eggs and dairy products, distinguishing it from a vegetarian diet. Randomized trials have demonstrated that low fat vegan diet has significantly improved blood lipid concentration, glycemic control, and body weight in comparison to conventional diet which includes intake of animal products. Additionally vegan diet also showed to reduce HbA1c in diabetic patients. The observed improvements in blood lipid concentrations, glycemic control, and body weight on vegan diet may be attributed to several factors. Individuals who follow a vegan diet tend to consume lower calories, fat, and cholesterol. In-addition, they consume higher amounts of dietary fiber, vitamin C and

potassium [Barnard et al., 2009]. According to the studies it was observed that adherence to plant-based diet with exercise improves diabetes with minimal requirement of treatment but the association between the two is underexplored [Trapp et al., 2012]. To reach a definitive conclusion on this matter, further research is necessary, incorporating longer follow-up periods and larger sample sizes. Additionally, more research is required to explore the connections between specific commonly consumed foods in world and glycemic control. This would provide a more comprehensive understanding of the impact of dietary choices on blood glucose control.

Mediterranean diet: A miracle to diabetes epidemic:

In 1960 Ancel Keys postulated Mediterranean diet that is well studied dietary pattern and is characterized by high intake of fruits, vegetables, legumes, nuts, olive oil, MUFA, whole grains, fish, adequate consumption of red wine & fat dairy products and low intake of red meat, sugary beverages, butter & cream as shown in figure 1. Mediterranean dietary pattern reflects the traditional eating behavior of countries around Mediterranean Sea mainly South Italy and Greece back in 1960 and it is found to resemble healthy dietary patterns like vegetarian diet as it is comprised of plant-based food, high consumption of whole grain, vegetables, and fruits. Currently Mediterranean diet is found to improve glycemic control and diabetes associated cardiovascular risk factors. A meta-analysis reported that adherence to Mediterranean diet reduced the risk of T2DM by 19% [Guasch-Ferré et al., 2017, Schwingshackl et al., 2015]. Meta-analysis of 10 research studies involving 136,846 subjects reported that higher adherence to Mediterranean diet pattern reduces the risk of prevalence of diabetes by 23% [Kolooverou et al., 2014]. American Heart Association (AHA) and ADA stats that Mediterranean diet can improve glycemic control and associated cardiovascular complications in diabetic patients [Fox et al., 2015]. A Study was carried involving 101,504 post-menopausal women observed for 15 years and total 10,815 cases were found to suffered from diabetes. Moreover, it was observed that higher adherence to Mediterranean diet lowers the risk of diabetes as compared to lower adherence to Mediterranean diet by 15% [Cespedes et al., 2016].

Four different meta-analysis involving T2DM diabetic patients observed that Mediterranean diet reduce the level of glycosylated hemoglobin A1c(HbA1c) by 0.30–0.47 % when compared to control diet [Ajala et al., 2013; Carter et al., 2014; Esposito et al., 2015; Huo et al., 2015]. A study was carried including 259 T2DM patients with 31kg/m²

mean body mass index (BMI). These subjects were randomly assigned to either traditional Mediterranean diet (TM) or low carbohydrate Mediterranean diet (LCM) or ADA diet for 12 months. After 12 months, 10.1, 7.4 & 7.7 kg weight reduction was observed respective to LCM, TM & ADA diet. The levels of HbA1c and triglycerides was found to be significantly greater in LCM than ADA diet. It is to be noted that the HDL was measured to be increased only in the patients adhered to LCM diet [Elhayany A et al, 2010].

Shai et al conducted the clinical trial on diabetic patients and were randomly assigned to Mediterranean diet or low-fat diet followed by 24 months observation. At the completion of the study, a reduced HOMA-IR index was found in patient assigned to Mediterranean diet as compared to low-fat diet [Shai I et al., 2008]. Additionally, similar results were found in a different clinical trial conducted for 12 months on 215 newly diagnosed T2DM patients [Esposito et al., 2009]. Therefore, Adherence to Mediterranean diet holds an inverse relationship with insulin resistance. Moreover, Mediterranean diet includes olive oil and oily fish including sardines that lead to increased adiponectin that might be responsible for insulin sensitivity [khazrai et al., 2014].

Undoubtedly, escalated total cholesterol & reduced HDL in T2DM patients increases the risk of developing cardiovascular disorder. Moreover, Mediterranean diet found to improve total cholesterol and HDL level. Therefore, Mediterranean diet might help in reducing the risk of cardiovascular disorder [Esposito et al., 2015]. several studies reported the pivotal role of Mediterranean diet in prevention of T2DM associated microvascular and macrovascular complications [Díaz-López et al., 2015]. Thus, Mediterranean dietary pattern might work as miracle to T2DM patients due to presence of its nutritional characteristics if it is followed by exercise (figure 2).

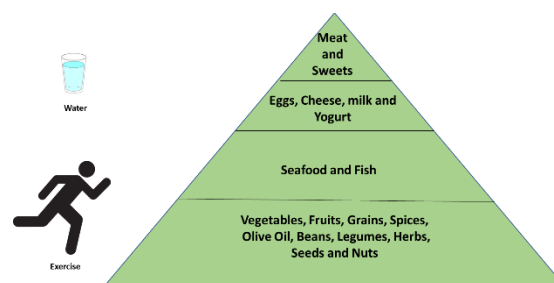


Figure 1: Mediterranean diet pyramid

Mediterranean diet is not just a diet: It's a holistic lifestyle approach:

The term “diet” often makes the people to drop without giving a start as it comes with negative connotations. Popularly the diet involves restriction

or elimination of entire food groups such as fats, carbohydrates, or dairy products. Additionally, it also restricts amount of calorie intake. This may tend to discourage people from starting or committing to a diet management plan. Unlike other diets, Mediterranean diet is not just it should be embraced as way of life [Dernini 2011]. Mediterranean encourages fresh and seasonal cooking with use of extra virgin olive oil. It not only emphasizes the fresh eating but also direct people to socialize with others. Contrary to quick frozen meal that is prepared in microwave and eating it alone while watching television. Mediterranean lifestyle encourages people to enjoy their meals in company of others, fostering a sense of community and connection. The first pyramid of Mediterranean diet was introduced in 1993 however it has undergone several changes during time while it stays close to the original concept or framework [D'Alessandro et al., 2014, Willett et al., 1995]. The Mediterranean diet has experienced a continuous rise in popularity, both in popular culture and the field of medicine.



Figure 2: Role of Mediterranean diet in risk reduction of diabetes

Patient's Awareness towards T2DM and Diet Management:

Diabetes patients are least aware of knowledge related diabetes and importance of diet in its management. It is must for the diabetes patients to have sufficient information related to diabetes for its management. A study was carried out to compare the two groups of diabetes patients i.e., a group having patients who have received diabetes education and other haven't received it. As the result, it was observed that group have received diabetes education are more aware about the diabetes and have better quality of life than another group [Magurová et al 2012]. A cross-sectional study reported that diabetes patients and normal population have insufficient knowledge and are not aware about the diabetes [Parimalakrishnan et al., 2015]. The other study carried out in India also reported that 63% of diabetic population don't know the DM and most of them are not aware of the diabetes associated complications [Shah et al., 2009].

Most of the times diabetes patients faces problem to decide their dietary pattern it might be due to controversies over the several diets or lack of knowledge. Several times diabetics are not sufficiently aware related to the importance of diet management. It is found that dietary knowledge plays imperative role in the selection of dietary pattern and in the management of T2DM [Sami et al 2020]. According to the study carried out in China, only 54.10% of diabetes population agree that balanced diet plays an important role in diabetes management [Jingran et al., 2015]. A study including 75 diabetes patients found that all of the patients were aware of importance of fruits and vegetables in their diet but 62.7% were not aware the quantity they required on regular basis. About 50% of them were not informed of the three types of fat, 42.7% were not aware about the importance of carbohydrate in diet and 21.3% were not aware of carbohydrate sources [Kiren et al., 2017].

Strategies to educate T2DM population to improve adherence to diet management:

There are numerous benefits of diet management for the prevention and management of T2DM. As, it is reported in several studies that T2DM patients are least aware to the importance of diet management so it is crucial to take a step to educate such patients to prevent health risk involve with T2DM.

Strategy 1: Dietary recommendation should reach every T2DM and prediabetic patient:

To attain this goal, a meeting should be conducted between representatives of national groups. In this type of meeting, similarities between different dietary guidelines recommended for diabetes and different educational initiatives should be explored. A committee involving various leading authors and publishers should be assembled to develop the broad dietary guidelines and information related to diet and diabetes for T2DM patients. The Prepared guidelines and information could be transferred to leading publishers.

Strategy 2: Enhancing knowledge of T2DM patients through selection and preparation of food.:

The published dietary guidelines might not reach every patient through articles and books. So, there is a need to print the recommended dietary guidelines in a manual. These manuals not only help the vendors to make the availability of food included in the dietary guidelines, but these manuals could be distributed among the people through the vendor. The other way to make these manuals available to large diabetic population they could be uploaded too social medial. Different versions of these manuals should be prepared to target diverse diabetic populations. Inexpensive food data banks displaying

the full information of food content, its source and processing would be developed and made available at supermarket and other places so that if patient is interested to know about the source and processing of food then he/she might have it through these food data bank.

Strategy 3: Establishing the programme by professional organizations to educate diabetic population.

Various professional organizations should actively take part in educating the diabetic population. These organizations should organize camps targeting the diabetic population at different locations. Through these camps, information regarding the importance of dietary pattern and its recommendation should be conveyed to the patients.

[Institute of Medicine (US) Committee on Dietary Guidelines Implementation; Thomas PR, 1991]

The above discussed strategies might help the diabetes patients to get more aware about the importance of dietary pattern and guidelines. These approaches might lead to the reduced risk of diabetes and related complications.

DISCUSSION:

It is well known that diabetes and associated complications are rising at alarming rate despite of available oral hypoglycemic agent and insulin therapy. Obesity and sedentary lifestyle are most prominent factors leading to the high risk of diabetes and associated complications. Moreover, Nutrition transition is one of the contributor to these factors [Popkin, 2015]. The four critical factors led to the drastic change in lifestyle and dietary pattern includes technology, urbanization, increased income per capita and expansion of global trade [Ley et al., 2014; Popkin, 2015]. These drastic changes due to nutrition transition need to be managed through appropriate dietary pattern and physical activity.

Diet management holds the paramount importance in the prevention and management of T2DM and complications [Sami et al, 2017]. According to Knowler, Lifestyle modification with calorie restriction and increased physical activity led to reduced risk of developing diabetes in high risk patient with impaired glycemic control by 58% [Knowler, 2002]. The ADA recommended that specific diet might not prevent the risk of diabetes but appropriate dietary pattern would manage it [Maiorino et al., 2017]. Several studies have reported the importance of diet management in the prevention and management of T2DM. Recently, several studies reported the significant impact of Mediterranean diet on reducing the risk of T2DM and associated complications. Meta-analysis of 10

research studies involving 136,846 subjects reported that higher adherence to Mediterranean diet pattern reduces the risk of prevalence of diabetes by 23% [Kolooverou et al., 2014]. American Heart Association (AHA) and ADA stats that Mediterranean diet can improve glycemic control and associated cardiovascular complications in diabetic patients [Fox et al., 2015]. Some studies suggest that Mediterranean diet holds an inverse relationship with insulin resistance [Shai I et al., 2008; Esposito et al., 2009]. Mediterranean diet with low carbohydrate contents would be work as miracle for T2DM. In the ancient times, some of the physician has recommended specific diet in the treatment of T2DM but none of them talked about the importance of appropriate dietary pattern over specific diet.

As modern time arrives more of the physician started to concentrate on the diet and lifestyle modifications for the diabetes patients but least of the patients are aware about the importance of diet management [Parimalakrishnan et al., 2015]. Magurová et al, conducted observational study including diabetes patients who received the information regarding diabetes and who hasn't received it. It was notable, the group that has received education are more aware about the diabetes and managing the diabetes better by lifestyle and dietary modification than another group [Magurová et al 2012]. There is a thrust need to develop measures to educate the diabetic patients about the T2DM and diet management. These measures should be constructed in such a way that every information related to diabetes, diet and lifestyle modification should reach out to most of the diabetes population. Various strategies have been discussed in this chapter that would help the professionals to educate diabetic population and improve their quality of life.

CONCLUSION:

With several evidence, one could draw the conclusion that diet management plays an important role in reducing risk of T2DM and associated complications. It also recommended that specific diet might not prevent the risk of diabetes, but appropriate dietary pattern would manage it. So, Mediterranean dietary pattern has been studied by various researchers and they reported that Mediterranean diet could reduce the risk of diabetes by improving glycemic control, HbA1C, triglycerides and insulin resistance. However, it is notable that least people are aware about the importance of diet management and the type of food they should choose to eat. So, there is a thrust need to reach out to such people and educate them. Strong measures should be taken to spread awareness, and this is possible only when physicians and other health professionals interestingly take part in such strategies.

CONFLICT OF INTEREST:

The authors declared no conflict of interest.

AUTHOR'S CONTRIBUTIONS:

All the authors have contributed equally. Megha Sahu has analyzed the different research and review articles and thus wrote the manuscript. Dr. Mukesh Nandave helped in reviewing and edition of manuscript. All the authors approved the final version of manuscript.

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