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DIETARY MANAGEMENT OF TYPE 2 DIABETES

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Abstract:

Introduction: *Diabetes mellitus is considered to be one of the most important publish health issues over the world. It was estimated in the year 2017 that more than 425 million individuals were affected, and reports suggested that this number will become 629 million individuals by the year 2045. The most important risk factor for diabetes mellitus is unhealthy diet, with associated high mortality and morbidity in more than 185 countries around the world.*

Aim of the work: *we tried to understand the association of diet with type 2 diabetes mellitus and shed some light on the dietary management of this disease.*

Methodology: *we conducted this review using a comprehensive search of MEDLINE, PubMed and EMBASE from January 2001 to March 2017. The following search terms were used: diabetes mellitus type 2, management of diabetes mellitus, low carbohydrate diet, lifestyle modification for treatment of type 2 diabetes mellitus.*

Conclusion: *Many factors regarding diet have been studied including the composition of diets and the quality of food in them. Low carbohydrate diets have shown to be associated with best outcomes regarding prevention and treatment of diabetes mellitus type 2. However, the role of these diets remains controversial especially on the long-term basis. Therefore, studies are still needed to establish more solid evidence that can be used to form guidelines*

Keywords: *diabetes mellitus type 2, low-carbohydrate diet, healthy lifestyle*

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INTRODUCTION:

Diabetes mellitus is considered to be one of the most important publish health issues over the world. It was estimated in the year 2017 that more than 425 million individuals were affected, and reports suggested that this number will become 629 million individuals by the year 2045. This huge number of individuals with diabetes mellitus leads to annual social and economic huge burden on the societies and health systems. Therefore, it is necessary to establish new protocols that will slow or even revers this significant increase in diabetes incidence and prevalence. These protocols must focus on modifiable risk factors like increased weight, physical activity, and unhealthy diet [1].

The most important risk factor for diabetes mellitus is unhealthy diet, with associated high mortality and morbidity in more than 185 countries around the world. Therefore, the first step in managing diabetes and decreasing its burden, is to manage and improve nutritional intake of individuals, which will further reflect on their metabolism and weight gain. In this review we will discuss dietary managements and difficulties in this aspect [2].

METHODOLOGY:

- **Data Sources and Search terms**

We conducted this review using a comprehensive search of MEDLINE, PubMed and EMBASE, from January 2001 to March 2017. The following search terms were used: diabetes mellitus type 2, management of diabetes mellitus, low carbohydrate diet, lifestyle modification for treatment of type 2 diabetes mellitus

- **Data Extraction**

Two reviewers have independently reviewed the studies, abstracted data and disagreements were resolved by consensus. Studies were evaluated for quality and a review protocol was followed throughout.

Prevention of Diabetes through Dietary Modification

Weight Loss

Body mass index is a measurement that is used to determine the presence/absence of excess adipose tissue in the body. Higher body mass index has been associated with diabetes mellitus, with Asians being more susceptible and having lower thresholds for developing diabetes than Europeans. In addition, waist circumference is also associated with diabetes risk and is thought to be more strongly associated with diabetes than body mass index. Therefore, clinicians should continuously observe both the waist circumference and the body mass index. Increasing body mass index in early ages is also considered to be an independent risk factor that is associated with diabetes mellitus even in the presence of normal current body mass index and waist circumference [3].

The application of lifestyle modifications that involve restriction of calories intake, and increase in physical activity, led to a significant decline in the risk of diabetes development in susceptible patients [3].

Food Types

The consumption of certain types of food and drinks has been proven by multiple studies to decrease the risk of developing diabetes. For example, consumption of whole grains is significantly associated with lower incidence of diabetes, while consumption of white rice, and other processed grains is significantly associated with higher incidence of diabetes. This becomes of special importance in populations like Asians where white rice is considered to be the main food. Diabetes mellitus risk has also been shown to increase with the intake of red processed meat like sausages and bacon [4].

A meta-analysis on several prospective studies has concluded that risk of diabetes mellitus was not associated with the consumption of fish or other types of seafood. However, these results were different among different regions around the world. For example, in Asia, seafood consumption led to a decline in diabetes risk, whereas in North America seafood consumption led to an increase in diabetes risk. These disparities in the relationship between diabetes risk and seafood is not well-understood, but could be attributed to different fish types, methods of cooking, and pollution exposure of fish in different regions [5].

The overall vegetables and fruits intake were not correlated with the risk of developing diabetes. However, the intake of green vegetables rich in leaf led to significant reduction in the risk of developing diabetes. Lower risk of developing diabetes mellitus was also noticed in patients who consumed larger amounts of whole fruits [5].

Dairy products, especially yogurt, were found to correlate with less risk of developing diabetes. Nuts have also been found to decrease the risk of developing diabetes. This is thought to be due to their high content of PUFA and MUFA. However, evidence on this is not solid, and more larger and well-controlled studies are needed in this issue[6].

Carbohydrates

The relative proportion of carbohydrates to all diet has not been found to significantly influence the risk

of developing diabetes mellitus. On the other hand, some studies have suggested that the consumption of cereal fibers may be associated with lower diabetes risk. However, fruits fibers have not been found to have similar effects on reducing the risk of developing diabetes mellitus [7].

Beverages

Increased consumption of sweetened beverages has been strongly correlated with a higher incidence and risk of developing diabetes mellitus type 2, according to a large meta-analysis and a large European cohort study. These studies were able to prove that these beverages will significantly increase the risk of diabetes mellitus type 2, even after the adjustment of body mass index and other related factors. They were also able to prove that the intake of water, tea, and coffee were associated with decreased risk of diabetes mellitus [8].

The consumption of alcohol has been found to correlate with the development of diabetes mellitus. However, this correlation depended on the dose of consumption as lower doses protected against diabetes, but higher doses increased the risk of developing diabetes [9].

The consumption of coffee has also been found to reduce the risk of developing diabetes mellitus in a large meta-analysis that included date from 28 cohorts. This effects of coffee against diabetes were found to be dose-dependent, and were independent of caffeine index in the coffee, suggesting that caffeine itself did not play a role in protection against diabetes mellitus [8].

Dietary Management of Diabetes

Weight loss

It is currently established that lifestyle interventions that will decrease weight, is significantly associated with lower risk of developing diabetes mellitus. In several large studies, weight loss was associated with lower diabetes risk as well as improvements in depression, sleep apnea, urinary incontinence, and overall quality of life. Moreover, this weight loss led also to a reduction the risk of developing cardiovascular events [10].

In individuals where it is difficult (or impossible) to control weight and other comorbidities with simple lifestyle changes, clinicians should consider metabolic surgeries and bariatric surgeries. This applies mostly in individuals who have a body mass index that is higher than $35kg/m^2$ In this subpopulation, a recent meta-analysis has shown that surgery led to improved significant loss of weight and decreased risk of diabetes when compared to other non-surgical interventions. Moreover, patients who underwent surgery had a significant reduction in the rates of developing cardiovascular diseases following the surgery, when compared to patients who only received pharmacological interventions [11].

Dietary patterns

Current evidence supports the intake of food types that include fruits, legumes, vegetables, whole grains, yoghurt, and nuts. Dairy products other than yoghurt can also be beneficial but should be consumed with caution. However, some experts sill recommend against the large intake of fruits, legumes, and whole grains, because of their sugar content. Debates are still ongoing on the intake of fruits specifically[10].

Concerns are also present on the intake of nuts, as despite their proven benefits in decreasing the risk of developing diabetes mellitus, they till have high calories and large content of energy. Therefore, more studies are required on both nuts and fruits intake to establish solid evidence on their association with diabetes mellitus [10].

Optimal macronutrient composition

The control of diet and nutrients within diet is considered to be the single most important intervention in the battle against diabetes mellitus type 2. The European guidelines, for example, recommend that of total diet intake, about 60% are carbohydrates, 20% are proteins, and the remaining are fat. However, the more recent guidelines published by the American Diabetes Association have recommended that no certain regimen can work for all people, and individuals should follow diet regimens that are tailored to their current status and needs. Generally, the regimen that is associated with best outcomes consists of low carbohydrates intake, and low fats intake [12].

In general, when considering any regimen that includes different composition of macronutrients, there are three points that must always be taken into consideration. The first point is that most trials conclude that the decreased intake of carbohydrates is more important than the decreased intake of fat when discussing the risk of diabetes mellitus, although both regimens are associated with similar effects on weight. The second point is that when considering any regimen with any composition of macronutrients, the duration of applying this regimen and the adherence level to this regimen must be considered as both factors could significantly affect the success of this regimen. The third point is that regardless of the

regimen and its composition, the quality of both carbohydrates and fat, along with other compositions, is important and can significantly affect outcomes [13].

The presence of different diet approaches that are composed of different macronutrients and have different definitions has made research on diabetes prevention and treatment more complicated. For example, the term 'low carbohydrates' can range from the intake of daily 4% of carbohydrates to daily 40%. This is similar in fats and proteins intake. Therefore, the best approach currently in the management and prevention of diabetes is to establish diet regimens based on individuals' assessment, and focus on the duration of the regimen, adherence to the regimen, and quality of food included [13].

Oils

The possible benefits or harms from different types of oil remain unclear with no solid evidence supporting results on them. This includes coconut oil and palm oil where no clear results and recommendations are present. However, more common types of oil like virgin olive oil has been proven to be associated with significant improvements in the risk of diabetes mellitus type 2, and in the management and treatment of the disease. Moreover, virgin olive oil has been found to also decrease the risk of developing cardiovascular events along with other diseases [14].

Vitamin and mineral supplementation

No current recommendations support the use of mineral supplementations and vitamin supplementations in diabetes patients or any individuals unless they already have deficiencies. However, diabetic patients should still be counseled on the importance and roles of minerals and vitamins. Moreover, they should be encouraged to obtain balanced diet that includes a variety of nutritional supplements. This is because diabetic patients are already vulnerable to nutritional deficiencies, especially when diabetes is poorly controlled. Specific vitamins and minerals supplements are recommended in selected diabetic populations including pregnant females and elderly patients [12].

Foods to avoid

More evidence is present that emphasize on avoiding read meat, white rice, refined grains, sweetened drinks, and other sugary products, in order to reduce the risk of developing diabetes mellitus type 2.

However, debates regarding this issue are still present. For example, evidence present on the potential harmful effects of read meat remains weak to make strong conclusions. Therefore, further larger and better-controlled studies are needed to create more solid evidence [4].

The quality of consumed carbohydrates should also be considered when determining carbohydrates consumption. For example, refined grains and refined fibers are not recommended while whole fibers and whole grains are associated with less diabetes risk. Generally, risk of diabetes mellitus increases as the glycemic index of the food increase, making foods with lower glycemic index more favorable [15].

However, debates are still ongoing regardless the significance of these factors in affecting the risk of diabetes mellitus type 2. Some guidelines discuss the reduction of sodium and trans-fats intake, with the assumption that these can not only affect diabetes risk, but also cardiovascular diseases risk. More research is needed in this area before reaching any solid conclusions on which established recommendations can be made [16].

Alcohol

The consumption of alcohol in moderate amounts have been found to be associated with lower risk of developing diabetes mellitus and improved insulin sensitivity. Moreover, few studies have also claimed that moderate consumption of alcohol could be associated with lower risks o of developing cardiovascular events, especially in diabetic patients. However, this remain a controversial issue as evidence on favorable effects of alcohol is not solid, and alcohol has many other harms that outweigh its possible benefits. In fact, it is considered to be one of the most important causes of morbidities and mortality around the world [9].

Reversing Type 2 Diabetes through Diet

Previously, clinicians used to think the diabetes mellitus type 2 was an irreversible disease that will inevitably progress following diagnosis. However, recent advances show a great potential for diabetes remission. When discussing diabetes mellitus type 2, the term 'remission' is used to describe a state where the levels of glucose in the patient become lower than the levels required to diagnose diabetes, without the use of hypoglycemic pharmacological agents, and for a certain duration that is at least a year. Factors that can positively or negatively affect remission remain to be of debate [17].

Low Calorie Diet

The intakes of a diet with low calories have been associated with improved outcomes in diabetic patients. A previous study has concluded that after 7 days of using a diet with low caloric index, glucose levels in the plasma returned to normal baseline values, despite the cessation of oral hypoglycemic agents. Moreover, after about 8 weeks of following the same diet, insulin secretion that is stimulated by glucose returned to baseline levels. However, it was still unclear if these outcomes were a result of the restriction of caloric intake, or the quality or the composition of the new diet [18].

Other studies have been conducted to assess the long-term effects of following such diets. In a previous study, these effects were shown to last as long as 6 months following the application of the new diet. In addition, researchers found the rate of diabetes remission was significantly associated with the duration of the disease and decreased in patients with diabetes for longer durations. A more recent study that was performed in the UK has concluded that up to half diabetic patients were able to achieve remission that lasted for over a year, when they followed a strict low-caloric diet. This study is planned to continue, and results will be published after four years of follow up. However, one important limitation to these kinds of diets is the poor compliance, as these diets are hard to follow especially for long-terms [19].

Another significant concern is the ability of this low-caloric diet to decrease and prevent complications associated with diabetes, rather than just cause remission to the diabetes itself. Evidence on this specific issue is absent, but primitive results are promising. For example, many studies have established that a remission from diabetes mellitus type 2 will lead to significant declines in the risk of developing cardiovascular events. Moreover, the risk of diabetic foot that led to amputation was also reduced following two years of following a diet with low calories. This was also associated with decreased pain from the neuropathy. Progressions of complications of the retina were also found to stop when patients follow these diets. However, some complications were found to worsen or progress when the patient has a sudden normalization of glucose levels. These include maculopathy which has been found to worsen in patients whose diabetes improved suddenly. Therefore, it is recommended that diabetic patients, who start a diet with low calories, perform routine images of the retina for at least six months following the initiation of this diet [20].

Low Carbohydrate Diet

The reduction of intake of carbohydrates used to be considered the main and only line of treatment of diabetes mellitus type 2 before the introduction and development of therapeutic insulin. However, despite the use of insulin and other pharmacological agents in reducing glucose levels and controlling hyperglycemia, the restriction of carbohydrates remain to be an potential line of management and treatment. The reason behind this importance, is the large role of carbohydrates on insulin and glucose levels [15].

The American Diabetes Associated performed a thorough systematic review on studies that assessed low carbohydrate diets and their effects on diabetes mellitus type 2 management. They found that most studies concluded that low carbohydrate diets will significantly improved HbA1c levels, when compared to other diets (including diets with low fats). Moreover, these diets were associated with a significantly less need to use hypoglycemic pharmacological agents [15].

With regarding glycemic control, also varying evidence exists regarding low carbohydrates diet and diabetes mellitus type 2. Some studies have revealed that when it comes to glycemic control, diets with low carbohydrates achieve the most favorable outcomes compared to other types of diets. The effects of a low-carbohydrates diet in controlling hyper glycemia was found to be dose-dependent, with more strict diets achieving better control of hyperglycemia. However, debates are still ongoing regarding the long-term effects of low-carbohydrates diet on glycemic control, as some claim that these effects are only short-termed. Solid evidence to reach a conclusion in this issue is not present, as most studies focus mainly on the effects of weight loss on glycemic control [21].

Another important concern in following diets with low carbohydrates is that the effects of these diets on the cardiovascular systems. The problem is that in such diets, compensation of low carbohydrates usually comes by increasing the levels of fat in the diet, especially saturated fats. This has been a huge concern for the effects of these diets on developing cardiovascular diseases on the long-term. However, most studies have found that after following a low-carbohydrates diet, lipid markers have also improved, including cholesterol and triglycerides levels [22].

In addition, current evidence suggests that following a diet with low intake of carbohydrates can decrease the levels of LDL particles. However, it is still

essential to continuously monitor LDL levels in all patients who follow a diet with low carbohydrates, as there have been some reports of cases who paradoxically developed increases in LDL levels [23].

Finally, a diet with low carbohydrates will place patients at a higher risk of developing hypoglycemia attacks. Therefore, patients who follow such diets must be well informed of the importance of strictly following their glucose blood levels and should be taught how to prevent a hypoglycemic attack from happening. In addition, the use of hypoglycemic agents should be tailored to suit the new diet. The most important thing in a low-carbohydrates diet is the achievement and maintenance of refined sugars restriction. Whole grains and fibers can still be consumed in small amounts [22].

Patient Education

Evidence on the effects of nutritional therapies in the prevention and management of diabetes mellitus type 2 has been present with many large studies. However, achieving optimal outcomes is still considered challenging due to many factors related to the disease and the patients. Generally, most guidelines on the management of diabetic patients recommend the initiation of management through improved lifestyle and modifying diets. This will be then following by the administration of hypoglycemic pharmacological agents. However, in real clinical practice, many clinicians do not follow these guidelines, and start immediately with pharmacological agents. The main reason behind this is lack of sufficient knowledge of this issue among clinicians. Another reason is that many clinicians find this to be time consuming and requiring longer time in teaching the patients and following them. An approach to resolve this issue is the establishment of specialized centers where patients can find nutritionists who are specialized in dealing with diabetic patients. However, these centers require many resources, and cannot be established in poor settings. Therefore, the best approach will become in these cases, to raise the awareness of clinicians toward the importance of lifestyle modifications and diet changes in the management of diabetic patients [16].

CONCLUSION:

During the last twenty years, many studies have been conducted to study different lifestyle modifications and their effects on the prevention and treatment of diabetes mellitus type 2. These studies have shown significant beneficial effects of physical activity and diet changes in patients with diabetes mellitus type 2. Many factors regarding diet have been studied including the composition of diets and the quality of food in them. Low carbohydrate diets have shown to be associated with best outcomes regarding prevention and treatment of diabetes mellitus type 2. However, the roles of these dets remain controversial especially on the long-term basis. Therefore, studies are still needed to establish more solid evidence that can be used to form guidelines.

REFERENCES:

1. International Diabetes Federation. IDF diabetes atlas.8th ed. IDF, 2017; www.diabetesatlas.org
2. Collaborators GBDRF *et al.* Global, regional, and national comparative risk assessment of 79 behavioural, environmental and occupational, and metabolic risks or clusters of risks in 188 countries, 1990-2013: a systematic analysis for the Global Burden of Disease Study 2013. Lancet. 2015; 386: 2287-2323.
3. Hu FB. Diet, lifestyle, and the risk of type 2 diabetes mellitus in women. N Engl J Med. 2001; 345: 790-797.
4. Pan A. Red meat consumption and risk of type 2 diabetes: 3 cohorts of US adults and an updated meta-analysis. Am J Clin Nutr. 2011; 94: 1088-1096.
5. Wu JH. Omega-3 fatty acids and incident type 2 diabetes: a systematic review and meta-analysis. Br J Nutr. 2012; 107 Suppl 2: S214-227.
6. Tong X, Dong JY, Wu ZW, Li W, Qin LQ. Dairy consumption and risk of type 2 diabetes mellitus: a meta-analysis of cohort studies. Eur J Clin Nutr. 2011; 65: 1027-1031.
7. Hauner H. Evidence-based guideline of the German Nutrition Society: carbohydrate intake and prevention of nutrition-related diseases. Ann Nutr Metab. 2012; 60 Suppl 1: 1-58.
8. Malik VS, Popkin BM, Bray GA, Despres JP, Willett WC, Hu FB. Sugar-sweetened beverages and risk of metabolic syndrome and type 2 diabetes: a meta-analysis. Diabetes Care. 2010; 33: 2477-2483.
9. Baliunas DO *et al.* Alcohol as a risk factor for type 2 diabetes: A systematic review and meta-analysis. Diabetes Care. 2009; 32: 2123-2132.
10. Evert AB *et al.* Nutrition therapy recommendations for the management of adults with diabetes. Diabetes Care. 2014; 37 Suppl 1: S120-143.
11. American Diabetes A. Standards of medical care in diabetes--2014. Diabetes Care. 2014; 37 (1): 14-80.
12. Canadian Diabetes Association Clinical Practice Guidelines Expert C *et al.* Nutrition therapy. Can J Diabetes. 2013; 37 (1): 45-55.
13. Johnston BC *et al.* Comparison of weight loss

among named diet programs in overweight and obese adults: a meta-analysis. JAMA. 2014; 312: 923-933.

14. Schwingshackl L, Lampousi AM, Portillo MP, Romaguera D, Hoffmann G, Boeing H. Olive oil in the prevention and management of type 2 diabetes mellitus: a systematic review and meta-analysis of cohort studies and intervention trials. Nutr Diabetes. 2017; 7: e262.

15. Bisschop PH *et al.* Dietary carbohydrate deprivation increases 24-hour nitrogen excretion without affecting postabsorptive hepatic or whole body protein metabolism in healthy men. J Clin Endocrinol Metab. 2003; 88: 3801-3805.

16. Pastors JG, Warshaw H, Daly A, Franz M, Kulkarni K. The evidence for the effectiveness of medical nutrition therapy in diabetes management. Diabetes Care. 2002; 25: 608-613.

17. Buse JB *et al.* How do we define cure of diabetes? Diabetes Care. 2009; 32: 2133-2135.

18. Lim EL, Hollingsworth KG, Aribisala BS, Chen MJ, Mathers JC, Taylor R. Reversal of type 2 diabetes: normalisation of beta cell function in association with decreased pancreas and liver triacylglycerol. Diabetologia. 2011; 54: 2506-2514.

19. Lean ME *et al.* Primary care-led weight management for remission of type 2 diabetes (DiRECT): an open-label, cluster-randomised trial. Lancet. 2018; 391: 541-551.

20. Turner RC, Cull CA, Frighi V, Holman RR. Glycemic control with diet, sulfonylurea, metformin, or insulin in patients with type 2 diabetes mellitus: progressive requirement for multiple therapies (UKPDS 49). UK Prospective Diabetes Study (UKPDS) Group. JAMA. 1999; 281: 2005-2012.

21. Feinman RD *et al.* Dietary carbohydrate restriction as the first approach in diabetes management: critical review and evidence base. Nutrition. 2015; 31: 1-13.

22. Teimourian B, Rogers WB, 3rd. A national survey of complications associated with suction lipectomy: a comparative study. Plast Reconstr Surg. 1989; 84: 628-631.

23. Volek JS, Sharman MJ, Forsythe CE. Modification of lipoproteins by very low-carbohydrate diets. J Nutr. 2005; 135: 1339-1342.