



## Nutritional Management of Diabetes

Usman Malik R<sup>1\*</sup>, Furqan K Hashmi<sup>2</sup>, Yousaf AM<sup>3</sup> and Khadka S<sup>4</sup>

<sup>1</sup>School of Pharmacy, Xian Jiaotong University, China

<sup>2</sup>University College of Pharmacy, University of the Punjab, Pakistan

<sup>3</sup>Department of Pharmacy, Comsats University Islamabad, Pakistan

<sup>4</sup>Shree Birendra Hospital, Nepal

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\*Corresponding author: Usman Rashid Malik, School of Pharmacy, Xian Jiaotong University, Xian, China, Email: usmanmalik\_ucp@hotmail.com

### Abstract

Diabetes mellitus is a multifaceted unending disease and is a key source of death worldwide. It is responsible for more than a million amputations every year. It is anticipated that 400 million people worldwide will suffer from diabetes by 2030. The likelihood of developing diabetes depends upon a blend of genetic factors, obesity, living style and environmental factors. There are two major types of diabetes, insulin dependent and insulin independent. Diabetes is diagnosed on the basis of blood glucose levels. A fasting blood sugar level between 100 mg/dl and 125 mg/dl indicates the condition of pre-diabetes and level greater than 125 mg/dl is an indication of diabetes. A healthy eating pattern, regular physical activity, nutritional and drug therapy are the key components of diabetes management. Diabetes Mellitus is directly related to carbohydrate, lipid and protein metabolism. Therefore, the nutrition therapy plays an integral part in diabetes management. Nutritional therapy is suggested for the entire people with Type I and Type II diabetes as effective component of the treatment plan. The foremost aim of the nutritional therapy is to improve overall health principally by attaining individualized glycemic, blood pressure and lipid levels. Foods having a high glycemic index will produce a more increase in blood glucose and will lead to a faster progression to Type I diabetes. Ranges of eating patterns (combinations of different foods and food groups) are suitable for the nutritional management of diabetes. For good health, vegetables, whole grains, fruits, legumes and dairy products are considered a good source of carbohydrates intake as compared to intake from other carbohydrate sources. Naturally occurring fructose in foods such as fruits may result in better glycemic control. Protein intake has no significant effect on glycemic control and there is no ideal amount of protein intake. Furthermore, there is no clear confirmation of benefit from vitamin or mineral supplementation in people with diabetes. However, the use of omega-3 fatty acids (EPA, DHA and ALA) is highly recommended for individuals with diabetes and protects against the development of Type I diabetes. Also, the higher levels of zinc in drinking water may have protective effects against Type 1 diabetes.

**Keywords:** Diabetes management; Nutritional therapy; Eating patterns in diabetes

## Introduction

Diabetes mellitus is a multifaceted unending illness and needs uninterrupted medical care along with adopting the risk reduction approaches to prevent complications such as cardiovascular disease, blindness, kidney disease [1]. Diabetes mellitus is a key cause of mortality worldwide. It is responsible for more than a million amputations each year and is also a most important cause of blindness and kidney failure in developed countries. The genetics play a major role in the development of diabetes; however, research suggests that dietary choices also are of crucial value [2]. The proper dietary adherence can improve glycemic control and insulin sensitivity; thus, contribute to overall quality of life and lifestyle improvement [3].

## Prevalence of Diabetes

The estimated prevalence of diabetes in 2010 was 285 million worldwide and is projected to affect 438 million people near 2030. According to the International Diabetes Federation (IDF) in 2010, the top five countries with respect to diabetes prevalence were India, China, Russia, USA and Brazil. Moreover, the top five countries with the highest prevalence of diabetes in the adults were UAE, Nauru, Saudi Arabia, Bahrain and Mauritius. IDF also concluded that the middle and low income countries are at the greatest jeopardy of diabetes [4].

## Risk Factors

There are a variety of factors that may result in the development of diabetes. The likelihood of developing diabetes depends upon genetic factors, lifestyle, obesity and environmental factors. The risk factors vary for Type I and Type II diabetes. Type I diabetes develops more likely because of an abnormal reaction of the body to the B-cells which may be triggered by viral or other infections. Type II diabetes occurs due to the inability of the body to make ample insulin or if insulin produced is not used properly. The threat of developing Type II diabetes can be averted by alterations in lifestyle [5].

## Diagnosis of Diabetes

Diabetes mellitus is diagnosed mostly on the basis of plasma glucose levels, the fasting plasma glucose (8 hrs after glucose intake) and the random plasma glucose value (2 hrs after 75 gm oral glucose intake) also called as oral glucose tolerance test (OGTT).

Recently, a third method has been introduced by an International Expert Committee to diagnose diabetes called as hemoglobin A1C test. This test gives an estimation of glucose in hemoglobin and also provides an average blood

sugar level over 2-3 months. The levels of 6.5% and higher indicates diabetes [6,7].

## Blood Glucose Levels

The normal fasting blood sugar level is between 70 and 99 mg/dl. Values between 100 mg/dl and 125 mg/dl indicate pre-diabetes condition and level higher than 125 mg/dl indicates diabetes. The normal random blood sugar level is less than 140 mg/dl. Any value greater than 200 mg/dl is an indication of diabetes. The normal range for hemoglobin A1c test is between 4% and 5.6% for people without diabetes. Levels between 5.7% and 6.4% indicate pre-diabetes or increased risk of diabetes, and that of 6.5% or higher indicate diabetes.

## Treatment of Diabetes

There are two major ways of diabetes treatment:

- Nutritional therapy
- Pharmacotherapy or the drug therapy

## Nutritional Therapy/Management of Diabetes

Diet is a central element of management in every disease. In diabetics, drug treatment without adequate nutritional therapy will not be effective. A healthy eating outline, routine physical activity and pharmacotherapy together form the key components of diabetes management.

It is a known fact that diabetes is directly associated to carbohydrate, protein and lipid metabolism. Research shows that before the introduction of insulin therapy, medical nutrition therapy was the only option of therapy for diabetic patients [8]. Therefore, nutrition therapy is an integral part of diabetes management.

## Objectives of Nutritional Management of Diabetes

The major objective of nutritional therapy in diabetic people is to monitor the metabolic parameter like glucose, lipids, body weight, blood pressure, renal function etc. to guarantee successful health effects. In this regard, the general goals recommended by American Diabetes Association (ADA). Blood pressure to be maintained at 140/80 mmHg, A1C should not be more than 6.5%, and LDL cholesterol should be around 100 mg/dl and triglycerides 150 mg/dl. HDL cholesterol for men should be maintained at 40 mg/dl and for women at 50 mg/dl [9,10].

Some other aims of the nutritional therapy are adequate weight control, provision of nutritional requirements and guarantee of the consistency and compatibility of nutritional therapy with the drug therapy if used [11].

### Dietary Principles for Diabetes Mellitus

The dietary principles vary for different types of diabetes. Some dietary principles are as follows:

#### ➤ Type I Diabetes

In Type I diabetes, the key principle is that the patients should take insulin at times consistent with the time of food intake. This assists to reduce the peaks of hyper as well as hypoglycemia. The patients should also reduce the saturated fat and the salt intake for better management.

#### ➤ Type II Diabetes

Type II diabetics should eat low glycemic index foods like apple, soya beans, peas and grapefruits etc. and reduce salt and saturated fat intake in order to maintain LDL cholesterol levels. Physical activity is recommended to improve the disease state and to prevent the occurrence of cardiovascular events. Generally encouraged food items for Type II diabetics are lean meat, wheat-bread, leafy vegetables and eggs.

### Glycemic Index and Sweeteners

The glycemic index (GI) is a measurement of extent to which a certain food increases the blood glucose levels after it is eaten. Foods having a high glycemic index will cause

more increased blood glucose levels. One potential study found that a diet having a higher glycemic index will lead to a quicker development to Type I diabetes; however, such a diet may influence the disease progression but not diabetes initiation [12].

The sugar-sweetened beverages, which include fruit drinks, soft drinks, iced tea, energy drinks and vitamin water drinks, have high glycemic index; therefore, their high consumption has shown to be associated with obesity and ultimately to Type II diabetes. Studies conducted on over 300,000 people established the fact that the consumption of one to two sweetened beverages per day causes a 26% increase in the development of Type II diabetes [13].

### Recommendations for Nutritional Management

Nutritional therapy is suggested for the entire people with Type I and Type II diabetes as effective part of the treatment plan. The foremost aim of the nutritional therapy is to improve overall health principally by attaining individualized glycemic, blood pressure and lipid levels. Individuals suffering from diabetes should receive individualized Medical Nutrition Therapy to achieve treatment goals [14-16].

Carbohydrate	<ul style="list-style-type: none"> <li>Total carbohydrate: 50-60% of daily energy requirements, which can include sugars up to 10% of daily energy requirements.</li> </ul>
Total dietary fibre	<ul style="list-style-type: none"> <li>Adults: &gt; 25-35 g/day.</li> <li>Children: 5g plus 1g/year of age as a guide.</li> <li>Should include both soluble and insoluble fibre.</li> </ul>
Protein	<ul style="list-style-type: none"> <li>Adults: &gt; 0.86 g/kg/day.</li> <li>Children: RNI for age and gender.</li> </ul>
Fats	<ul style="list-style-type: none"> <li>Total fat: &lt; 30% of daily energy requirements.</li> <li>Saturated and polyunsaturated fats: each &lt; 10% of daily energy requirements.</li> <li>Use of monounsaturated fats should be preferred.</li> <li>Fish rich in omega-3 fatty acids should be consumed at least once per week.</li> </ul>
Alcohol	<ul style="list-style-type: none"> <li>Alcohol consumption should be limited to 5% of total energy requirements or two drinks per day, Whichever is less.</li> <li>Regular alcohol intake can contribute to weight gain, poor glycemic control and elevated lipids.</li> </ul>
Sweeteners	<ul style="list-style-type: none"> <li>Nutritive and nonnutritive sweeteners may be used moderately as part of a well-balanced diet.</li> <li>Use of saccharin and cyclamate is not recommended during pregnancy and lactation.</li> <li>Aspartame is contraindicated in individuals with phenylketonuria.</li> </ul>
Micronutrients (vitamins & minerals)	<ul style="list-style-type: none"> <li>Routine use of vitamins and mineral supplements is not recommended for peoples with diabetes except in cases of inadequate consumption or other special needs.</li> <li>Daily vitamin and mineral requirements should be obtained from a well-balanced diet.</li> </ul>

**Table 1:** Recommendations for the Nutritional Management of Diabetes Mellitus [17].

**Energy Balance in Overweight and Obese:** For overweight adults suffering from Type II diabetes or at risk for diabetes, it is recommended to reduce the energy intake while maintaining a healthy eating pattern to encourage weight loss. An optimum weight loss may offer clinical benefits (improved blood pressure and better glucose and lipid levels) in various individuals with diabetes, in particular, in the early disease stage.

**Eating Patterns and Macronutrient Distribution:** The facts advocate that there is no perfect percentage of calories from carbohydrate, fats and proteins for people suffering from diabetes. Therefore, the macronutrient distribution should be based on individualized evaluation of eating patterns and personal preferences. A range of eating patterns (combinations of different foods and food groups) are suitable for the nutritional management of diabetes. The personal preferences (e.g. culture, economics, traditions and religion) should be considered for the recommendation of one eating combination above another.

**Carbohydrate amount and Quality:** For good health, vegetables, whole grains, fruits, legumes and dairy products are considered a great source of carbohydrates intake as compared to intake from other carbohydrate sources particularly those containing added fats, sugars or sodium. Carbohydrates consumed from natural sources provide adequate amounts of both fiber and micronutrients. The dietary fiber plays a major role in the diabetes nutritional management and cholesterol maintenance.

**Dietary Fiber and Whole Grains:** It is suggested that diabetes patients should consume the whole grains and the dietary fiber in amounts recommended for people without diabetes for better glycemic control.

**Fructose:** Fructose consumed from naturally occurring foods such as fruits results in better glycemic control compared with sucrose or starch. The free fructose does not have damaging effects on triglycerides, HDL and LDL provided that the intake is not excessive. The intake of sugar-sweetened beverages (from any sweetener including sucrose syrup and high-fructose corn syrup should be avoided, in diabetic patients and those at risk for diabetes, to reduce risk for weight gain and cardiovascular disease.

**Non Nutritive Sweeteners (NNSs):** The utilization of NNSs has the potential to decrease overall calorie and carbohydrate intake if replaced with caloric sweeteners.

**Proteins:** In patients with diabetes and no indication of diabetic kidney disease, evidence suggests that there is no ideal amount of protein intake for better glycemic control. But in diabetic patients with an evidence of kidney disease,

decreasing the quantity of dietary protein in the diet below usual intake is not suggested.

In patients with Type II diabetes, ingested protein increases the insulin response without rising plasma glucose concentrations. Therefore, it is suggested that carbohydrate foods which are high in protein should not be used to treat hypoglycemia.

**Total Fat:** There is no ideal amount of total fat intake for diabetics. Fat quality seems to be more important than the fat quantity.

**Omega-3 Fatty Acids:** A few research studies does not suggest the intake of omega-3 (EPA and DHA) supplements for diabetics for the prevention or treatment of cardiovascular problems. But most of the data recommends that an addition of foods containing omega-3 fatty acids (EPA and DHA) and omega-3 linolenic acid (ALA) in diabetics has beneficial effects for the prevention of heart disease. The intake of omega-3 fatty acids found in flax seeds, fish, canola, walnuts, soy and greens has protective effects against the advancement of Type I diabetes in children [18]. Research suggests that fish at least two times per week is also suitable for people with diabetes. Cod liver oil, taken during pregnancy, is also associated with a reduced risk of Type I diabetes in offspring [19].

**Micronutrients and Herbal Supplements:** The studies suggest that there is no clear evidence of benefit of vitamin or mineral supplements in diabetic patients who do not have any essential deficiencies. There is an inadequate evidence to support the use of micronutrients such as magnesium, chromium, vitamin D and other herbs or supplements to develop glycemic control in diabetics.

**Alcohol:** Diabetic patients who drink alcohol should be advised to take alcohol in moderation. One drink per day or less is suggested for adult women and maximum two drinks per day for adult men. Alcohol intake may be a cause of an increased risk of delayed hypoglycemia in diabetics especially if patient is on insulin therapy.

**Sodium:** It is appropriate to reduce the intake of sodium to less than 2,300 mg/day in diabetic patients. But in patients with both hypertension and diabetes, reduction in sodium intake should be done on individual basis [20].

**Zinc:** A few studies have found that higher zinc levels in drinking water may be protective against Type 1 diabetes [21].

**Nicotinamides:** Nicotinamide, a component of vitamin B3, has shown to guard against diabetes and prevent beta cell

damage in animal studies. Also, in children it has shown to prevent the development of Type I diabetes [22].

**Antioxidant Supplements:** Free radicals play a vital role in the inflammation process which damages the beta cells in Type I diabetes [23]. The anti-oxidants protect the body from free radicals and therefore, are thought to defend the body from oxidative stress because of the production of free radicals. Nevertheless, some evidence in animals suggests that the antioxidant supplements may also amplify insulin resistance resulting in null and void effect. Thus, the relationship is not so simple. Antioxidant supplementation such as vitamin E, vitamin C and carotene is not recommended in diabetics because of lack of evidence of efficacy and safety.

**Advanced Glycation End-Products(AGEs):** The heat processed foods contain AGEs which have shown to be a cause of Type I and Type II diabetes in the animal studies. A study has shown that if a mother consumes AGEs during pregnancy, AGEs may produce oxidative stress and inflammation and may affect the fetus may raise the risk of diabetes in offspring [24].

### Gestational Diabetes Mellitus and Diet Therapy

The major approach of diet therapy for the period of pregnancy is to provide adequate energy along with achieving strict management of blood glucose levels. The pregnant women must consume sufficient energy in the form of carbohydrates, protein, vitamins and minerals for the better health of fetus.

### Conclusion

Diabetes Mellitus is directly correlated to carbohydrate, lipid and protein metabolism. A healthy eating pattern, regular exercise and medication are the chief constituents of diabetes management. Nutritional therapy forms an integral part of diabetes management as it efficiently ameliorates overall health; accordingly, it is highly recommended for patients suffering from Type I and Type II diabetes. Thus, nutritional therapy plays a significant role in the management of diabetes.

### Conflict of Interests

The authors report no conflict of interests.

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