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Nutritional Management of Diabetes Through Proper Feeding For Sustainable Living

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Abstract

This study examined nutritional management of diabetes through proper feeding for sustainable living. Diabetes mellitus is a group of metabolic disorders characterized by high blood glucose with common associated symptoms like polyuria, polydipsia and polyphagia due to persistent rise in blood glucose. The different types of diabetes, causes, prevalence, symptoms, risk factors, diagnosis, and principles of Nutrition *in diabetes management were explained. There are two major types of diabetes, insulin-dependent and insulin-independent. Diabetes has become a serious public health concern Nationwide; experts predict this number will rise to 643 million by 2030 and 783 million by 2045. Diabetes is diagnosed based on blood glucose levels. A fasting blood glucose level between 100 mg/dl and 125 mg/dl indicates a pre-diabetes condition; a level greater than 125 mg/dl indicates diabetes. A healthy eating pattern, regular exercise, and medication are the chief constituents of diabetes management. Foods having a high glycemic index will produce a greater increase in blood glucose and will lead to a faster progression to diabetes mellitus. 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, healthy fats and nuts, and lean protein are considered healthy for diabetics. The higher your blood sugar is and the longer you live with it, the greater your risk for complication such as cardiovascular (heart and blood vessel) issues, neuropathy, nephropathy, retinopathy, amputations and sexual dysfunction due to nerves and blood vessels damage. The study concluded that, the state, type, quality and quantity of the combination of food we eat can prevent or cause diseases in the body and diabetes can best be managed by eating healthy diet, maintained healthy lifestyle and regular check-ups. The study recommended that nutritional knowledge on adequate choice of diets and lifestyle plays a significant role in the management of diabetes mellitus for proper living*

Keywords: Nutrition, diabetes mellitus, prevalence, complications and dietary management

Introduction

Nutrition is the process by which the body takes in and utilizes nutrients from food to maintain optimal health and function (WHO, 2022). Good nutrition involves consuming a balanced diet that provides the necessary nutrients, vitamins, and minerals to support growth, maintenance, and repair of body tissues. Man, biologically speaking is a product of his nutrition. ''Diabetes'' comes from the Greek word ''diabainein'' meaning to siphon which refers to excessive urination associated with the condition while mellitus comes from the latin word meaning ''honey sweet'' which refers to the sweet taste of the urine in people with diabetes, (World Health Organization, 2022). Therefore, Diabetes mellitus (DM), is a group of metabolic disorders characterized by high blood sugar levels, resulting from defects in insulin secretion, insulin action or both with

commonly associated symptoms like polyuria, polydipsia and polyphagia due to persistent rise in blood glucose.

DM develops when the pancreas doesn't make enough insulin or any at all, or when the body isn't responding to the effects of insulin properly. DM affects people of all ages. Most forms of diabetes are chronic (lifelong), and all are manageable with medications and/or lifestyle changes. Glucose (sugar) mainly comes from carbohydrates in foods and drinks, the blood stream carries glucose to all the body's cells to use for energy. When glucose is in the bloodstream, it needs help – a 'key' – to reach its final destination, this key is insulin (a hormone). If the pancreas isn't making enough insulin or the body isn't using it properly, glucose builds up in the bloodstream, causing high blood sugar (hyperglycemia) (http://my.clevelandclinic.Org/health/disease/7104).

DM 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. American Diabetes Asoociation, (2022), report that genetics play a major role in the development of diabetes and that dietary choices also are of crucial value. Proper dietary adherence can improve glycemic control, insulin sensitivity and healthy weight through meal planning, portion control, healthy food choices, and snacking: thus, contribute to overall quality of life and lifestyle improvement in livelihood (Rahati *et al.*, 2014). American Diabetes Association, (2022), noted that diabetes management is all about adopting a lifestyle that is environmentally friendly, economically viable and socially responsible while maintaining effective diabetes management.

Types and Causes of Diabetes Mellitus

Diabetes mellitus (DM) is one of the serious non – communicable and chronic diseases of carbohydrates that is ravaging people's normal nutritional health status at a global scale. It occurs either when the pancreas does not produce enough insulin (a hormone that regulates blood glucose) or when the body cannot effectively use the insulin it produces (Chukwuone & Nnaemaka, 2023).

Type 1 diabetes is a chronic autoimmune disorder in which the body's immune system attacks and destroys the insulin – producing beta cells in the pancreas, a hormone essential for regulating blood sugar levels (American Diabetes Association, 2022). Type 1 diabetes is caused by certain genetic variations that increase the risk factor, autoimmune response identifies the body's own insulin producing cells as foreign and attacks them, and environmental factor such as viral infections, exposure to certain chemicals, or other environmental triggers that contributes to the autoimmune response in genetically predisposed individuals with symptoms such as increased thirst and hunger, frequent urination, fatigue, slow healing of wounds, tingling and numbness in hands and feet, recurring skin gum or bladder infections, fluctuating blood pressure, unexplained weight loss and ketones in the urine. Usman, et al (2020), reported that diabetics should take insulin therapy at times consistent with the time of food intake to assist reduce the peaks of hyperglycemia as well as hypoglycemia, blood glucose monitoring regularly to maintain optimal glycemic control, balanced diet and regularly exercise to manage blood sugar level and reduce the risk of complications. Type 2 diabetes is a chronic condition characterized by insulin resistance and impaired insulin secretion, leading to high blood sugar levels (WHO, 2022). One may not have any symptoms at all, or may not notice it since they develop slowly, it's the most common type - about 90% - 95% of people living with diabetes have type 2. Several factors and conditions contribute to varying degrees of insulin resistance including obesity, lack of physical activity, diet, hormonal imbalances, age, genetics and certain medications. WHO, (2022), revealed that this type of diabetes can be best managed by lifestyle modifications, medications and monitoring.

The third type of diabetes, gestational diabetes is triggered by pregnancy usually in the trimester. It is caused by hormonal changes during pregnancy affecting the insulin's ability to work properly, American Diabetes Association, (2022). Gestational

diabetes can have several effects on both the mother and the baby. The mother can have increased risk of developing type 2, hypertension and preeclampsia, cesarean delivery and postpartum depression, while the baby according to National Institute of Child Health and Human Development, (2022), may develop macrosomia (excessive birth weight), hypoglycemia (low blood sugar), respiratory distress syndrome and increased risk of type 2 diabetes in childhood and adolescence. Usman, et al., (2020), also revealed other type of diabetes as type 3c diabetes, that occur when the pancreas experiences damage (other than autoimmune damage), which affects its ability to produce insulin such as pancreatitis, pancreatic cancer, cystic fibrosis and hemochromatosis can all lead to pancreas damage that causes diabetes. Having your pancreas removed (pancreatectomy) also results in type 3c.

Latent Autoimmune Diabetes in Adults (LADA): Like Type 1 diabetes, LADA also results from an autoimmune reaction, but it develops much more slowly than Type 1 diabetes. People diagnosed with LADA are usually over the age of 30. Maturity onset diabetes of the young (MODY)**:** MODY, also called monogenic diabetes, happens due to an inherited genetic mutation that affects how the body makes and uses insulin. There are currently over 10 different types of MODY. It affects up to 5% of people with diabetes and commonly run in families.

Neonatal diabetes: This is a rare form of diabetes that occurs within six months of life. It's also a form of monogenic diabetes. About 50% of babies with neonatal diabetes have the lifelong form called permanent neonatal diabetes mellitus. For the other half, the condition disappears within a few months from onset, but it can come back later in life. This is called transient neonatal diabetes mellitus.

Brittle diabetes: Brittle diabetes is a form of type1 diabetes that's marked by frequent and severe episodes of high and low blood sugar levels. This instability often leads to hospitalization. In rare cases, a pancreas transplant may be necessary to permanently treat it. These categories are no exclusive and some people may have features of multiple types of diabetes.

Prevalence of Diabetes Mellitus

Diabetes has become a serious public health concern Nationwide. The estimated prevalence of diabetes in 2010 was 285 million worldwide and about 537 million adults across the world have diabetes. Experts predict this number will rise to 643 million by 2030 and 783 million by 2045, International Diabetes Federation (IDF, 2022). The top five countries with respect to diabetes prevalence were China, India, Pakistan, Russia, USA and Brazil. IDF, also concluded that the middle - and low-income countries are at the greatest jeopardy of diabetes. Urban dwelling, physical inactivity, advanced age, hormonal imbalances, autoimmune disease, genetics, certain medications and unhealthy diet are important risk factors for diabetes mellitus among Nigerians. Interpersonal relationships, psychological functioning, and role performance of families of persons with diabetes have all been found to suffer following dealing with persons with diabetes mellitus. Managing diabetes involves a team effort- you'll want medical professionals, friends and family on your side. Ogberah & Ekpebegh, (2020) reported the economic burden of diabetes management on Nigerians is very significant with various costs affecting individuals, households and the healthcare systems such as medications and food expenses spent on diabetes care.

The prevalence of diabetes in Nigeria is a growing concern, with a significant increase in recent years. According to Ogbera & Ekpbegh, (2O20), the following statistics are:

Nationally: 0.24% children and adolescents (0 – 19years), 5.7% of the adult population (aged 20 – 79 years) has diabetes while 1.9% of the adult population (aged 20 – 79 years) has undiagnosed diabetes. Regionally, urban areas: 7.2% (Lagos), 6.5% (Kano), while rural areas have 3.8% (Oyo), 3.5% (Kaduna).

Age specifications show as follows: 20 –

39 years, 2.35 male and 2.1% female, 40 – 59years, 6.3 male, 5.8% female and 60 – 79 years 14.1% male and 12.9% female, 80years and above 20.6%. Status recorded are Prediabetes: 34.5%, type 1 diabetes: 5-10%, type 2 diabetes: 85-90% and gestational diabetes: 9.2%. Based on the research, 22.2% of adults with diabetes are obese, 35.1% of adults with diabetes are physically inactive and 15% of adults with diabetes are family history. This means that, management of diabetes involves a comprehensive approach to control blood levels, prevent complication and improve quality of life (Centers for Disease Control and Prevention, (2022). This is why nutrition education is beneficial to help remedy the havoc wrecking the universe by the high prevalence of diabetes.

Symptoms and Risk factors of Diabetes Mellitus.

In most cases, DM is usually asymptomatic (Estaghamti et al., 2011). As a result of this, people can have DM and be completely unaware as the symptoms are usually harmless. However, Suresh, (2016) and the National Institute of Diabetes and Digestive Kidney Diseases (NIDDK, 2022) enumerated some symptoms of DM. These includes Frequent urination, which may result in polyuria due to too much glucose in the blood. Intense hunger (polyphagia) due to insulin not working properly or not there at all. Increased or frequent thirst (Polydipsia) due to excess and frequent urination, which mean the cells are not getting enough energy. Unusual weight gains or unexplained weight loss as a result of intense hunger. Increased fatigue due to defective insulin making it unable for glucose to enter the cells and provide with energy. Blurred vision due to tissue being pulled from the eye lenses making the eye unable to focus. Slow healing of wounds and cuts due to poor blood circulation, nerve damage, hormonal imbalance and elevated glucose levels. Recurring skin, gum, or bladder infections due to too much sugar in the blood leading to difficulty in recovering from the bladder and vaginal infections in women. Fluctuation in blood pressure as a result of damage to nerves, blood vessels, dehydration, stress and anxiety and kidney damage all leading to increased blood pressure. Erectile dysfunction in men due to damage to blood vessels and nerves, psychological factors due to stress, anxiety and depression is a common complication if diabetes affecting up to 75% of men.

DM can be caused by modifiable risk factors such as obesity, physical inactivity, unhealthy diet, smoking, high blood pressure, high cholesterol while non – modifiable risk factors include family history of diabetes, age, ethnicity, polycystic ovary syndrome and history of gestational diabetes and other risk factors are medications, sleep apnea and stress. A study by Unai, et al, (2020) reveals that there are about 150 DNA variations that are associated with the risk of developing DM. this genetic variation is thought to act by subtly changing the amount, timing and location of gene activity which affects the development and functions of beta cells of the pancreas, the release and processing of insulin and cells sensitivity to the effects of insulin. Research also shows that the incidence and prevalence DM vary according to an individual's ethnicity, with Japanese, Hispanics and Native Americans having highest risks (Chukwuone & Nnaemeka, 2023., Unai, et al, 2020). It has shown higher prevalence rates in Asians compared with the white American population (Karter, et al, 2013).

Similarly, Chukwuone and Naemeka, (2023) stated that obesity (Body mass index that is above 30kg/ m2) is the strongest factor for the development of DM and it is associated with metabolic disorders which result in insulin resistance. Chkwuone and Nnaemeka, (2023), also demonstrated that a sedentary lifestyle is strongly linked to DM. Physical inactivity enables the prevention of skeletal muscle cells contraction thereby causing a reduction in blood flow into the muscle, and increases the intra-abdominal fat, which is a known risks factor that promotes insulin resistance and prevents the improvement of glucose update. Chukwuone and Nnaemeka, (2023) revealed that a low-fiber diet, saturated fats,

processed foods, soft drinks, tobacco and alcohol affects insulin resistance and the risk of DM in varying degrees. There are some medical conditions which can potentially give rise to, or exacerbate DM including obesity, hypertension, elevated cholesterol (combined hyperlipidemia), chronic pancreatitis, cancer and conditions called metabolic syndromes (Yanling et al., 2014).

Common Complications of Diabetes Mellitus

Complications of DM result from negligence or failure to attend to obvious signs and symptoms that were earlier detected. Centers for Disease Control and prevention, (2022) stated that DM complications can be acute (short-term) or chronic (long-term). Acute complications includesHypoglycaemia, Hyperglycaemia, Hyperosmolar Hyperglycaemic Non-ketotic Syndrome (HHNS) (an emergency condition that occurs when blood glucose levels shoot up too high with a severe case of dehydration and lack of ketones present in the blood or urine), Diabetic ketoacidosis (DKA) (a life-threatening condition where the lack of insulin and high blood sugars leads to a combination of ketosis and acidosis resulting in the accumulation of ketone bodies and acidity in the blood) and Hypertension. This is commonly called a 'silent killer' in people with DM as a result of high blood pressure, usually characterized by a heart attack, stroke, kidney disease and vision problems. European Association of the Study of Diabetes (EASD,2020) and Suresh, (2016) stated that chronic complications (long-term problems) of DM include microvascular and macrovascular complications and diabetic retinopathy (severe damage to the eye leading to glaucoma, cataracts and even loss of vision), diabetic Nephropathy (kidney disease), diabetic Neuropath (a type of nerve damage), foot complications which may lead to amputation, skin complications, heart problems such as ischemic heart disease, erectile dysfunction, stroke, mental ill-health as uncontrolled diabetes raises the risk of suffering from depression, anxiety and some other mental disorders, hearing loss, gastroparesis (inability of the stomach to work properly) and Peripheral Arterial Diseases (PAD) symptoms may include pain in the leg, tingling and sometimes problems walking properly.

Diagnosis of diabetes

Diabetes mellitus is diagnosed mostly on the basis of plasma glucose levels, the fasting plasma glucose (8hrs after glucose intake) and the random plasma glucose value (2hrs after 75 gm oral glucose intake) also called as Oral Glucose Tolerance Test (OGTT). A third method has been introduced by an International Expert Committee (hppts://www.diabetesalas.org), to diagnose diabetes called as HbA1C or glycated hemoglobin test, which provides your average blood sugar level over the past 2-3 months. The levels of 6.5% and higher indicates diabetes (IEC, 2009). The normal fasting blood sugar level is between 70 and 99mg/dl. Values between 100mg/dl and 125mg/dl indicate pre-diabetes condition and level higher than 125mg/dl indicates diabetes. The normal random blood sugar level is less than 140mg/dl. Any value greater than 200mg/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 (Usman *et al.,* 2020). Blood sugar (glucose) is key to determining how well the current treatment plan is working. It gives individual information on how to manage diabetes on a daily – and sometimes even hourly – basis. Blood glucose levels can be monitor with frequent checks with a glucose meter or a continuous glucose monitor (CGM), and healthcare provider will determine the best blood sugar range for you.

Dietary Management of Diabetes

There are two major ways diabetes can be managed, nutritional therapy and pharmacotherapy or the drug therapy. Diabetes is a complex condition, so its management involves several strategies. In addition, diabetes affects everyone

differently, so management is highly individualized. Being diagnosed with diabetes is a life-changing event, but it doesn't mean you can't live a happy and healthy life. Managing diabetes involves consistent care and diligence, while it'll likely be very overwhelming at first, over time you'll get a better grasp on managing the condition and being in tune with your body as stated by Academy of Nutrition and Dietetics, (2022). 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 in the family, routine physical activity and pharmacotherapy together form the key components of diabetes prevention and management. It is a known fact that diabetes is directly associated to carbohydrate, protein and lipid metabolism. Dietary management of diabetes in Nigeria can be achieved using locally available foods such as, Vegetables: leafy green like spinach, pumpkin leaves, bitter leaf, bell pepper, eggplant, and garden eggs, Fruits: grapefruits, lemons, strawberries, Whole grains: brown rice, whole wheat, millets, plantain and bitter yam. Protein sources: legumes like beans, peas, nuts and seeds. Lean meat such as chicken and fish. Healthy fats: Avocado, nuts, olive oil, pumpkin seeds and sunflower seeds. Center for Disease Control and Prevention, (2022), emphasized the avoidance of the following foods because they are like potholes or accidents that can occur on that road if one those not take preventive measures. Foods like Sugary drinks: soda, sports drinks and sweetened teas and coffee, Refined carbohydrates like, white bread, sugary snacks and sweetened yogurts, Processed meats such as, sausages and bacon, Fried foods and processed and packaged foods. Research shows that before the introduction of insulin therapy, medical nutrition therapy was the only option of therapy for diabetic patients. That nutrition therapy is an integral part of diabetes prevention and management (Usman *et al.*, 2020). This management involves a personalized meal plan that considers the individual's nutritional needs, lifestyle and health goals. Nutrition education should be encouraged to increase awareness of people on the importance of dietary management approach in the prevention and management of DM by sensitizing on the different local food crops which have low glycemic index.

Oral diabetes medications (taken by mouth) help manage blood sugar levels in people who have diabetes but still produce some insulin (people with Type 2 diabetes and prediabetes). People with gestational diabetes may also need oral medication, Metformin is the most common. Insulin: Type 1 diabetics need to inject synthetic insulin to live and manage diabetes and some with Type 2 diabetes also require insulin. There are several different types of synthetic insulin and each start to work at different speeds lasting in your body for different lengths of time, the four main types according to hppts://clevelandclinic.org/health/diseases/7104, include injectable insulin with a syringe(shot), insulin pens, insulin pumps and rapid-acting inhaled insulin.

Exercise: physical activity increases insulin sensitivity (and help reduce insulin resistance), so regular exercise is an important part of management for all people with diabetes. It is also important to maintain a healthy weight, blood pressure and cholesterol level.

Nutritional therapy is suggested for the entire people with Type 1, Type 11and other type of diabetes as effective part of the management 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 (Usman *et al.*, 2020).

Table1: Nutritional Management of diabetes Mellitus (Association C. D, 1999).

Food Group	Daily Intake
Carbohydrate	▪ Total carbohydrate: 50-60% of daily energy requirements, which can include sugars up to 10% of daily energy requirements.
Total dietary fibre	▪ Adults: >25-35 g/day. ▪ Children: 5g plus 1g/ year of age as a guide. ▪ Should include both soluble and insoluble fibre.
Protein	▪ Adults: > 0.86 g/day. ▪ Children: RNI for age and gender.
Fats	▪ Total fats: < 30% of daily energy requirements. ▪ Saturated and polyunsaturated fats: each < 10% of daily energy requirements. ▪ Use of monounsaturated fats should be preferred. ▪ Fish rich in omega-3 fatty acids should be consumed at least once per week.
Alcohol	▪ Alcohol consumption should be limited to 5% of total energy requirements or two drinks per day, whichever is less. ▪ Regular alcohol intake can contribute to weight gain, poor glycemic control and elevated lipids.
Sweetners	▪ Nutritive and nonnutritive sweetners may be used moderately as part of a well- balanced diet. ▪ Use of saccharin and cyclamate is not recommended during pregnancy and lactation. ▪ Aspartame is contraindicated in individuals with phenylketonuria.
Micronutrients (vitamins &minerals)	▪ Routine use of vitamins and mineral suppliments is not recommended for people with diabetes except in cases of inadequate consumption or other special needs. ▪ Daily vitamin and mineral requirements should be obtained from a well-balanced diet.

Conclusion and Recommendations

Man is a product of nutrition, this means that the essential components of the human body which is made up of the bones, blood, skeleton and its muscles, heart; brain, spleen, cells, water and the electrolytes, are each a product of man's nutrition and each is maintained or repaired, replenished or rejuvenated from the essential nutrients singly or in combination contained in food. The state, type, quality and quantity of the combination of food we eat can prevent or cause diseases in our body. Based on this discourse, the following recommendations were made:

1. There should be awareness given by Health care professionals, researchers, policy makers and the general public on the dietary management of diabetes.
2. Indigenous food crops like, vegetables, fruits, whole grains, nuts and seeds and their nutritional and health benefits should be taught in schools, colleges and university to promote acceptability over highly processed foods which are detrimental to health.
3. Educationists, Professional bodies and non-governmental organizations should create public enlightenment on the proper choice of foods/diet and lifestyle of individuals necessary to improve healthy living for sustainable livelihood.

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