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Incidences of Diabetes in Nigeria: – An Update on Nutritional Therapies for Prevention and Management: A Review

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Abstract

Over the past few decades, diabetes mellitus has become a significant non-communicable disease in Nigeria. The incidence and epidemiological trends of diabetes in Nigeria are summarized in this review, which also assesses nutritional interventions for managing and preventing the disease. According to recent estimates, the frequency is within 5.7% to 7.0% nationwide, with significant regional and urban-rural differences. Urbanization, the shift in diet toward ultra-processed foods and refined carbohydrates, physical inactivity, and rising obesity rates are some of the main causes. Prevention and glycemic control continue to be largely dependent on nutritional therapy, which includes dietary modification, low-glycemic index patterns, increased dietary fiber, functional foods, and weight management. In order to put the evidence into practice, we also provide case studies, data summaries, and culturally relevant Nigerian meal plans. Strengthening public health policies, improving access to dietetic services, and scaling community-based interventions are essential to curb the growing diabetes epidemic.

Keywords: *Diabetes mellitus, Nigeria, incidence, nutritional therapy, glycemic index, dietary fiber, public health, meal planning.*

Introduction

Persistent hyperglycemia brought on by deficiencies in insulin secretion, action, or both is a hallmark of diabetes mellitus, a chronic metabolic disease. It is linked to both macro-vascular and micro-vascular issues that significantly raise morbidity and death. Due to changes in lifestyle, urbanization, and demographics, diabetes in Nigeria has evolved from a relatively uncommon ailment in the middle of the 20th century to a significant public health issue. A significant percentage of cases go undetected despite advancements in awareness and testing, which leads to problems and delayed presentation. Diabetes mellitus (DM) is a metabolic disease characterized by an absolute or relative insulin shortage that causes hyperglycemia and both acute and long-term consequences [41].

Over time, the prevalence of diabetes mellitus in various parts of the world has grown to be a major public health concern, particularly for individuals with comorbid diseases that make managing and treating the disease very challenging due to inadequate healthcare infrastructures. Additionally, diabetes mellitus (DM) is a broad category of metabolic illnesses that frequently have a significant disease burden (Anthonia and Chukwuma, 2014) and necessitate ongoing care throughout life [3].

In addition to reaching pandemic proportions globally, diabetes mellitus is a chronic illness that is expected to disproportionately impact emerging nations. The prevalence of DM in the world is estimated to progressively increase from 425 million people in 2017 to 629 million by 2045 [19].

The estimated prevalence of diabetes in Africa is 1% in rural areas and ranges from 5% to 7% in urban sub-Saharan Africa (Kengne et al, 2005). DM population will increase from 14.2 million in 2015 to 34.2 million in 2040 [19]. DM is seen to be predominant in some regions such as South Africa, the Democratic Republic of Congo, Nigeria, and Ethiopia. The African region will have the greatest percentage increase of DM (143%) between 2019 and 2045 [27].

Similarly, in Nigeria, DM has about 158million people, who are in the most populous country in Africa, and this accounts for one-sixth of Africa's population. Nigerians have about 50% urban dwellers with cultural diversity and 398 documented ethnic groups (World population prospects, 2012).

DM have been reported to have prevalent rates ranging between 0.8%-4.4% [39], [12], [36], in some rural locality in Nigeria while the prevalent rate in the urban cities have been reported to range between 4.6%- 7% [13]. In the past, studies conducted decades ago have shown generally low prevalence rates of diabetes in Nigeria. Studies conducted between 1963 and 1971 still reported less than 1% of diabetes in Nigeria, with the range between 0.8%- 2.8% of Nigeria's population. Likewise, studies conducted from 1988 to 1998 showed that most patients had noninsulin-dependent (type 2) diabetes [13].

There has been an increase in the rate of diabetes world [22], [40]. increased prevalence of DM from 0.8-4.4% in some rural communities in Nigeria and 6.8% increase in urban areas [42]. As of 2019, 8.2million Nigerians were estimated to have impaired glucose tolerance, and it's projected to rise to 11.5million by 2030 (IDF, 9th edn). It is paramount to note that impaired glucose tolerance is a major risk factor for the future development of type 2 diabetes and cardiovascular diseases.

Previously, diabetes was categorized into two types: juvenile onset (insulin-dependent, type 1) and maturity onset (non-insulin dependent) diabetes, with juvenile onset diabetes rarely seen in Nigeria.

Currently in Nigeria, of the four classes of Diabetes mellitus, three types are frequently recognized, which are type 1 Diabetes mellitus, type 2 diabetes mellitus, and gestational diabetes [45]. DM is associated with acute and chronic (vascular) complications which reduce quality of life, result in disability and can lead to untimely death [3], this should be of great concern to Nigerians as it has caused morbidity and mortality which is increasing (Ogbera et al,2007), DM complications also includes hyperglycemic emergencies, diabetic foot ulceration and stroke [10], [31]. Chronic kidney disease and visual loss resulting from DM are gradually increasing among Nigerians [1], [2]. Urbanization and economic growth of many countries, alongside changes in diet favouring more calorie consumption, are one of the major risk factors of DM [19], [25]. The threat of DM increases to individuals, families, and the community at large. However, the danger of DM crisis calls for immediate attention, prevention, diagnosis, and management through nutritional management [7].

Epidemiology and Incidence of Diabetes in Nigeria

Prevalence Trends

According to national statistics, the prevalence of diabetes has steadily increased from roughly 2.2% in the early 1990s to roughly 5.7%–7.0% in recent years. This growth is a result of shifting lifestyles, longer lifespans, and demographic shifts. Millions of people are currently impacted, placing a heavy financial and healthcare strain on society. In Nigeria, diabetes is treated using both pharmaceutical and non-pharmacological approaches. Dietary management is an essential cornerstone for persons with diabetes to achieve sufficient glycaemic control and prevent long-term issues. Nutritional considerations have a major impact on all of the traditional risk factors for atherosclerotic disease. The risk of different metabolic syndromes can be predicted by food and exercise in addition to underlying genetics [27]. Nutrition therapy lowers the Hb a/c by 0.5 to 2%, according to several studies. These individuals don't need to follow a set diet, but their diets are frequently impacted by their cultural, religious, and socioeconomic background.

The objectives of nutrition therapy is to promote the enjoyment of variety of nutrient-dense foods in appropriate portion sizes to achieve individual glycemic, blood pressure and lipid goals, achieve individual glycemic blood pressure and lipid goals, achieve and maintain body weight goals, delay or prevent complications of diabetes [8]. Research has shown that the consumption of low glycaemic foods such as soyabeans, grapefruits, bambara nuts etc have been able to reduce the effect of DM on individuals [35]. The potential glycaemic effect of a meal can be altered by changing either the glycemic index or the carbohydrate content of the food [15] [32].

Regional Variations

Prevalence varies by region, with southern and urban areas frequently reporting higher rates than northern and rural ones. These discrepancies are a reflection of variations in food, physical activity, healthcare access, and socioeconomic status. However, Nigeria is a fairly diverse country with significant ethnic, cultural, and nutritional disparities within its geopolitical zones. These regional food trends have an impact on nutritional status as well as the distribution and risk of type 2 diabetes mellitus (T2DM). Regional differences in dietary quality and metabolic health outcomes are caused by differences in staple foods, food preparation techniques, socioeconomic status, and urbanization levels. Designing successful, culturally appropriate nutritional treatments for diabetes prevention and management requires an understanding of these geographical variations [33].

1. South-West Nigeria

Yoruba-speaking regions in the South-West typically eat diets high in cassava-based dishes like eba, amala, and lafun, which are frequently served with vegetable-rich soups like efo riro and ewedu. Nonetheless, rising urbanization has increased the consumption of rice that has been refined, Pastries and bread, Fast food and sugary drinks.

Modern dietary changes have raised glycemic load and contributed to the rising prevalence of obesity and diabetes in urban areas like Lagos and Ibadan, even though traditional diets contain fiber from vegetables and tubers [29].

2. Southeast Nigeria

According to [33], the diets of the Igbo-speaking South-East region have historically included:

Staples made from cassava (fufu, akpu)

Yam-based dishes, such as pounded or boiling yams

Soups high in vegetables, such as egusi, okra, and onugbu

Legumes, like beans (ewa)

Higher energy density diets have been linked to increased consumption of processed carbs and meals heavy in palm oil, even in the presence of nutrient-rich soups. In places like Enugu and Onitsha, urbanization and decreased physical activity have further raised the risk of diabetes.

3. Sout-South Region: The South-South is renowned for its high fish intake and soups that are high in vegetables, such as:

- Edikang Ikong
- Afang soup
- Soup with okra

These diets are typically more balanced and contain comparatively high levels of protein and micronutrients. However, rising prevalence of metabolic illnesses have been linked to increased consumption of fried street foods, alcohol, and refined carbohydrates in metropolitan areas like Port Harcourt and Warri. In contrast to other zones, the region continues to consume a comparatively high amount of dietary fiber [33].

4. Northern Nigeria (North-West, North-East, North-Central)

Northern diets are heavily based on:

- Millet
- Sorghum
- Maize
- Rice (increasingly refined)
- Dairy products (especially in pastoral communities)

Traditional foods such as *tuwo masara*, *tuwo shinkafa*, and *kunu* are widely consumed. These foods can be nutritious when minimally processed, but modern refining of grains and increased sugar intake have reduced dietary fiber content. In urban areas such as Kano, Kaduna, and Maiduguri, rising consumption of processed foods and sedentary lifestyles has significantly increased obesity and diabetes prevalence [37].

Key Regional Dietary Differences and Diabetes Risk

According to [38], across Nigeria, several patterns emerge:

- High-fiber traditional diets are more common in rural areas
- Urban populations consume more refined carbohydrates and processed foods
- South-South diets retain relatively higher protein and vegetable content
- Northern diets rely heavily on grains, which may be healthy or unhealthy depending on processing level
- Increased western dietary influence is common across all regions

These differences influence glycemic load, insulin resistance, and obesity rates across populations.

Public Health Implications

Instead of using a one-size-fits-all strategy, regional dietary diversity necessitates customized nutritional interventions [43]. Successful tactics consist of:

- Encouraging customary, high-fiber meals in every area
- Cutting back on sugar-sweetened drinks and processed carbs
- Including nutrition education initiatives that are culturally relevant
- Promoting physical exercise among urban residents
- Enhancing dietary counseling in the community

To effectively lower the risk of diabetes, public health programs must take into account regional food availability, price, and cultural acceptability.

Risk Factors

Obesity, sedentary lifestyles, poor diets high in saturated fats and refined carbohydrates, aging, family history, hypertension, and dyslipidemia are major risk factors. Due to decreased physical activity and greater access to meals high in energy, urbanization increases these risks. However, consuming a lot of calories is one of the main risk factors for diabetes mellitus [20]. The Glycemic indices can be lowered by consuming fewer meals high in carbohydrates by proper processing, and diabetes can be prevented or managed by ingesting fewer foods high in carbohydrates [9]. T2DM is a complex metabolic disease that is impacted by a number of genetic, environmental, behavioral, and socioeconomic variables. Rapid urbanization, dietary shifts, and lifestyle modifications are the main causes of Nigeria's rising diabetes prevalence. Effective prevention, early diagnosis, and intervention efforts depend on an understanding of the major risk factors.

Non-Modifiable Risk Factors

Growing older raises the chance of having type 2 diabetes, especially after age 40. This is because β-cell activity and insulin sensitivity gradually deteriorate over time. However, because of changes in lifestyle, younger persons in Nigeria are receiving more diagnoses.

Genetics and Family History

However, inherited genetic susceptibility affects insulin secretion and glucose metabolism, people with a family history of diabetes are much more at risk. Additionally, some ethnic groups might be more predisposed than others.

Ethnicity

Although lifestyle is still the key factor, African groups, including Nigerians, may be more susceptible to insulin resistance when exposed to obesogenic surroundings.

Risk factors that can be changed

Poor Nutrition

Diabetes risk is greatly increased by eating a diet high in processed carbs, added sugars, and saturated fats. In Nigeria, increased consumption of, white rice, white bread and sugary beverages. Processed snacks has replaced traditional high-fiber diets, contributing to poor glycemic control and weight gain.

Physical Inactivity

Sedentary lifestyles reduce glucose uptake by skeletal muscles and promote weight gain. Urbanization in Nigerian cities has led to reduced occupational and recreational physical activity, increasing diabetes risk.

Overweight and Obesity

Excess body weight, particularly abdominal obesity, is one of the strongest risk factors for T2DM. It promotes insulin resistance, chronic inflammation, and metabolic dysfunction. Even modest weight gain significantly increases risk [5].

Low Dietary Fiber Intake and High Glycemic Index Diets

Low consumption of fiber-rich foods reduces satiety, increases postprandial glucose spikes, and worsens insulin resistance.

Reduced intake of legumes, vegetables, and whole grains is a major dietary concern in Nigeria. Frequent consumption of high glycemic index foods leads to rapid increases in blood glucose and insulin demand, eventually contributing to β-cell exhaustion and insulin resistance [6].

Dyslipidemia and Hypertension

The chance of developing type 2 diabetes is greatly increased by metabolic disorders such excessive blood pressure and abnormal lipid profiles, which are directly associated with insulin resistance.

Smoking and Alcohol Use

Increased belly fat formation, poor glucose metabolism, and metabolic disorders are all caused by excessive alcohol use and cigarette smoking.

Environmental and Socioeconomic Risk Factors
Urbanization

Reduced physical activity and greater access to processed meals, fast food, and sugar-filled beverages are linked to urban living.

Food insecurity and poverty

Despite under-nutrition in certain situations, low-income populations may rely on inexpensive, high-calorie but low-nutrient diets, raising the risk of diabetes. Insufficient Knowledge of Nutrition Unhealthy eating habits and a delayed diagnosis of diabetes are caused by a lack of knowledge about good eating habits.

Interaction of Risk Factors

T2DM risk factors are interrelated. For example, poor diet leads to obesity, which in turn increases insulin resistance. Similarly, physical inactivity worsens weight gain and metabolic dysfunction. These synergistic interactions accelerate disease development, especially in urban Nigerian populations [5].

- **Public Health Implications**

In order to reduce the risk of diabetes in Nigeria, integrative approaches are needed, such as:

- The promotion of conventional diets high in fiber
- A decrease in the use of processed carbohydrates
- Promotion of consistent exercise Community-based screening initiatives
- Lifestyle counseling and nutrition education
- Interventions in policy aimed at food ecosystems

Type 1 and Type 2 Diabetes: Pathophysiology, Management, and Treatment

Type 2 diabetes mellitus is characterized by increased pancreatic beta-cell dysfunction and insulin resistance. Chronic hyperglycemia exacerbates metabolic dysregulation and raises the risk of consequences such cardiovascular disease, nephropathy, neuropathy, and retinopathy by causing glucotoxicity and lipotoxicity. According to [5], the following recommendations were provided by the American Diabetes Association for the treatment of both type 1 and type 2 diabetes:

Type 1 DM which can achieve much if the following dietary principles are observed,

i. Integrate and synchronize with the insulin treatment's time of action: Patients receiving insulin therapy should eat at a regular time that coincides with the insulin preparation's time of action. This will lessen the occurrence of hypoglycemia and blood glucose peaks.
ii. Cut back on saturated fat because dietary restrictions may lower the incidence of coronary heart disease in diabetics.
iii. Limit salt intake: Due to the increased risk of hypertension, diabetics should limit their salt intake. Nonetheless, growing patients should consume sufficient amounts of vital nutrients.
iv. Metabolic profile: Increased body weight is frequently linked to better glycaemic management with insulin therapy. Due to the possibility that weight gain could negatively impact blood pressure, lipids, and glycaemia,
The following recommendations will be helpful since the American Diabetes Association has demonstrated that altering one's diet has a higher chance of improving type 2 diabetes. Medical nutrition therapy should focus on lifestyle modifications that lead to decreased calorie intake and increased energy expenditure through physical activity because many people with type 2 diabetes are overweight and insulin resistant. Consequently, consuming less calories and exercising frequently can help reduce body weight. Increased physical exercise can also improve insulin resistance, lower cardiovascular risk factors, and improve glycaemia [6].
i. Reduce saturated fat and maintain reduced plasma low-density lipoprotein cholesterol levels. 90 Diabetes Mellitus – Insights and Perspectives
ii. Eating low glycaemic index foods such as soya beans, apple, grapefruits, peas (groundnuts), increasing intake of vegetables, fruits, legumes and whole grain cereals that may mostly have low glycaemic indices.
iii. Keep salt intake low
iv. Fried food is not good for diabetes patients, lean meat, game meat (bush meat), green, leafy vegetables, and garden egg should all be encouraged for DM patients.
v. Physical activity: Increased physical activity can lead to improved glycaemia, decreased insulin resistance, and reduced cardiovascular risk factors.
Studies has shown that giving people that have metabolic syndrome omega-3 fatty acid supplements or placebo for six months lowered inflammation and weight loss when compared to people who did not take the supplements. Adequate omega-3 intake in pregnancy decreased the risk of obesity in children and reduced the risk of diabetes in the future. Generally, diabetic patients should reduce fat intake, increase carbohydrate and fibre intake of foods [11]. Findings have clearly stated that diabetics should select vegetables and grains so that the starches, fibre and micronutrients needed will be in adequate amounts [5]. However, diabetics should select food from the following food groups,
Carbohydrate: 50–60% of the diet should consist of this [6]. Regarding the glycemic index and fiber content, the quality of the carbohydrate is crucial when consuming it for diabetes [29]. Another crucial predictor of the glycemic response is the amount of carbohydrates [28]. Choosing whole grains, fruits, vegetables, and low-fat milk is crucial when incorporating carbohydrates for diabetics [6].

Nutritional Transition in Nigeria

Nigeria's traditional diets, which are abundant in whole grains, legumes, and vegetables, are giving way to Westernized diets that are high in refined carbohydrates, sweets, and fats. Increased calorie intake, obesity, and metabolic diseases like diabetes are all influenced by this shift. When the pancreas stops making insulin, type 1 diabetes develops. The immune system destroys the insulin-producing beta cells in the pancreas because it believes they are foreign intruders. Because the pancreas cannot make insulin due to cell death, glucose cannot enter cells and instead builds up in the bloodstream to hazardous amounts. Increased blood sugar can harm the kidneys, eyes, and heart and, if left untreated, can lead to ketoacidosis [6].

As a result, individuals with type 1 diabetes must exercise caution when consuming meals high in sugar, such as spaghetti, white bread, and soft drinks. Patients with type 1 diabetes should eat meals with a low glycaemic index. The rate at which a food affects blood sugar levels is measured by the glycemic index. Blood sugar is raised more quickly by foods with a high glycemic index than by those with a low glycemic index. Those who have type 1 diabetes should refrain from missing meals or eating late. The Mediterranean diet, which includes whole wheat, brown rice, quinoa, oats, fruits, vegetables, beans and pulses, and lentils, is recommended for those with type 1 diabetes. Soft drinks, simple carbs, and trans-fats are among the foods they should stay away from [3].

Patients with type 2 diabetes are unable to identify early symptoms because they cannot make insulin. Typically, people are unaware that they have type 2 diabetes until consequences including kidney damage, cardiovascular disease, and nerve damage arise. Fortunately, blood sugar levels can be controlled with a nutritious diet. Meat, fish, and dietary restrictions are all part of type 2 diets. A combination of lipids, proteins, and carbs should be included in the diet. The majority of the carbohydrates consumed should come from vegetables. Diets for type 2 diabetes should include complex carbohydrates with a low glycaemic index and a high protein content, along with plenty of other nutrients like vitamins, fiber, and certain proteins and fats that will naturally help to regulate blood sugar levels [31].

The diet should be rich in fruit, vegetables, beans, lentils and oatmeal. Simple carbohydrates and processed foods containing high levels of sugar should be avoided. Foods containing pasta, flour, white bread, white rice, biscuits, pastries and soft drinks should be avoided.

Nutritional Therapies for Prevention and Management

Dietary management of diabetes is essential, particularly when combined with exercise. It is an essential cornerstone method for attaining appropriate glycemic control in diabetes mellitus, according to [31]. By achieving and maintaining ideal nutritional status, preventing both acute and long-term issues, and establishing appropriate glycemic control, diets used to treat diabetes mellitus aim to promote general health. People with diabetes mellitus should eat 45–65% carbs, 15–20% protein, and 25–35% fat per day, according to [16]. In the 2015 IDF World Diabetes Day campaign, healthy eating was emphasized as one of the most crucial elements of managing type 1 diabetes and avoiding type 2 diabetes [6], [34].

According to research, the quantity of macronutrients taken is less important than the quality of dietary fats and carbs [4]. In addition to improving quality of life and lowering the need for insulin or diabetes drugs, healthy food programs maintain blood glucose levels within the recommended range [46]. Dietary management for diabetes has several health benefits, such as:

(i) Keeping blood pressure, cholesterol, and blood glucose levels within the ranges recommended by medical professionals, and (ii) helping people lose weight or maintain a healthy weight.

(iii) It postpones or stops the development of diabetes-related problems.

(iv) It offers the person greater energy and makes them feel wonderful.

Dietary Modification

Effective dietary modification emphasizes whole, minimally processed foods, portion control, and balanced macronutrient distribution. Reducing refined sugars and increasing consumption of vegetables, legumes, and whole grains are central strategies. In Nigeria, management of persons with DM is composed of both non-pharmacological and pharmacological means. Dietary management is a key cornerstone in achieving good glycaemic control in DM individuals and the prevention of long-term complications. Nutritional factors play a significant role in modulating all the traditional risk factors of atherosclerotic disease. Diet and activity play a major role in determining the risk of this metabolic syndrome, in addition to underlying genetics (Mbata *et al*., 2021). Different studies show that nutrition therapy reduces the Hb a/c by 0.5% to 2%. No standardized diet is required for these people, but diets are often influenced by socio-economic status, cultural, and religious beliefs [6].

Low-Glycemic-Index Diets

A key element of nutritional therapy for the prevention and treatment of diabetes mellitus, especially type 2 diabetes, is low glycemic index (GI) meals. The propensity of foods containing carbohydrates to increase postprandial blood glucose levels in comparison to a standard reference, usually glucose or white bread, is the basis for the glycemic index, a physiological classification system [5]. Foods are classified as low (≤55), medium (56–69), or high (≥70) GI. Low-GI foods cause blood glucose levels to rise more slowly and steadily.

Low-GI diets have therapeutic value because they can regulate glucose homeostasis. These diets decrease postprandial hyperglycemia excursions and enhance insulin sensitivity by slowing stomach emptying and carbohydrate absorption [8]. Research suggests that following low-GI eating habits can lower glycated hemoglobin (HbA1c) levels by roughly 0.5% to 2%, making them useful for long-term glycemic control [20]. Low-GI diets have also been linked to better lipid profiles and a lower risk of cardiovascular problems, which are frequent comorbidities in people with diabetes [25].

Due to the availability of native foods with advantageous glycemic qualities, low-GI diets are both feasible and culturally adaptable in Nigeria. Legumes like cowpeas and bambara nuts, as well as staples like millet, sorghum, and unripe plantains, have comparatively low glycemic indices and are extensively consumed [35].

Similarly, fruits like apples and citrus, and vegetables like ugu (pumpkin leaves), bitter leaf, and okra provide micronutrients and dietary fiber that improve glucose control [15]. These foods help weight management, which is crucial for the prevention and treatment of diabetes, by controlling blood glucose levels and promoting satiety.

Conversely, high-GI foods, including refined grains (white rice, white bread), sugary beverages, and processed snacks, are rapidly digested and absorbed, leading to sharp increases in blood glucose and insulin demand. Frequent consumption of such foods has been linked to insulin resistance, obesity, and increased risk of developing type 2 diabetes [17]. The ongoing nutritional transition in Nigeria, characterized by increased intake of these energy-dense, low-fiber foods, has significantly contributed to the rising incidence of diabetes.

It is crucial to remember that the glycemic reaction to a meal is affected by a variety of factors, including portion size, food combinations, processing methods, and cooking techniques, in addition to the GI of specific items. For example, the overall glycemic impact of a meal can be reduced by combining carbohydrates with proteins, lipids, or dietary fiber [20]. Therefore, rather than focusing on specific food choices, dietary advice should highlight entire dietary patterns. Low-GI diets have various drawbacks despite their advantages. The whole nutritional makeup of foods is not taken into consideration by the glycemic index, and metabolic variations may cause individual glycemic reactions to differ. However, low-GI diets continue to be an affordable, evidence-based method for enhancing glycemic control and lessening the burden of diabetes when incorporated within a comprehensive dietary plan.

By delaying the absorption and digestion of carbohydrates, low-GI diets lower postprandial glucose increases. Including foods like millet, sorghum, beans, and unripe plantains promotes improved glucose management. Nutrition therapy aims to achieve individual glycemic, blood pressure, and lipid goals, achieve and maintain body weight goals, delay or prevent complications of diabetes, and encourage the enjoyment of a variety of nutrient-dense foods in appropriate portion sizes [26]. According to research, eating low-glycemic foods such as soybeans, grapefruits, bambara nuts, etc. will lessen the effects of diabetes mellitus on [37].

High-Fiber Diets

It is commonly known that eating a diet high in fiber can prevent type 2 diabetes. Diets high in fiber improve glycemic control through a variety of processes, such as improved insulin sensitivity, decreased postprandial glucose response, and delayed carbohydrate digestion. Soluble fiber lowers glucose absorption rates and increases blood glucose stability by slowing stomach emptying and creating viscous gels in the gut. The incidence of type 2 diabetes is inversely correlated with dietary fiber consumption, according to epidemiological data. People who eat a lot of whole grains, legumes, fruits, and vegetables are far less likely to develop diabetes than people who eat refined carbs, according to large cohort studies and meta-analyses [18]. Short-chain fatty acids, which enhance insulin sensitivity and control lipid metabolism, are also produced by fiber fermentation in the colon.

In the Nigerian context, dietary transition from traditional fiber-rich foods to refined carbohydrates has contributed significantly to the rising prevalence of diabetes. Urbanization and westernized diets have increased consumption of white rice, processed wheat products, and sugar-sweetened beverages, while reducing intake of indigenous high-fiber foods such as millet, sorghum, legumes, and leafy vegetables [19]. This nutritional shift has been identified as a key driver of metabolic disorders in Sub-Saharan Africa. Therefore, promoting high-fiber dietary patterns rooted in traditional Nigerian foods represents a culturally appropriate and cost-effective strategy for diabetes prevention and management (Famakin *et al*., 2016, Ogbonna *et al*., 2018).

Functional Foods and Nutraceuticals

Functional foods containing bioactive compounds (e.g., polyphenols and antioxidants) may enhance metabolic health. Indigenous foods such as moringa and bitter leaf have shown potential benefits. According to *[18]* functional foods provide health benefits beyond basic nutrition due to their bioactive components. Types include:

- **Fortified foods** (enhanced with vitamins/minerals)
- **Probiotic foods** (containing beneficial microbes)
- **Prebiotic foods** (supporting gut bacteria)
- **Whole foods** (naturally rich in bioactive compounds)

Examples include probiotic yogurt, fortified cereals, whole grains, and green tea.

However, Nutraceuticals originate from various sources:

- **Plants:** e.g., curcumin (turmeric), resveratrol (grapes), lycopene (tomatoes)
- **Animals:** e.g., omega-3 fatty acids (fish oil), collagen
- Microorganisms: e.g., probiotics

Key Components of Functional Foods and Nutraceuticals

Antioxidants

Antioxidant-rich functional foods, like fruits, vegetables, and nuts, are essential for scavenging free radicals. These substances aid in the prevention of chronic illnesses like cancer and cardiovascular disorders by lowering oxidative stress and inflammation. Additionally, they promote general health and vascular health [46]. Sesamol, sesamin, and sesamolin are among the chemicals that give sesame seed oil its remarkable antioxidant qualities. These bioactive substances have neuroprotective properties, improve detoxifying enzyme function, and guard against oxidative damage. Carotenoids, retinol, and α-tocopherol are among the water-soluble and lipid-soluble antioxidants found in milk. Antioxidant activity is also enhanced by bioactive peptides produced during digestion. Similar to this, honey has enzymes, flavonoids, and phenolics that lower the risk of disease and fight oxidative stress.

Prebiotics and Probiotics

Probiotics are live beneficial bacteria that promote gut health, whereas prebiotics are indigestible carbohydrates that promote the growth of helpful gut microbes.

These ingredients are abundant in foods like garlic, onions, bananas, yogurt, and fermented goods. Probiotics and prebiotics work together to support a balanced gut microbiome, which is critical for immune system performance, digestion, nutritional absorption, and even mental health. Improved immunity and a lower risk of certain diseases have been associated with a healthy gut microbiota [18].

Fatty Acids (Omega-3)

The health of the heart and brain depends on omega-3 fatty acids, which are present in foods like walnuts, flaxseeds, and fish. ALA, EPA, and DHA are the main varieties. In humans, the conversion of ALA into EPA and DHA is ineffective. Omega-3 fatty acids exert anti-inflammatory effects by inhibiting pathways involved in inflammation, such as COX enzymes and NF-κB signaling. They help reduce triglyceride levels, lower cardiovascular risk, and support brain function. DHA, in particular, is crucial for cognitive performance and may reduce the risk of neurodegenerative diseases [46].

Health Benefits of Functional Foods and Nutraceuticals

According to [17], these products offer multiple health advantages beyond basic nutrition, including:

- **Cardiovascular health:** Omega-3s, garlic, and plant sterols help reduce heart disease risk and lower cholesterol.
- **Digestive health:** Probiotics and prebiotics improve gut function and reduce digestive disorders.
- **Immune support:** Nutrients like vitamin C enhance immune defense.
- **Cognitive function:** Compounds such as omega-3s and ginkgo biloba support brain health.
- **Bone health:** Calcium and vitamin D strengthen bones and prevent osteoporosis.

Anti-inflammatory effects: Many compounds reduce inflammation and the risk of chronic diseases.

Weight Management

A key tactic in the prevention and treatment of type 2 diabetes mellitus (T2DM) is weight control, especially in societies like Nigeria, where the prevalence of overweight and obesity is on the rise. The risk of developing type 2 diabetes is increased by excess body weight, particularly central adiposity, which is significantly linked to insulin resistance and poor glucose metabolism [17], [20]. Obesity and diabetes are becoming more common in Nigeria as a result of the country's continuous nutritional transition, which is marked by a rise in the intake of processed foods high in energy and a decrease in physical activity [Ejike et al., 2012]. Insulin sensitivity and glycemic outcomes are improved by losing weight through calorie restriction and increased physical exercise. Long-term success requires sustainable lifestyle adjustments.

Medical Nutrition Therapy (MNT)

Medical Nutrition Therapy is a cornerstone in the management of type 2 diabetes mellitus and offers a structured, individualized, and evidence-based approach to dietary control. In Nigeria, its effectiveness is enhanced when combined with culturally appropriate foods and integrated with lifestyle interventions such as weight management and physical activity.

Strengthening MNT services can significantly reduce the burden of diabetes and improve long-term health outcomes [14].

MNT involves individualized dietary planning, often delivered by dietitians, focusing on carbohydrate monitoring, balanced nutrition, and patient education to support long-term diabetes management. In Nigeria, MNT is most effective when aligned with locally available and culturally acceptable foods. Traditional diets can be modified to support diabetes management without eliminating cultural food preferences [14].

Recommended Foods:

- Beans, cowpeas, lentils
- Whole grains (millet, sorghum, brown rice, acha)
- Vegetables (ugu, spinach, okra, bitter leaf)
- Fruits (orange, pawpaw, apple, watermelon)
- Lean proteins (fish, skinless poultry, eggs)

Foods to Limit:

- White rice, white bread, refined flour products
- Sugary beverages and sweets
- Deep-fried foods and trans fats
- Highly processed snacks

MNT in Nigeria must also consider affordability, food availability, and cultural eating patterns, including communal eating habits and meal timing.

Case Studies of Diabetes Mellitus

Diabetes can exacerbate a number of issues, including dementia, acute or chronic illnesses, decreased renal function, altered nutrient absorption, oral and dental issues, and digestive troubles [44]. The rise in the incidence and prevalence of metabolic diseases (like diabetes mellitus) in Nigeria and around the world calls for immediate action to prevent metabolic diseases in healthy individuals, as well as to adopt appropriate dietary management in patients with metabolic diseases. This is especially crucial in Nigeria, where the majority of people's diets consist mostly of basic foods high in carbohydrates [32]. While certain carbs are broken down slowly, others are broken down quickly, releasing glucose into the bloodstream. Health problems associated with high blood glucose such as obesity, metabolic syndrome and diabetes are due to high glycemic [33].

Case Study 1: A 52-year-old urban male with newly diagnosed type 2 diabetes (fasting glucose 9.5 mmol/L, BMI 31 kg/m^2) adopted a calorie-controlled, low-GI diet rich in legumes and vegetables. After 12 weeks, fasting glucose reduced to 6.8 mmol/L with modest weight loss.

Case Study 2: A 45-year-old rural female with impaired glucose tolerance improved glycemic indices through increased fiber intake (vegetables, whole grains) and daily physical activity, preventing progression to diabetes over six months. Table 1 shows the Statistical Summary of Diabetes Prevalence in Nigeria.

Table 1: Statistical Summary of Diabetes Prevalence in Nigeria

Period	Estimated Prevalence (%)	Source
1990s	2.2	Early national surveys
2010–2017	5.7	Systematic reviews
2020s	7.0	Recent estimates

Source: *[30]*

Table 2: Summary of the the incidences of Diabetes Mellitus in different Geopolitical Zones in Nigeria and their Sources

S/no	Author	Year	State	Geopolitical zone	Study Design	Prevalence (%)
1.	(Adijat, Folakemi, Adejumo, & Atolagbe, 2021)	2021	Osun	South-west	Retrospective descriptive	2.6
2.	(Gezawa *et al.*, 2015)	2015	Maiduguri	North-east	Prospective	7.0
3.	(Ramalan, Habibu, Maiyaki, Uloko, & Muhammad, 2021)	2021	Kano	North-west	Prospective	4.1
4.	(Akinlade, Lasebikan, Satope, & Rahamon, 2017)	2018	Oyo	South-west	Cross-sectional	7.3
5.	(Danjin, Usman, & Adamu, 2016)	2017	Gombe	North-east	Retrospective descriptive	5.2
6.	(Aladeniyi *et al.*, 2017)	2017	Oyo	South-west	Cross-sectional	5.3
7.	(Sabir, Isezuo, & Ohwovoriole, 2011)	2011	Sokoto	North-west	Cross-sectional prospective	4.6
8.	(Omorogiuwa *et al.*, 2010)	2010	Edo	South-south	Cross-sectional	9.0
9.	(Ekpenyong, Akpan, Ibu, & Nyebuk, 2012)	2012	Akwa Ibom	South-east	Cross-sectional	23.1
10.	(Oyegbade, Abioye-Kuteyi, Kolawole, Ezeoma, & Bello, 2007)	2007	Osun	South-west	Cross-sectional	5.0
11.	(Puepet & Ohwovoriole, 2008)	2008	Plateau	Northcentral	Cross-sectional prospective	4.0
12.	(Nyenwe, Odia, Ihekwaba, Ojule, & Babatunde, 2003)	2003	Port Harcourt	South-south	Cross-sectional prospective	6.8
13.	(Anzaku & Musa, 2013)	2012	Plateau	Northcentral	Cross-sectional prospective	8.3
14.	(Adeniyi, Uloko, & Musa, 2010)	2010	Kano	North-west	Cross-sectional	2.0
15.	(Etukumana, Puepet, & Obadofin, 2013)	2014	Plateau	Northcentral	Cross-sectional prospective	4.1
16.	(Nwafor & Owhoji, 2001)	2001	Port harcourt	South-south	Cross-sectional preospective	2.3
17.	(Ejike, Uka, & Nwachukwu, 2015)	2015	Abia	South-east	Cross-sectional	3.0
18.	(Isara & Okundia, 2015)	2015	Edo	South-south	Cross-sectional	5.0
19.	(Enang *et al.*, 2014)	2014	Cross River	South-south	Cross-sectional	7.0
20.	(MA., 2016.)	2016	Kano	North-west	Prospective	10
21.	(Olamoyegun, Iwuala, Olamoyegun, Olaniregun, & Kolawole, 2015)	2014	Oyo	South-west	Prospective	7.0

Source: *[46]*

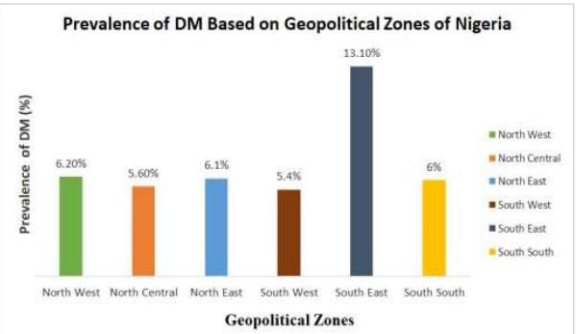

Figure 2: Prevalence of DM across geopolitical zones of Nigeria

Source: *[46]*

The geo-political zones of Nigeria included in this study were: North-west, North-east, North-central, South-west, South-South, and Southeast, it involves all categories of individuals aged 18 years and above. The total number of participants recruited in all the reported studies was 63259 [46]. The prevalence ranges from 2.0% in Kano to 23.1% in Akwa Ibom, with a mean prevalence of 6.3%. The prevalence of DM in each geopolitical zone is shown in Figure 2 below. Southeast has the highest prevalence of DM (13.1%) while Southwest has the lowest prevalence of DM (5.4%) [46].

Sample Nigerian Dietary Meal Plans for Diabetes

Breakfast: Oatmeal with groundnuts and a small portion of fruit.
Lunch: Brown rice with vegetable soup (ugu, okra) and grilled fish.
Dinner: Beans porridge with steamed vegetables.
Snacks: Fresh fruits (moderate portions) and nuts.

Alternative Plan:

Breakfast: Unripe plantain porridge.
Lunch: Millet swallow with vegetable soup.
Dinner: Moi-moi with salad.
Snacks: Carrots and cucumbers.

Public Health Implications

To combat diabetes in Nigeria, multi-sectoral strategies are required, including health education, improved access to wholesome foods, and legislative modifications that reduce the consumption of dangerous products. In Nigeria, the prevalence of type 2 diabetes mellitus (T2DM), a major public health concern with extensive social, economic, and medical consequences, is rising. Rising obesity rates, sedentary lifestyles, and ongoing dietary changes have caused the disease to spread from metropolitan elites to rural populations. Nigeria's already overworked healthcare system is being strained by diabetes, a chronic non-communicable disease (NCD) [25].

2. Burden on the Health System

According to [21], the need for healthcare services, such as diagnosis, long-term monitoring, and complication management, has dramatically increased due to the rising incidence of type 2 diabetes. Numerous Nigerian healthcare institutes deal with issues like:

- Limited availability of endocrinologists and dietitians
- Inadequate screening programs for early detection
- High patient-to-doctor ratios
- Insufficient access to essential medications and diagnostic tools

As a result, many cases are diagnosed late, often when complications such as neuropathy, nephropathy, or cardiovascular disease have already developed.

3. Economic Burden

- People with diabetes, their families, and the healthcare system all bear a heavy financial burden. Direct expenses include things like medication, lab work, hospital stays, and problem-solving. Indirect costs include things like decreased productivity, disability, and early mortality. Nigeria's high out-of-pocket healthcare expenditures cause many people to suffer from catastrophic health spending, which can lead to treatment cessation and poor sickness outcomes [25].

4. Changes in Lifestyle and Nutrition

According to [27], the ongoing nutrition change in Nigeria is one of the biggest public health causes of diabetes, and it is typified by:

- Increased consumption of refined carbohydrates (white rice, bread, pastries)
- High intake of sugar-sweetened beverages
- Increased fast-food consumption
- Decline in traditional high-fiber diets

These dietary shifts, combined with reduced physical activity due to urbanization, have accelerated the prevalence of obesity and insulin resistance.

5. Inequities in Disease Distribution

- Socioeconomic inequality has an impact on T2DM in Nigeria. While rural communities can have less access to healthcare facilities and diabetes education, urban inhabitants are more likely to have sedentary lives and consume processed meals. Furthermore, low-income groups are more likely to develop metabolic diseases because they frequently eat cheap, low-nutrient diets.

6. Difficulties in Public Health

The following are major obstacles to diabetes care in Nigeria:

Low knowledge of early symptoms and risk factors.

- Inadequate systems for routine screening and surveillance. Inadequate incorporation of nutrition services into primary healthcare, inadequate availability of nutritious foods in impoverished urban populations, cultural myths and attitudes around diabetes [20], [21]. treatment.

Strategies for Prevention and Control:

A multi-sectoral approach is necessary for an effective public health response:

Health Promotion and Education: Programs for community-based education should focus on:

- Benefits of high-fiber diets
- Importance of weight management
- Reduction of refined sugar and processed foods
- Physical activity promotion

Screening and Early Detection: Routine screening for high-risk individuals (obese, hypertensive, family history) is essential for early diagnosis and prevention of complications.

Nutrition Policy Interventions

Government policies should promote:

- Availability and affordability of whole grains, legumes, and vegetables
- Regulation of sugar-sweetened beverages
- Nutrition labeling and public awareness campaigns

Integration into Primary Healthcare

Primary healthcare treatments, such as Medical Nutrition Therapy (MNT) and lifestyle counseling, should include diabetes prevention and control.

Role of Nutrition in Public Health Prevention

At the population level, nutrition continues to be the key to preventing diabetes. Disease incidence can be considerably decreased by promoting low-GI foods, high-fiber diets, and weight-management techniques. Promoting traditional Nigerian diets high in vegetables, legumes, and whole grains provides an affordable and culturally acceptable solution [5].

Conclusion

Over the past few decades, diabetes mellitus has become a serious public health concern in Nigeria, where its prevalence has expanded dramatically. This emerging tendency is closely linked to rapid urbanization, lifestyle changes, and the continuous nutritional shift characterized by increased consumption of processed foods, refined carbs, and high-calorie diets combined with decreased physical activity. According to epidemiological data demonstrating a steady rise in prevalence, millions of Nigerians either have diabetes or are at high risk due to low glucose tolerance. Type 2 diabetes, which is still the most prevalent type, is primarily brought on by modifiable risk factors such as obesity, sedentary lifestyles, and unhealthy eating habits.

Sadly, a significant percentage of cases go undetected, which increases the risk of consequences such as retinopathy, nephropathy, neuropathy, and cardiovascular illnesses, as well as late presentation. In addition to lowering quality of life, these issues place a heavy financial strain on people, families, and the healthcare system.

Unfortunately, a large portion of cases remain undiagnosed, raising the risk of late presentation and consequences such as retinopathy, nephropathy, neuropathy, and cardiovascular diseases. These problems not only reduce quality of life but also put a significant financial burden on individuals, families, and the healthcare system.

In Nigeria, nutritional therapy has become essential for managing and preventing diabetes. This review's findings show that dietary treatments can dramatically improve glycemic control, lower HbA1c levels, and stop the progression of diabetes. Examples of these interventions include low glycemic index diets, high fiber intake, weight management techniques, and the addition of functional foods. Additionally, regionally accessible foods and culturally tailored Nigerian meal plans offer workable and long-lasting solutions for managing diabetes.

Notwithstanding these encouraging tactics, a number of issues still exist, such as restricted access to dietetic services, low public awareness, financial limitations, and inadequate healthcare infrastructure. Effective diabetes control at the individual and population levels requires addressing these obstacles. All things considered, the fight against diabetes in Nigeria necessitates an integrated strategy that includes early detection, lifestyle change, nutritional therapy, and robust public health regulations.

Recommendations

- **Strengthening Public Health Policies**

The Nigerian government should develop and implement comprehensive national diabetes preventive and control initiatives. High-fat diets, sugar-filled beverages, and ultra-processed meals ought to be outlawed. Subsidies and incentives should be provided to promote the production and consumption of healthful, locally sourced foods, including legumes, whole grains, fruits, and vegetables.

- **Encouraging Nutrition Education and Awareness**

To inform the public about the causes, risk factors, and prevention of diabetes, extensive public health initiatives should be carried out. The significance of balanced meals, portion control, and foods with a low glycemic index should be emphasized in nutrition education. To be effective, community-based awareness initiatives should be adapted to local languages and cultures.

- **Integration of Medical Nutrition Therapy (MNT) into Healthcare**

In Nigeria, primary healthcare services ought to incorporate medical nutrition therapy. Hospitals and community health centers should hire more qualified dietitians and nutritionists. Continuous education on the dietary treatment of diabetes should be provided to medical practitioners.

- **Promotion of Healthful Lifestyle Habits**

Regular physical activity, such as walking, cycling, or organized exercise regimens, should be promoted. Strategies for managing weight should be encouraged, especially for those who are overweight or obese. To encourage sustained commitment to healthy lifestyles, behavioral interventions ought to be used.

- **Early Diagnosis and Screening**

Diabetes and prediabetes should be routinely screened for, particularly in high-risk groups. Early detection of undiagnosed instances should be achieved through community engagement efforts. Widespread access to reasonably priced diagnostic services is necessary.

- **Promotion of Research and Data Collection**

To track changes in diabetes incidence and prevalence in Nigeria's various areas, more epidemiological research should be done. To provide dietary recommendations that are culturally appropriate, research should concentrate on native foods and their glycemic effects. To direct interventions and resource distribution, data-driven policies ought to be promoted.

- **Encouragement of Nutraceutical Development and Functional Foods**

The creation and marketing of nutraceuticals and functional foods generated from regional resources, such as whole grains, legumes, and moringa, should be funded. To encourage innovation in this field, cooperation between government, business, and academia should be improved.

- **Enhancement of Healthcare Facilities**

Healthcare institutions should have access to diagnostic equipment and prescription drugs in order to successfully manage diabetes. To lessen the differences in diabetes care between urban and rural areas, rural healthcare systems should be improved. Health insurance coverage should include diabetes management services, including nutrition counseling.

- **Development of Culturally Appropriate Dietary Guidelines**

Traditional Nigerian foods that have been shown to improve glycemic control should be included in national dietary guidelines. To assist people in making educated nutritional decisions, useful meal plans ought to be distributed. Dietary guidelines should take cultural and religious factors into account.

- **Collaboration across Sectors**

It is crucial that government agencies, healthcare providers, educational institutions, and non-governmental organizations work together. Redesigning products to include less sugar, salt, and unhealthy fats should be the focus of the food sector. Healthy nutrition and physical activity should be encouraged in schools and workplaces.

Authors' Contributions Statement:

- Prof. Owuamanam, C.I.: Conceived and designed the study.
- Monu, A I.O.: Conducted the literature search.
- Ofoedum, A.F.: Conducted the data collection.
- Prof. Bede, E.N.: Drafted and revised the manuscript.
- Monu, A.I.O. AND Ibeabuchi, J.C.: proofread and revised the manuscript.
- Ofoedum, G.N: Revised the manuscript
- OCI, BEN, MAIO, IJC. OGN and OAF Read and approved the final version of the manuscript.

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