Preventing Diabetes Mellitus in Nigeria: Effect of Physical Exercise, Appropriate Diet, and Lifestyle Modification

Olasunkanmi R. Adeleke    George O. Ayenigbara
Department of Human Kinetics and Health Education, Adekunle Ajasin University, Akungba Akoko, Nigeria

Abstract
In this systematic review, we explored the effects of physical activity, diet, and lifestyle on the prevention of diabetes mellitus in Nigeria. Diabetes is an autoimmune disease which occurs when the body does not produce or respond properly to insulin, a hormone essential for daily life. Diabetes is an incurable disease, which has no racial, social, or sex barrier. The risk factors include a poor diet, lack of physical activity, obesity, and an unhealthy lifestyle. About 100 million people in the United States have diabetes mellitus, and the total economic costs of diabetes exceed USD 132 billion a year. Diabetes accounts for 1 in every 10th USD spent on health care in the United States, and an estimated 48 million Americans may develop diabetes by 2050. However, it is estimated that in 90% of the patients with type 2 diabetes the disease could be prevented if people adopted a healthy lifestyle, including regular physical activity, a moderate-good diet, and modest weight. Because of the deleterious health consequences which include blindness; kidney damage; cardiovascular disease; and reduced life span, as well as high treatment costs, prevention of the disease in Nigeria, where you are confronted with a poor health care system, poverty, and ignorance, but also have ample opportunities for physical activity and rich local nutrients to supply an ideal diet, is a viable option. Consequent upon this, the paper recommends, among others, that available local resources be used for this purpose.

Introduction
Diabetes mellitus is an incurable chronic disease affecting people of all races, sex, economic and social status, and of all ages. About 100 million people in the United States have diabetes mellitus, a disease in which the body does not produce or respond properly to insulin, a hormone essential for daily life [1]. In those with diabetes, the pancreas, which produces insulin (the hormone that regulates carbohydrate and fat metabolism), does not function as it should. The pancreas, located below the stomach, contains the islets of Langerhans cells, which produce glucagon and insulin, which are critically important in metabolism. While glucagon stimulates the release of glucose and, therefore, acts to elevate blood sugar levels, the action of the insulin is the opposite. Insulin decreases the level of glucose in the
body by causing tissue cell membranes to open in order that glucose can enter the cells more freely [2].

Glucose is the primary form of sugar that the body cells use for energy production. When a person without diabetes eats a meal, the level of glucose in the blood rises, triggering the production and release of insulin by special cell clusters in the pancreas; the insulin produced allows to use glucose effectively by the body. Without sufficient insulin, the glucose in the blood is unable to enter most body cells, so the cells' energy needs are not met. The levels of glucose in the blood rise higher after each meal. This unused glucose eventually passes through the kidneys, which are unable to process the excessive glucose, and thus expel them through the urine.

Deprived of the fuel it needs, the body begins to break down stored fat as a source of energy. This process produces weak acids called ketones. A buildup of ketones leads to ketoacidosis, an upheaval in the body’s chemical balance that brings on nausea, vomiting, abdominal pain, lethargy, and drowsiness. Severe ketoacidosis can lead to coma and eventually death. Diabetes can lead to deleterious complications. Uncontrolled glucose levels slowly damage blood vessels throughout the body; thus, individuals who become diabetic early in life may face devastating complications even before they reach middle age [3]. Diabetes is the number 1 cause of blindness, nontraumatic amputation, and kidney failure, and diabetes increases the risk of heart attack or stroke by 2 or 3 times [1].

It is estimated that 90% of cases of type 2 diabetes could be prevented if people adopted healthy lifestyle behaviors, including regular physical activity, a moderate diet, and modest weight loss. For people with prediabetes, healthy lifestyle measures are more effective than medication for delaying or preventing the development of diabetes. Exercise (endurance and/or strength training) are important to prevent diabetes. Also important is a moderate diet to control body fat.

Nigeria is a developing nation that is plagued with low level of education, superstition, poverty, poor health care services, and near nonexistent health statistics. If the costs of diabetes in America are more hat USD 132 billion a year (according to the American Diabetes Association) and about 100 million people have diabetes mellitus [1], the situation in Nigeria could be better imagined than experienced. Sequel to this, it became imperative to review preventive efforts because prevention of diabetes mellitus is better than cure, and also because Nigeria offers abundant opportunities for physical activity and local diet, the key preventive and management components of diabetes mellitus.

### Methodology

This is a theoretical research on the prevention of diabetes mellitus in Nigeria through the exploration of effects of physical activity, diet, and lifestyle modification. As such, the method used was a systematic review process to search for studies in different reputable journals. Articles from international health agencies such as the World Health Organization were also consulted.

### Deleterious Consequences of Diabetes Mellitus

Though there is no accurate statistics on the morbidity, mortality, and economic effects of diabetes mellitus in Nigeria, available records from developed nations like America indicate that diabetes mellitus may be placing a huge burden on Nigerians. Specifically, elevated blood sugar levels seem to be involved in the development of:

1. Damage to the blood vessels – leaving diabetics prone to cardiovascular disease (diabetics are twice as likely as other people to have hypertension and to develop heart disease) [2].
2. Damage to the retina – leaving diabetics at risk of blindness (diabetics are 17 times as likely to go blind as nondiabetics).

In addition, diabetics, compared with nondiabetics, have double the risk of cancer of the pancreas [4]. Furthermore, the diagnosis of any chronic disease produces an impact the patient has to contend with. The emotional reaction to having a lifelong incurable disease, as well as the lifestyle adjustments required by the disease, may constitute a problem for the patient and their family members [5].

Also, diabetes shortens life expectancy by an average of 8 years – 7.8 years for men and 8.4 years for women [6]. The risk of premature death among people with diabetes is about twice that of people without the disease; furthermore, according to the American Diabetes Association, the total economic costs of diabetes are more than USD 132 billion a year. Diabetes accounts for 1 of every 10th USD spent on health care in the United States, and an estimated 48 million Americans may develop diabetes by 2050 [7]. In Nigeria, a poor nation, provided with a poor health care system and near nonexistent health statistics, the costs of treating diabetes, in addition to the morbidity and man hour losses due to the disease, could be enormous and devastating.
**Prevention of Diabetes Mellitus**

Diabetes mellitus is an incurable chronic disease; therefore, efforts should be directed at the prevention and management of the disease. According to previous studies [1, 4, 8, 9], key component factors to prevent diabetes mellitus include, among others, physical exercise, diet, and lifestyle modification.

**Exercise and Diabetes Prevention**

Exercise may enhance glucose tolerance and insulin sensitivity in several ways. In their review, Borghouts and Keizer [8] noted that both acute and chronic exercise may affect blood glucose and insulin activity favorably. According to them, up to 2 h after an acute bout of exercise, glucose uptake is in part elevated due to an insulin-independent mechanism, probably involving an exercise-induced increase in GLUT-4 receptors in the cell membrane. Additionally, an exercise bout can increase insulin sensitivity for up to 16 h afterwards. Chronic exercise training potentiates the effect of exercise on insulin sensitivity through multiple adaptations in glucose transport and metabolism.

Exercise heightens the sensitivity to insulin (a great benefit for diabetics) and may lower the risk of developing diabetes. In studies of high-risk individuals who exercised, took medication, or did nothing, those who became more active had the lowest incidence of diabetes [10]. Also, apart from making cells more sensitive to insulin, exercise (endurance and strength training) helps stabilize blood glucose levels [11]. Exercise burns excess sugar and makes cells more sensitive, and exercise also helps to keep body fat at a healthy level and to prevent obesity, a key risk factor for type 2 diabetes.

Borghouts and Keizer [8] conclude that exercise plays an important, if not essential, role in the prevention and treatment of impaired insulin sensitivity. Given the epidemic of obesity and type 2 diabetes in the United States and other industrialized nations, these beneficial effects of exercise on carbohydrate metabolism underscore its importance as preventive medicine.

**Nutrition and Diabetes**

A carefully planned diet, containing the right components of balanced nutrients in adequate proportion, is indispensable for preventing diabetes mellitus. A balanced diet contains carbohydrates, fats and oil, proteins, vitamins, mineral salts, and water.

Carbohydrates are converted to glucose after digestion, and, with the help of insulin, this glucose will enter the cells to be used for energy production. But when glucose fails to enter the cell, it remains in the blood and is filtered by the kidneys into the urine. To prevent this situation, individuals should refrain from refined sugars and consume carbohydrates which contain fibers. Refined sugars have been alleged to contribute to a wide variety of health problems, including obesity, diabetes, heart diseases, and cancer. A diet rich in high-glycemic-index foods theoretically may lead to insulin resistance and high serum triglyceride levels – risk factors for diabetes and heart disease [12].

On the other hand, complex carbohydrates, i.e., carbohydrates with plenty of fibers, are health friendly. Those consuming complex carbohydrates are less likely to develop diabetes than those eating less fibers [13]. To corroborate this assertion [1], it was opined that eating more fruits, vegetables, and whole grains, but no fat or low-fat milk and dairy products, is a healthful way to get the carbohydrates you need. Fiber-rich choices have the added benefit of promoting digestive health and reduce the risk of type 2 diabetes and heart disease. Other forms of fiber-rich carbohydrate sources in Nigeria are cocoyam, sweet potatoes, plantain, water yam, cassava, maize, and grains.

Also, vitamins are important components of the diet for preventing diabetes mellitus. Vitamins are needed in small quantities, and they are involved in almost every metabolic process in the human body. For example, vitamin D may enhance immune cell functions to help prevent autoimmune diseases like type 1 diabetes. Harris [14] indicated that a dose of ≥2,000 IU daily may have a strong protective effect on children at risk for type 1 diabetes. Besides, vitamins enhance overall well-being of individuals, help to protect against diseases, and facilitate recovery from illness.

In Nigeria, vitamins are obtained from a variety of fruits and vegetables, such as onions, tomatoes, citrus, grapes, garden eggs, pepper, spinach, banana, mango, cashew, waterleaf, and bitter leaf, etc. Vitamins are also obtained from food crops such as nuts, cereals, and grains. Vitamin D can also be produced when the skin is exposed to the sunlight [15].

Coffee and tea consumption prevents the development of diabetes mellitus. Over the course of the past 10 years, several studies have shown that consumption of caffeinated beverages such as coffee and tea are associated with a reduced risk of type 2 diabetes. Huxley et al. [4] affirmed that every additional cup of coffee consumed in a day was associated with a 7% reduction in the excess risk of diabetes. They also reported that decaffeinated coffee and tea are beneficial, and concluded that high intakes of coffee,
decaffeinated coffee, and tea are associated with a reduced risk of diabetes. Such a finding suggests that other components in coffee and tea, such as magnesium, chromium, lignans, and chlorogenic acid, may be involved. Therefore, decaffeinated coffee, coffee, and tea may be consumed to prevent and manage type 2 diabetes.

**Ways to Lower the Risk of Developing Type 2 Diabetes**

To prevent diabetes, one should modify what one does and what one consumes. It is important to watch what you eat to avoid overweight or obesity. Type 2 diabetes is a health problem associated with overweight or obesity. More than 80% of people with type 2 diabetes are overweight. You can lower your risk for developing type 2 diabetes by losing your weight and increasing the amount of physical activity you do. Obesity contributes to health problems in several ways. Obesity increases the buildup of fat cells; fat cells secrete hormone-like substances called adipokines (adipocytokines) into the bloodstream, which may affect metabolic processes, and some of these effects are pathogenic, such as an increased insulin resistance, a factor in diabetes development. It is, perhaps, as a result of this that diabetes was identified as a health problem associated with obesity.

As a part of lifestyle modification, you should refrain from consuming soft drinks such as coca cola, sprite, fruit juices, 7UP, Fanta, and malt drinks, for example. In a review of 88 studies, researchers linked soft drinks with increased calorie intake, higher body weight, lower consumption of calcium and other nutrients, and a greater risk of other medical problems such as diabetes. In a long-term, large-scale study of women, those who consumed ≥1 soft drink per day had twice the risk of developing diabetes compared to those who consumed ≤1 soft drink a month [16].

In addition, alcohol consumption should be stopped as a part of lifestyle modification. Apart from the other deleterious consequences of alcohol, experts [10, 17–19] affirmed that alcohol consumption causes obesity. Just as obesity is a causative factor of diabetes mellitus, because it induces insulin resistance, leading to excess production of insulin, a situation which may lead to insulin finding its way in large quantity to the blood stream and consequently in the urine [12]. To further underscore the relationship between obesity and diabetes, Gibbs [20] affirmed that obesity increases the risk of type 2 diabetes by an astonishing 1,480% with a BMI of 27–29; 2,660% with a BMI of 29–31; 3,930% with a BMI of 31–33; and 5,300% with a BMI of 33–35.

Another important aspect of lifestyle modification for preventing diabetes and obesity is avoiding a sedentary lifestyle and living an active life. Apart from helping the body to function at its best, an active lifestyle, like physical activity, speeds up metabolism and builds lean body mass, so an active lifestyle helps the body to burn more calories, and body fat decreases, thus preventing obesity and concomitant diabetes mellitus. An active lifestyle heightens the sensitivity to insulin (a great benefit for diabetes) and may lower the risk of developing diabetes [1]. An increase in physical activity can prevent type 2 diabetes even in those at high risk of developing the disease. In studies of high-risk individuals who exercised, took medication, or did nothing, those who became more active had the lowest incidence of diabetes [10].

It is, therefore, necessary that, apart from deliberate participation in physical exercise, individuals should be active in performing daily chores such as sweeping, cutting grasses, brisk walking, washing, and gardening, and for example. Individuals should refrain from sitting for hours watching videos or films and using an elevator and house help to do house chores. In rural Nigeria where opportunities abound for active living, such as trekking long distances to the farm, bush clearing, manual cultivation of the land, and hunting, people should avail themselves of these opportunities.

Another aspect of lifestyle modification one can adopt to prevent diabetes mellitus is regular medical checkup. To underscore the importance of early medical checkup for diabetes prevention, the American Diabetes Association recommends screening every 3 years for all men and women from 45 years of age onwards. The American College of Endocrinology recommends screening at age 30 years for individuals at risk, including those who are overweight, sedentary, have a family history of diabetes, or have high blood pressure or heart disease. Random blood glucose testing is important as well as tests for stress and depression, both factors that are known to glucose metabolism and control [21]. To prevent the onset of diabetes, therefore, one should avoid a lifestyle that may predispose individuals to emotion, stress, and depression.

**Conclusion**

After review of the available literature, the following conclusions are drawn:
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Diabetes mellitus is an incurable autoimmune disease that can be prevented through physical exercise, diet, and lifestyle modification. Obesity is a key causative risk factor of diabetes mellitus; diabetes mellitus affects predisposed individuals irrespective of age, sex, race, or socioeconomic status. Diabetes is a costly disease to control, and, therefore, prevention is a viable option. Health education, focusing on an appropriate diet, a healthy lifestyle, and physical activity, is imperative for preventing diabetes mellitus.

**Recommendations**

Consequent upon these conclusions, the following recommendations were made:

Individuals should be encouraged to create time to take part in regular physical exercises. Healthy diets, prepared with locally available nutrients, should be consumed to prevent diabetes mellitus. Individuals should live an active life. A sedentary lifestyle should be avoided to prevent obesity, which is a causative risk factor in diabetes mellitus. Health education, with emphasis on a healthy lifestyle, i.e., regular physical exercise and consumption of an appropriate diet, should be transmitted to Nigerians by the local, state, and federal governments. Nigerians should be encouraged to inculcate the habit of a regular medical checkup to detect the early onset of diabetes and, thus, prevent the development of diabetes mellitus.

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**Statement of Ethics**

As this study was designed as a write-up paper, there were no ethical issues.

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