**BSC. FOOD SCIENCE NUTRITION AND DIETETICS.**

**PROJECT**

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**Prevalence of type 2 diabetes and dietary behavior in Upper Kabete**

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# Abstract

Diabetes mellitus is a global health challenge with increasing prevalence, particularly in low- and middle-income countries. This study focuses on the impact of dietary habits and lifestyle behaviors on the prevalence of diabetes in the local community of upper Kabete, Kenya. The research aims to assess the association between dietary patterns and the risk of type 2 diabetes, examine how the socio-cultural environment affects dietary preferences, and evaluate the effectiveness of different nutrition interventions in managing type 2 diabetes.

The study employs a cross-sectional design, with data collected through surveys and interviews among community members. Statistical analysis, including the Mann-Whitney U test and regression analysis, will be used to analyze the data and determine the factors influencing the prevalence of diabetes in the community.

The findings of this research are expected to contribute to the understanding of the epidemiology of diabetes in the local community of upper Kabete and provide insights for healthcare providers, policymakers, and public health agencies in devising evidence-based strategies to combat and prevent diabetes. By identifying key factors influencing the prevalence of diabetes, this study aims to improve diabetes management, enhance preventive measures, and ultimately enhance the overall health and well-being of the community.

# INTRODUCTION

### Background Information

Diabetes is a chronic, metabolic disease characterized by elevated levels of blood glucose over a long period of time, which leads over time to serious damage to the heart, blood vessels, eyes, kidneys and nerves (1). While 70–110 mg/dL fasting blood glucose is considered normal, blood glucose levels between 100 and 125 mg/dL are considered prediabetes, and 126 mg/dL or higher is defined as diabetes [2].

Diabetes mellitus is the most challenging public health threat of the twenty-first century and is an epidemic in many economically developing countries [3]. Diabetes is a major cause of morbidity and mortality worldwide yet preventable [[4](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10529624/)]. Diabetes is one of the most common noncommunicable diseases globally and it is the fourth-leading cause of death. Globally, an estimated 451 million individuals had diabetes in 2017, which is projected to rise to 693 million by 2045 [[5](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10127498/)].

The most common is type 2 diabetes, usually in adults, which occurs when the body becomes resistant to insulin or doesn't make enough insulin [[6](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10127498/)]. While it usually affects mature adults (over 40), younger people are also now being diagnosed in greater numbers as rates of overweight and obesity increase [7].

Type 2 diabetes mellitus (T2DM) accounts for approximately 90% of diabetes cases and drives the pandemic. In 2010, about 12.9 million people were killed by ischemic heart disease and stroke, an increasingly important risk factor for which is diabetes. As of 2015, more than 415 million adults have diabetes, and this number is expected to increase to 642 million by 2040 [8].

Diabetes is directly related to lifestyle habits such as dietary behavior, smoking and the level of activity; they soon progress and become chronic following its natural history if not diagnosed early and necessary interventions taken [9]. For people living with diabetes, access to affordable treatment, including insulin, is critical to their survival. There is a globally agreed target to halt the rise in diabetes and obesity by 2025 [[10](https://www.canada.ca/en/public-health/services/publications/diseases-conditions/framework-diabetes-canada.html)].

Analyzing the incidence trend of T2DM can help to understand and control the burden of disease. A major concern in diabetes is the complications that occur due to long-standing hyperglycemia [11]. The complications including cardiovascular diseases, neuropathy, nephropathy and retinopathy lead to disability and mortality. Hence, optimal glycemic control is fundamental to prevent and or delay these complications. Such improved glycemic control demands to be underpinned by self-management measures [[12](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10127498/)].

Self-management is the process of actively engaging in self-care activities with the goal of improving one’s behavior and well-being. Diabetes self-management includes regular exercise, taking a recommended diet, proper intake of prescribed medications, and blood glucose monitoring [[13](https://www.mountsinai.org/health-library/diseases-conditions/diabetes)].

### Statement of the Problem

Type 2 diabetes is emerging as a constant threat globally. It is one of the most common noncommunicable diseases globally. It is the fourth-leading cause of death and is an epidemic in many economically developing countries ([14](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4755459/)). In the past three decades the prevalence of type 2 diabetes has risen dramatically in countries of all income levels and has a more scope of development in developing countries like Kenya.

About 422 million people worldwide have diabetes, the majority living in low-and middle-income countries, and 1.5 million deaths globally are directly attributed to diabetes each year. Both the number of cases and the prevalence of diabetes have been steadily increasing over the past few decades. Undiagnosed diabetes poses a public health concern with costly public health implications especially in Africa [(15](https://bmcpublichealth.biomedcentral.com/articles/10.1186/s12889-018-6053-x)).

In Kenya, NCDs are estimated to account for 27% (284,000) of all deaths, with diabetes being responsible of about 10,000 deaths ([NIH](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10529624/#:~:text=In%20Kenya%2C%20NCDs%20are%20estimated,years%20%5B11%2C%2012%5D.)). In 2021, International Diabetes Federation reported Kenyan diabetes related mortality at approximately 15, 284 persons among individuals aged between 20–79 years. In 2013, the adjusted prevalence of diabetes in Kenyan adults was estimated at 3.6% which is projected to rise to 4.4% if no mitigations efforts are enforced by 2035 ([16](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10529624/)).

Health services struggle to cope with the demand to manage this chronic disease, particularly in Kenya. Evidence indicates that, if patients can keep their blood glucose levels low, the incidence of complications can be reduced, resulting in reduced hospital interventions and reduced health care system costs ([17](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10127498/)).

In 2021, the prevalence of type 2 diabetes (based on linked NDSS and APEG data) generally increased with increasing remoteness area. Age-standardized rates among people living in Remote and very remote areas were 1.4 and 1.5 times as high as those living in Major Cities and Inner regional areas, respectively. This disparity was more pronounced among females than males [(18](https://www.aihw.gov.au/reports/diabetes/diabetes/contents/how-common-is-diabetes/type-2-diabetes)).

There is a scarcity of data on health system diabetes service readiness and availability in Kenya ([19](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10529624/)). In Kenya, limited studies have been conducted to assess the prevalence of diabetes in the local communities and the availability of healthcare facilities in terms of diabetes management capacity ([20](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10529624/)).

### Justifications

Research shows that type 2 diabetes can be prevented or delayed with lifestyle changes. People with type 2 diabetes can't properly use the insulin made by their bodies, or their bodies aren't able to produce enough insulin ([21](https://www.who.int/news-room/fact-sheets/detail/diabetes#:~:text=A%20healthy%20diet%2C%20regular%20physical,screening%20and%20treatment%20for%20complications.)).

It is most commonly developed in adulthood, although it can also occur in childhood ([22](https://www.diabetes.ca/about-diabetes-(3)/what-is-diabetes#:~:text=Type%202%20diabetes%20is%20most,require%20medications%20or%20insulin%20therapy.)). Type 2 diabetes can sometimes be managed with healthy eating and regular exercise alone, but may also require medications or insulin therapy.

Due to unawareness among Kenyans, two-thirds of diabetic patients are undiagnosed and this is quite a big challenge to the health sector. With so many undiagnosed diabetics the country’s progress towards fighting and possibly eradicating diabetes becomes a more difficult task ([23](https://afyacode.com/diabetes-statistics-in-kenya/)).

It is therefore crucial to examine the burden and risk factors for diabetes and in the same way investigation into the specific availability and readiness of diabetes services.

The goal of this study is to develop a comprehensive analysis of the nutritional habits and dietary choices, factors influencing these choices and how it contributes to the prevalence of diabetes among different age groups within the local community of upper Kabete.

The outcomes will not only contribute to the academic understanding of diabetes epidemiology but will also provide nuanced understanding of the local health landscape that is crucial for healthcare providers, policymakers, and public health agencies in devising evidence-based strategies to combat and prevent diabetes.

By fostering a more targeted and efficient allocation of resources, this project has the potential to improve diabetes management, enhance preventive measures, and ultimately enhance the overall health and well-being of the community.

### Research Questions

What are the prevalent dietary habits and lifestyle behaviors among different age groups in the local community of upper Kabete?

How do these dietary habits and lifestyle behaviors correlate with the prevalence of diabetes in the community?

What socio-cultural factors influence dietary preferences and lifestyle behaviors related to diabetes in upper Kabete?

What are the main challenges faced by individuals in upper Kabete in maintaining healthy dietary habits and lifestyle behaviors to prevent diabetes?

### Hypothesis

Null Hypothesis (H0) - There is no significant association between dietary habits and lifestyle behaviors and the prevalence of diabetes in the local community of upper Kabete.

Alternative Hypothesis - There is a significant association between dietary habits and lifestyle behaviors and the prevalence of diabetes in the local community of upper Kabete.

Null Hypothesis - There is no significant difference in the prevalence of diabetes between different age groups in the local community of upper Kabete.

Alternative Hypothesis - There is a significant difference in the prevalence of diabetes between different age groups in the local community of upper Kabete.

### Objectives

* + 1. General Objective:

To determine the impact of dietary habits and lifestyle behaviors on the prevalence of diabetes among different groups.

* + 1. Specific Objectives:

To assess the association between dietary patterns and the risk of Type 2 diabetes.

To determine how the socio-cultural environment affects dietary preferences.

To assess how different nutrition interventions can be applied in the management of type 2 diabetes.

# LITERATURE REVIEW

### Overview

Diabetes, also called diabetes mellitus, is a condition that affects insulin, a hormone that breaks down sugars in the food you eat and converts them into glucose to fuel the body [(24](https://www.hopkinsmedicine.org/health/conditions-and-diseases/diabetes) ).

### How diabetes occurs

The medical name for diabetes is diabetes mellitus which has both Greek and Latin roots. Diabetes comes from Greek word that means to siphon and the most obvious sign of diabetes is excessive urination. Mellitus comes from a Latin word that means sweet like honey. The urine of a person with diabetes contains extra sugar [(25](https://www2.gvsu.edu/chm463/diabetes/diabetes-mellitus-good.htm) ).

Insulin is a hormone made by the pancreas that acts like a key to let glucose from the food we eat pass from the bloodstream into the cells in the body to produce energy. It also allows glucose to be stored in muscle, the liver and other tissues. This is part of a process known as glucose metabolism.

The body breaks down all carbohydrate foods into glucose in the blood, and insulin helps glucose move into the cells. When the body cannot produce or use insulin effectively, this leads to high blood glucose levels, called hyperglycemia.

The body uses glucose as its main source of energy. Glucose comes from foods that contain carbohydrates, such as potatoes, bread, pasta, rice, fruit and milk. When you have diabetes, your body either doesn’t respond to insulin or doesn’t produce insulin at all. This causes sugars to build up in your blood, which puts you at risk of dangerous complications [(26](https://www.hopkinsmedicine.org/health/conditions-and-diseases/diabetes)). After food is digested, the glucose is released and absorbed into the bloodstream. The glucose in the bloodstream needs to move into body tissues so that cells can use it for energy. Excess glucose is also stored in the liver, or converted to fat and stored in other body tissues.

Diabetes mellitus and diabetes insipidus are two distinct medical conditions that share the common symptom of increased thirst and urination but have different causes and treatments:

##### Diabetes Mellitus:

Diabetes mellitus, often referred to as just diabetes, results from problems with insulin, a hormone that regulates blood sugar (glucose).

There are two main types, Type 1 and Type 2 diabetes, with different underlying causes.

Type 1 Diabetes - Autoimmune destruction of insulin-producing beta cells in the pancreas, leading to an absolute insulin deficiency.

Type 2 Diabetes - Typically characterized by insulin resistance, where the body's cells don't respond effectively to insulin, and a relative insulin deficiency. Management involves medications (including insulin), lifestyle modifications, and dietary changes to regulate blood sugar levels.

###### Diabetes Insipidus:

Diabetes insipidus is a rare condition caused by a problem with the hormone vasopressin (antidiuretic hormone) or the kidneys' response to it. It leads to the inability to concentrate urine properly, resulting in excessive urination and thirst.

Central Diabetes Insipidus - Caused by defects in vasopressin (antidiuretic hormone, ADH) synthesis or release, often due to damage to the hypothalamus or pituitary gland.

Nephrogenic Diabetes Insipidus - Results from the kidneys' inability to respond to vasopressin.

Dipsogenic diabetes insipidus relates to disturbances in the hypothalamic control of thirst.

Treatment - Management depends on the type and cause of diabetes insipidus and may involve medications to replace vasopressin or improve kidney responsiveness.

2.1.1. Whys is diabetes increasing?

Type 2 diabetes is increasing at the fastest rate. There are large numbers of people with silent, undiagnosed type 2 diabetes which may be damaging their bodies. An estimated 2 million Australians are at high risk of developing type 2 diabetes and are already showing early signs of the condition.

Type 2 diabetes is one of the major consequences of the modern lifestyle. The combination of easy availability of high energy (kilojoule) foods at cheap prices, combined with more sedentary work and less physical activity, means most populations are developing more type 2 diabetes.

Genes also play a part with higher risk of type 2 diabetes in Chinese, South Asian, Indian, Pacific Islander and Aboriginal and Torres Strait Islander populations ([27](https://www.diabetesaustralia.com.au/about-diabetes/what-is-diabetes/)).

### Types of Diabetes

Diabetes can be classified as type 1, type 2 or gestational.

* + 1. Type 1 Diabetes

Type 1 diabetes, also called insulin dependent diabetes, is an autoimmune disease in which the immune system attacks and destroys the cells in the body that produce insulin. Type 1 diabetes generally develops in childhood or adolescence, but can also develop in adulthood. The rate of type 1 diabetes is rising worldwide, with the greatest increase occurring in children younger than age 5.

In people with type 1 diabetes, the body does not make enough of the hormone insulin, which enables the body to convert glucose into energy. Type 1 diabetes develops when the insulin-producing beta cells in the pancreas are destroyed due to an autoimmune process in which the body’s immune system mistakenly destroys its own organs or tissues. The onset of symptoms can happen quickly. People with type 1 diabetes may need daily insulin shots ([28](https://www.hopkinsmedicine.org/health/conditions-and-diseases/diabetes)) .

* + 1. Type 2 Diabetes

Type 2 diabetes is a metabolic disorder that results from the body’s inability to make enough insulin or to properly use insulin. Type 2 diabetes is the most common type of diabetes. In type 2 diabetes, the pancreas produces enough insulin, but the body cannot use it effectively. This is referred to as insulin resistance. Gradually, insulin production slows down, as is the case in type 1 diabetes. Previously unheard of in children and teens, type 2 diabetes is now being diagnosed more often in children and teens, which some research links to increasing rates of childhood obesity ([29](https://www.hopkinsmedicine.org/health/conditions-and-diseases/diabetes)).

The prevalence of type 2 diabetes in adolescents and young adults is dramatically increasing. Similar to older-onset type 2 diabetes, the major predisposing risk factors are obesity, family history, and sedentary lifestyle. Onset of diabetes at a younger age (defined here as up to age 40 years) is associated with longer disease exposure and increased risk for chronic complications. Young-onset type 2 diabetes also affects more individuals of working age, accentuating the adverse societal effects of the disease.

* + 1. Gestational Diabetes

Gestational diabetes develops during pregnancy when a hormone made by the placenta prevents the mother’s body from using insulin effectively. It is not caused by a lack of insulin but by other hormones produced during pregnancy that can make insulin less effective. Gestational diabetes insipidus results from excess maternal production of prostaglandins or it is due to placental synthesis of an enzyme called vasopressinase (leucyl cysteinyl aminopeptidase) that results in degradation of vasopressin [(30](https://themedicalbiochemistrypage.org/diabetes-type-1-and-type-2/)).

Gestational diabetic symptoms disappear following delivery of the baby [(31](https://www.hopkinsmedicine.org/health/conditions-and-diseases/diabetes)). Between three and 20 per cent of pregnant women develop gestational diabetes, depending on their risk factors. A diagnosis of gestational diabetes may increase the risk of developing diabetes later in life for both mother and child [\_ (32](https://www.diabetes.ca/about-diabetes/what-is-diabetes)).

* + 1. Prediabetes

In a condition called prediabetes, the blood sugar level is elevated but not to a degree that constitutes diabetes. People who have repeated tests showing elevated fasting glucose have increased risk of developing full-blown diabetes.

Pre-diabetes has no symptoms, but has a range of risk factors including obesity, smoking, heart disease, polycystic ovarian syndrome and high blood pressure. Without treatment, about one in 3 people with pre-diabetes will develop type 2 diabetes.

### Health Implications of diabetes

When the body cannot produce or use insulin effectively, this leads to high blood glucose levels, called hyperglycemia. Over the long-term high glucose levels are associated with damage to the body and failure of various organs and tissues ([33](https://www.diabetes.ca/managing-my-diabetes/preventing-complications/kidney-disease)).

Type 2 diabetes silently takes hold in the body over a matter of years, compromising the body’s ability to regulate blood sugar. By the time the disease is diagnosed, organ damage has often already occurred, and may be irreversible, even if the disease is well controlled thereafter [(34)](https://www.thinkglobalhealth.org/article/what-do-about-type-2).

Diabetes is among the leading cause of renal failure, limb amputation, blindness and a major trigger of cardiovascular disease which is a leading cause of death in diabetic patients. The complications of undetected, untreated and unmanaged diabetes result in serious human suffering and disability ([35](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10529624/)).

* + 1. People with Diabetes Have a Higher Risk of Colon Cancer

People with diabetes had a 47% increased risk of getting colorectal cancer, compared to people without diabetes, according to results of a large new study. Getting a colonoscopy dramatically reduced the risk, the results showed ([36](https://www.webmd.com/diabetes/news/20231114/people-diabetes-increased-risk-colon-cancer-study)).

People diagnosed with diabetes within the past 5 years have the greatest colorectal cancer risk, the study found, suggesting screening should be part of a person’s health care after they are diagnosed with diabetes ([37](https://www.webmd.com/diabetes/news/20231114/people-diabetes-increased-risk-colon-cancer-study)).

* + 1. Diabetes and Cardiovascular Complications

Diabetes mellitus (DM) is a strong predictor of cardiovascular morbidity and mortality and is associated with both micro- and macrovascular complications.Cardiovascular disease (CVD) causes up to 70% of all deaths in people with DM.

The chronic macro and microvascular complications of diabetes mellitus pose serious health challenges. Metabolic syndrome (MetSy) is characterized by central obesity, glucose intolerance, hyperinsulinemia, low high-density lipoproteins (HDLs), high triglycerides (TGs), and hypertension. MetSy precedes or accompanies diabetes, and it has been linked to an increased risk of cardiovascular disease and premature death ([38](https://www.cureus.com/articles/151022-metabolic-syndrome-in-type-2-diabetes-mellitus-patients-prevalence-risk-factors-and-associated-microvascular-complications#!/)).

### Symptoms of Diabetes

Depending on the type, diabetes can cause too much glucose in the blood or too little.

* + 1. Hyperglycemia (High Blood Sugar)

Diabetes is characterized by a failure to secrete enough insulin. Insulin is a hormone produced in the pancreas. It is needed by the body to convert glucose into energy. Without adequate insulin, abnormally high levels of glucose accumulate in the blood.

* + 1. Hypoglycemia (Low Blood Sugar)

Hypoglycemia is characterized by a blood sugar level that is too low to fuel the body’s normal functioning. Hypoglycemia may be a condition by itself, a complication of diabetes or a sign of another disorder.

Low blood sugar is defined as blood sugar below 70 milligrams (mg) per deciliter (dL). If your blood sugar stays low, you can become confused and have trouble speaking and seeing. Blood sugar that stays low for a longer period of time can lead to serious complications such as a coma or seizures ([39](https://www.healthline.com/health/diabetes/blood-sugar-level-chart#how-to-raise-blood-sugar)).

Problems with blood sugar regulation due to diabetes can cause: Headaches and irritability, Increased thirst due to frequent urination, Increased appetite (Hunger), Weight loss, Blurred vision, Fatigue (Unable to concentrate).

Even though type 1 diabetes may take years to develop, the onset of symptoms is fairly sudden and rapid. Undiagnosed and untreated, a person with type 1 diabetes can go into a life-threatening diabetic coma (ketoacidosis). Symptoms of type 2 diabetes are the same as the symptoms of type 1 diabetes, but unlike type 1 diabetes, symptoms tend to develop slowly and gradually  [(40)](https://www.hopkinsmedicine.org/health/conditions-and-diseases/diabetes).

### Risk factors for Diabetes

* + 1. The multiple causation of diabetes

Type 2 diabetes is a multifactorial disease meaning that it is influenced by the presence of multiple factors.

Diabetes, like most NCDs, results from a combination of genetic, physiological, behavioral and environmental factors ([41](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10529624/)). Other identified disease drivers include aging population, rapid urbanization and globalization of unhealthy lifestyle.

-Family history – People with relative who have diabetes are at risk of developing diabetes.

* Ethnic background - Among US adults aged 18 years or older, crude data for 2019–2021 indicated that non-Hispanic Asian adults, Asian Indian (10.8%) and Filipino (12.2%) subgroups had the highest prevalence [(42](https://www.cdc.gov/diabetes/data/statistics-report/index.html)).
* Age: Type 2 diabetes generally occurs in middle-aged adults, most frequently after age 40
* Gestational diabetes – people who developed diabetes during pregnancy are at increased risk of developing diabetes again later in life.
* Lifestyle – lifestyle activities such as smoking, consumption of high cholesterol food and use of alcohol contributes greatly the development of diabetes.

It is therefore crucial to understand the mechanism of action of diabetes, its impact on health and have a comprehensive analysis of how dietary patterns and level of regular physical activity is directly associated with the risk of Type 2 diabetes. It is important to also determine the interrelationship between diabetes and hypertension, multiple aspect of these chronic diseases and how different nutrition interventions can be applied in the management of type 2 diabetes.

### Diagnosis of diabetes

* + 1. Why should you measure your blood sugar?

Keeping track of your blood sugar is one of the most important elements of diabetes management. Careful monitoring of your blood sugar and knowing what may cause it to rise or fall can help you and a health team develop a diabetes care plan and set treatment goals. Measuring your blood sugar can help you:

* monitor how medications are impacting your blood sugar levels
* determine how different meals and food choices impact your blood sugar
* determine whether exercise or other lifestyle changes are impacting your blood sugar levels
  + 1. Test For Diabetes

Three tests can help health care professionals make a diagnosis of prediabetes and diabetes:

##### Fasting Plasma Glucose Test

A fasting plasma glucose test requires fasting (nothing to eat or drink except water) for eight hours before the test. You will have your blood drawn for this test. Then the plasma (the fluid part of the blood) is combined with other substances to determine the amount of glucose in the plasma. Blood glucose is measured in milligrams per deciliter (mg/dL).

##### Oral Glucose Tolerance Test **(OGTT)**

This test measures how well the body handles a standard amount of glucose. Patients are not allowed to eat for at least 12 hours before the test. A blood sample is then taken to measure the patient's fasting blood glucose level.

##### HbA1C (A1C or glycosylated hemoglobin test)

The A1C test can diagnose prediabetes and diabetes. It measures you average blood glucose control for the past two to three months. Blood sugar is measured by the amount of glycosylated hemoglobin (A1C) in blood.

### Preventing and Treating Diabetes

By managing your weight through proper nutrition and regular physical activity, quitting smoking, and finding healthy ways to deal with stress, you can prevent or delay the onset of diabetes or minimize its impact on your body. A healthy lifestyle will also reduce your risk of developing other medical conditions.

Treatment for diabetes depends on its type and severity, and may include:

* Frequent blood glucose checking to monitor blood glucose levels
* Lifestyle changes, including diet and exercise
* Oral medication
* Daily insulin injections
  + 1. Diabetes is a lifestyle disease

Being obese increases your risk of developing diabetes. Losing body weight and getting regular physical activity can significantly reduce your risk of developing diabetes.

Regular physical activity helps lower insulin resistance. This means your body can use its own insulin more effectively.

High blood pressure has been linked to complications from diabetes. People with diabetes and HBP should maintain a blood pressure of less than 130/80 mm Hg. Normal blood pressure is below 120/80 mm Hg

Diet is one of the most important modifiable risk factors for prediabetes and Type 2 diabetes. A healthy diet should also replace saturated fats with monounsaturated and polyunsaturated fats, avoid trans fats, reduce cholesterol and sodium (salt) and limit red and processed meats, refined carbohydrates and sweetened beverages.

Stressed people have a tendency of increased blood pressure which is a risk factor for developing type 2 diabetes.

* + 1. **R**ole of Nutrition in prevention and intervention of type 2 diabetes

Nutrition is fundamental for the treatment of type 2 diabetes. Different dietary Approaches and their effects on blood glucose regulation can be applied to curb and in the management of type 2 diabetes. Portion control, consuming food high in dietary fibre, food with low glycemic index, food preparation methods and overall dietary balance does bring blood sugar levels to ranges hence helps to manage diabetes.

Research shows that food and nutrition insecurity put people at risk of developing type 2 diabetes. In fact, adults who experience food and nutrition insecurity are 2 to 3 times more likely to have diabetes than people who do not experience food and nutrition insecurity ([43)](https://www.cdc.gov/diabetes/library/features/diabetes-and-food-insecurity.htm).

* 1. Diet

Diabetes is a lifestyle disease that is usually influenced by dietary behavior such as consuming foods with high glycemic index that increases sugar levels, consuming low fibre foods that increases digestion rate and causes blood glucose to rise.

The idea of being on a “diet” for a chronic lifelong condition like diabetes is enough to put many people off as knowing what to eat and maintaining an optimal eating pattern are challenging [(44](https://www.bmj.com/content/361/bmj.k2234)).

* 1. Glycemic Index

Eating healthy foods with a low glycemic index (GI) can help to optimize your blood sugar levels. This includes wholegrain breads, minimally processed breakfast cereals like rolled or steel cut oats, legumes, fruit, pasta and dairy products [(45](https://www.healthdirect.gov.au/type-2-diabetes))

* 1. Cholesterol

High cholesterol levels increase the probability of developing type 2 diabetes. Consuming proteins rich in fats such as meat and butter increase cholesterol levels in the blood vessels which increases the probability of hypertension. Hypertension is particularly associated with increased risk of developing type 2 diabetes.

* 1. Food preparation method

Food preparation is a factor for diabetes. For example, blending fruits rather than consuming as a whole which increases surface are for digestive juices and hence high blood glucose.

* 1. Portion sizes

Portion sizes can vary widely across cultures. Some cultures emphasize large portion sizes, which can lead to overconsumption of carbohydrates and calories, potentially exacerbating diabetes management.

* 1. Alcohol

Heavy use of alcohol can cause inflammation in the pancreas and limit its ability to produce enough insulin. Alcohol can cause liver damage and adds more sugar and starch to your diet that must either be used or stored as fat. Moderate your alcohol intake. Calories from alcohol are stored in the liver as fat. Liver fat makes liver cells more insulin resistant and can make your blood sugars higher over time [(46](https://www.mountsinai.org/health-library/selfcare-instructions/diabetes-and-alcohol#:~:text=When%20you%20drink%20alcohol%2C%20your,low%20blood%20sugar%20(hypoglycemia).)).

* 1. Vitamins

Antioxidant vitamins A, C and E are found decreased in diabetic subjects, possibly due to an increased need to control the excessive oxidative stress produced by abnormalities in glucose metabolism (PubMed).

* 1. Thiamin (vitamin B1)

Thiamine acts as a coenzyme in the active transference of aldehyde groups and glycation, as well as in neuro-transmission and neuronal conductivity, and may have effects on the development of various diabetic complications ([47](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4435229/)).

* 1. Pyridoxine (vitamin B6)

Diabetic Peripheral Neuropathy is one of the most important and significantly prevalent microvascular complications of Diabetes Mellitus. Pyridoxine is a key nutrient for protecting nerve health ([48](https://www.sciencedirect.com/science/article/pii/S1319016423000555)). One of the contributing factors for diabetic neuropathy is the advanced glycated end products which are predominantly higher in case of excessive oxidative stress. [Pyridoxine deficiency](https://www.sciencedirect.com/topics/pharmacology-toxicology-and-pharmaceutical-science/pyridoxine-deficiency) might contribute to this pathway ([49](https://www.sciencedirect.com/science/article/pii/S1319016423000555)).

* 1. Amino acids

Type 2 diabetes is often preceded by a long period of prediabetes, characterized by insulin resistance and impaired insulin secretion. Several amino acids (AAs) have been shown to be associated with insulin resistance and increased risk of type 2 diabetes.

1. Tryptophan

Dietary tryptophan was significantly associated with decreased risk of obesity and T2D risk ([50](https://onlinelibrary.wiley.com/doi/full/10.1002/oby.23343#:~:text=%E2%96%BA%20Dietary%20tryptophan%20can%20improve,rise%20of%20postprandial%20blood%20glucose.)). Accumulating data indicate that an altered metabolism of tryptophan and its active metabolites have important roles for the pathogenesis and development of complications of diabetes mellitus ([51](https://link.springer.com/chapter/10.1007/978-3-319-15630-9_7)).

1. Phenylalanine

phenylalanine modifies insulin receptor beta (IRβ) and inactivates insulin signaling and glucose uptake and positively correlated with T2D onset ([52](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9314339/#:~:text=Here%2C%20we%20report%20that%20phenylalanine,insulin%20resistance%20and%20T2D%20symptoms.)).

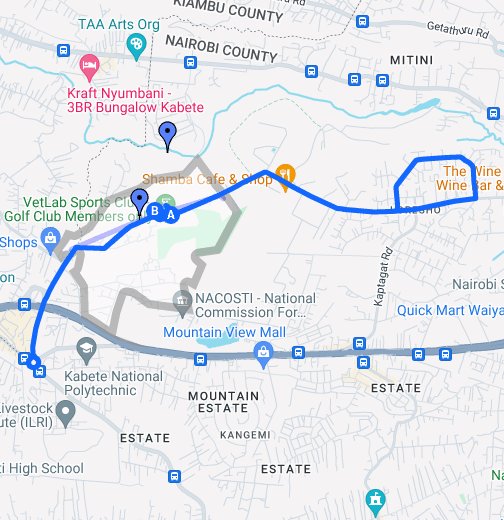
* 1. **Blood glucose levels and obesity**

Obesity is a major risk factor for cardiovascular disease and type 2 diabetes. Evidence from observational studies and randomized trials suggests that prediabetes and type 2 diabetes mellitus (T2DM) can develop in genetically susceptible individuals in parallel with weight (that is, fat) gain. Accordingly, studies show that weight loss can produce remission of T2DM in a dose-dependent manner ([53](https://www.nature.com/articles/s41574-020-0381-5)).

# MATERIALS AND MTHODS

### Study Site

The study will be conducted in upper Kabete, a suburban area in Kenya. The community is diverse, with a mix of residential and commercial areas. The population includes individuals from various age groups and socioeconomic backgrounds, providing a representative sample for the study.



### Study Design

This study will utilize a cross-sectional research design to assess the impact of dietary habits and lifestyle behaviors on the prevalence of diabetes among different age groups in the local community of upper Kabete, involving data collection at a single point in time.

### Study Population

The study population will include adults aged 18 years and above residing in upper Kabete. Participants will be selected using a stratified random sampling technique to ensure representation from different age groups and socioeconomic backgrounds.

* + 1. Inclusion criteria

Adults aged 18 years or older.

Residents of the selected Kenyan community for at least one year (to ensure consistent exposure to the local dietary environment).

Willing to provide informed consent.

People previously diagnosed with type 2 diabetes.

* + 1. Exclusion criteria

Individuals with a previous diagnosis of Type 1 Diabetes Mellitus.

Individuals currently pregnant or breastfeeding (as hormonal changes can impact blood glucose levels).

Individuals with conditions that could significantly interfere with dietary assessment or glucose measurements (this will need further specification based on your study's focus).

### Sample size determination

Fischer’s formula is suitable to determine the sample size since the study population is heterogeneous. The approach partitions the subjects into multiple strata, so that each stratum consists of homogeneous subjects and hence the stratified analysis has an improved testing power.

Confidence level (Z) = 1.96

Estimated proportion of the population with the characteristic of interest (P) = 0.5 (for maximum variability)

Margin of error (E) = 0.05 (5%)

Design effect (DE): 1 (assuming simple random sampling)

n=(E2Z×P×(1−P)​)×DE

n=(0.0521.96×0.5×(1−0.5)​)×1

n=(1.96×0.5×0.50.0025)×1

n=(0.00251.96×0.5×0.5​)×1

n=(1.96×0.250.0025)×1n=(0.00251.96×0.25​)×1

n=(0.490.0025)×1n=(0.00250.49​)×1

n=196

### Sampling method

Data will be collected using a structured questionnaire that will be administered to participants in face-to-face interviews. The questionnaire will include questions on demographic information, dietary habits, lifestyle behaviors, and medical history related to diabetes.

Anthropometric measurements taken using steel measuring tape and weighing scale to determine the prevalence of overweight and obesity through BMI.

##### SAMPLING PROCEDURE (sampling schema)

**Purposive Sampling KITISURU (WARD)**

**Purposive Sampling UPPER KABETE**

**SIMPLE RANDOM HOUSEHOLDS**

**QUANTITATIVE INDIVIDUALS**

##### ii) DATA COLLECTION TOOLS AND STATISTICAL ANALYSIS PROCEDURES

|  |  |  |  |
| --- | --- | --- | --- |
| **Variables** | **Methods** | **Tools** | **Analysis** |
| **Gender** | **Surveys** | **Observational Survey** | **SPSS** |
| **Dietary Preferences & Habits** | **Household interviews** | **Face to Face Survey** | **Excel** |
| **Diabetes knowledge and Awareness** | **Household surveys** | **Structured Questionnaires** | **SPSS** |

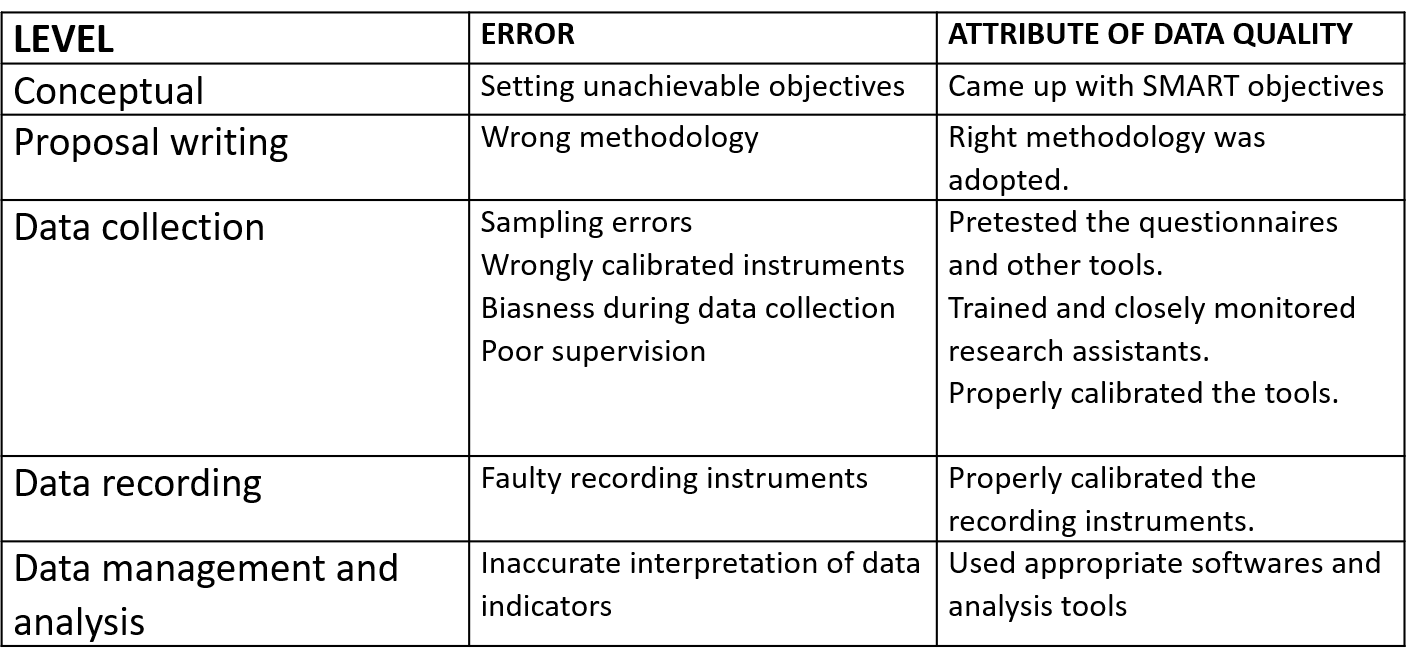
### Data Management

Data will be coded using standardized coding system to ensure consistency and ease of analysis.

Regular data monitoring will be conducted to ensure data quality and accuracy. This will involve checking for missing data, outliers, and inconsistency.

Data will be store and managed using secure computer systems and software like excel. Statistical software packages such as pandas will be used for data analysis.

##### DATA QUALITY CONTROL



Regular data monitoring was conducted to ensure data quality and accuracy. These involved checking for missing data, outliers, and inconsistency. Data is stored and managed using secure excel software.

Informed consent was obtained from all participants before data collection, and confidentiality of participants' information was ensured throughout the study.

### Limitations of The Study

The cross-sectional design of the study limits the ability to establish causality between dietary habits, lifestyle behaviors, and the prevalence of diabetes.

The study relies on self-reported data, which may be subject to recall bias and social desirability bias.

The study is limited to a specific geographic area (upper Kabete), which may limit the generalizability of the findings to other populations.

### Data analysis and presentation

Descriptive statistics will be used to summarize the characteristics of the study population, and inferential statistics to assess the association between dietary habits, lifestyle behaviors, and the prevalence of diabetes.

Multivariate analysis i.e. logistic regression will be used to identify independent associations between dietary patterns and T2DM prevalence while controlling for potential confounding factors (e.g. age, sex, bmi).

Mann-Whitney U test will be used determine whether there are significant differences in the prevalence of diabetes between different groups based on their dietary habits or lifestyle behaviors.

One sample t test will be used to determine the prevalence of T2DM in Upper Kabete based on the prevalence at national level.

### Ethical Considerations

Ethical approval for the study will be obtained from the relevant institutional review board. Informed consent will be obtained from all participants before data collection, and confidentiality of participants' information will be ensured throughout the study.

# DATA ANALYSIS

### Lifestyle Behaviors

|  |  |  |
| --- | --- | --- |
| **Weekly Consumption** | **Average Consumption Index** | **% Consumption Index** |
| Consumption Of Fruits And Vegetables | 159 | 81 |
| Consumption Of Beverages On | 94 | 47.6 |
| Consumption Of High Fat Foods | 89 | 45.2 |
|  |  |  |

|  |  |  |
| --- | --- | --- |
| **Behavioral Factor** | **Average Hours (per week)** | **Average Hours (per week)** |
| Physical activity(exercise & sports) | 27 hours | 16 % |
| Being Sedentary( Watching TV & using the computer). | 21 | * 1. % |

### Socio-cultural characteristics

### Diabetes Knowledge And Awareness

### DISCUSSION

High prevalence of type 2 diabetes was directly attributed to cultural practices and beliefs including cultural norm, beliefs and practices.

Demographic factors including the level of income were shown to contribute to the prevalence of type 2 diabetes in upper Kabete.

The high rate of unemployment in upper Kabete is an attribute that directly influence the high prevalence rate of type 2 diabetes.

# RECOMMENDATIONS

Implement targeted nutrition education programs that promote healthy eating habits and raise awareness about the link between diet and diabetes.

Advocate for policies that increase the availability and affordability of healthy food options in upper Kabete, such as subsidizing fresh produce and establishing farmers' markets.

Promote Regular Physical Activity by Organizing community-based physical activity programs, such as group fitness classes, sports leagues, and walking clubs.

Strengthen Healthcare Services for Diabetes Management byIncreasing the availability and accessibility of diabetes screening and diagnostic services in local health facilities.

# CONCLUSION

Through comprehensive data collection and analysis, we have identified significant associations between specific dietary patterns, socio-cultural factors, and the risk of type 2 diabetes.

The findings emphasize the importance of tailored nutrition interventions and the need for increased awareness and education about diabetes prevention and management.

Through collaborative efforts and evidence-based interventions, we can make significant strides in addressing the diabetes epidemic and promoting healthier lifestyles.

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