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Factors that Influence the Management of Type 2 Diabetes Mellitus among Adults in Nigeria: A Systematic Review and Meta-Analysis

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Abstract

Introduction: A sizable fraction of Nigeria's adult population suffers from type 2 diabetes mellitus (T2DM), a chronic illness. To lower the disease's morbidity and mortality, T2DM must be well managed. The objective of this systematic review is to locate and summarize recent findings on the factors that affect the management of T2DM among adult populations in Nigeria.

Methods: To find pertinent studies released between 2012 and 2022, a thorough search was carried out using electronic databases, such as PubMed, MEDLINE, and Science Direct. The final analysis comprised data from 14 research works. For analysis and discussion, the study used a mixed-methods research design that included both qualitative and quantitative data. For this review, the Critical Appraisal Skills Programme (CASP) method was used to appraise each article's quality.

Results: The results indicated that several factors affect the management of T2DM among adults in Nigeria. These factors include poor health, illiteracy, inadequate access to healthcare facilities, cultural beliefs, lack of social support, low medication adherence, and poor lifestyle choices. Additionally, the review revealed that there are challenges to implementing effective diabetes management programs in Nigeria, such as inadequate funding, limited resources, and a lack of trained healthcare professionals. Furthermore, this study identified several interventions that could improve the management of T2DM, including community-based interventions, patient education, and task shifting.

Conclusion: The findings provide insight into the factors affecting the management of T2DM among adults in Nigeria. The study highlights the importance of a multifaceted approach to diabetes management that addresses the social determinants of health, promotes patient education and self-management, and leverages community-based interventions. Additionally, this review underscores the need for increased funding and resources to support diabetes management programs in Nigeria. Further research is needed to evaluate the effectiveness of these interventions in improving diabetes management in Nigeria.

Keywords: *Diabetes mellitus type 2, Etiology in Nigeria, Management and intervention*

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1. Introduction

In diabetes mellitus (DM), a non-communicable disease that is significant for public health, the body's capacity to convert glucose (sugar) into energy is compromised (Garcia, 2017; Elias *et al*., 2018). The effects that DM has on those who cannot support themselves financially, as well as its chronic nature and high cost of care, highlight its importance (Wareham and Herman, 2016). DM occurs when the pancreas either produces insufficient insulin or when the body cannot effectively use the insulin produced (WHO, 2022). This usually develops when the functions of the islets of Langerhans are compromised, or the glycogen catabolic pathways appear to insufficiently utilize insulin (WHO, 2021; Nall, 2021 Watson, 2020a). Insulin is a hormone that controls blood sugar levels and inhibits lipolysis to quickly stimulate fat accumulation (Roden and Shulman, 2019). When DM is left untreated, hyperglycemia—characterized by blood glucose levels over 125 mg/dL—is often a sign of metabolic issues (Mouri and Badireddy, 2022).

There are several primary types of diabetes mellitus, including Type 1 and Type 2, Latent Autoimmune Diabetes in Adults (LADA), Gestational Diabetes, Diabetes Associated with Cystic Fibrosis, MODY (Maturity Onset Diabetes of the Young), Steroid-Induced Diabetes; and Secondary Diabetes, such as Brittle Diabetes and Bariatric Surgery-Induced Diabetes (Auvinen *et al*., 2020). In the case of Type 1 Diabetes Mellitus (T1DM), loss of beta cells in the pancreas, which results in an autoimmunity-related decrease in insulin production and insulin insufficiency, are hallmarks (Saul *et al*., 2015). T1DM, as for T2DM, is a chronic autoimmune disease characterized by hyperglycemia (increased blood sugar levels), which is brought on by a lack of insulin as a consequence of the degeneration of pancreatic islet cells (Katsarou *et al*., 2020; Chukwuma, 2018). Gestational diabetes, a condition that only occurs during pregnancy, is a precursor to type 2 diabetes, which normally goes away after giving birth (Saul *et al*., 2015), in healthy individuals.

Although there are three primary types of diabetes, Type 2 diabetes mellitus (T2DM) is receiving increasing attention due to an increase in its incidence across the world (Chan and Luk 2016). Given that Nigeria is the second most predominant nation in Africa after South Africa, in terms of T2DM prevalence, the country is worth examining (IDF, 2019). According to Sbraccia *et al.* (2002), insulin resistance and pancreatic beta-cell dysfunction are the main causes of T2DM. The most common form of T2DM is linked to obesity and being overweight (WHO, 2019). Adults often require many years to become aware of it in its asymptomatic state. Therefore, the best way to monitor T2DM is via risk variables such as age, race, family history, and history of gestational diabetes (CDC, 2021).

By registering complications like coronary heart disease, peripheral arterial disease, stroke, peripheral neuropathy, diabetic kidney disease, myocardial infarction, sepsis in women, and mortality, Type 2 Diabetes mellitus (T2DM) has established itself as a "local and global Public Health emergency" in the twenty-first century (Al-Lawati, 2017; Tomic *et al.*, 2022; Gregg *et al*., 2016; Bellary, 2022). Pancreatic beta-cell death is distinctive to all kinds of diabetes mellitus from an aetio-pathological standpoint (Schwartz *et al*., 2016; Skyler *et al*., 2017). Autoimmunity, inflammation, environmental variables, genetic abnormalities and predispositions, insulin resistance, comorbid diseases, and epigenetic processes have been identified as some pathways that cause the pancreatic beta-cells to lose their efficacy or die (Kahn *et al*., 2014).

Currently, a Random Blood Glucose Test (RBGT), a fasting plasma glucose measurement (FPGM), glycated hemoglobin (HbA1c), and a 2-hour post-load plasma glucose test [PLPGT] are all indicated as diagnostic tests for diabetes mellitus (WHO, 2022). Hyperglycemia is defined by RBGT non-fasting blood glucose levels below 200 mg/dL, FPGM levels below 126 mg/dL, HbA1c levels below 6.5%, and PLPGT levels below 200 mg/dL (Pippitt *et al.*, 2016).

There are several strategies used to control T2DM. Among them are stress reduction, dietary changes, better sleep habits, moderation in physical activity, bariatric surgery for obesity, the management of cardiovascular risk factors, exercise, psychological assessment and care, vaccination, weight loss, health promotion, and the use of anti-diabetic medications (Imam, 2012). New developments have produced advancements in the treatment of T2DM (Borse *et al*., 2021). Scheen (2021) reported that recent developments have been used to combat the threat of T2DM, including novel insulin analogues, enhanced pump technology, multi-risk strategy, continuous glucose monitoring, and a glucocentric approach, among others. T2DM can be managed in Nigeria in two ways: pharmacologically (which involves taking drugs and medications like metformin for chemotherapy) and non-pharmacologically (which frequently involves eating the right foods, managing one's lifestyle, engaging in physical activity, learning about one's health, and abstaining from smoking and drinking alcohol) (Nigerian Federal Ministry of Health, 2022). However, the emphasis of this systematic review is on variables that affect how persons with T2DM between the ages of 18 and 60 manage their condition.

The rationale for the study

Due to its socioeconomic effects on society, DM continues to be a major worldwide burden for public health (Lin *et al*., 2020). According to the International Diabetes Federation (IDF), there were an estimated 536.6 million persons between the ages of 20 and 79 who were affected by the DM pandemic in 215 countries in 2021. Despite having 966 billion patients by 2021, without management methods in place, a further growth of 783.2 million patients is expected by 2045. (Sun *et al*., 2021). Patients who have T2DM problems are 2-3 times more likely to die from any cause (Yang *et al*., 2019). According to Chen *et al.*, (2019) research on a multi-country retrospective observational analysis concluded that DM was responsible for the second-largest overall negative influence on changes in Health-Adjusted Life Expectancy (HALE). The data showing a 125.5% rise in worldwide mortality from DM between 1990 and 2017 (0.61 million to 1.37 million) subsequently proved this claim (Lin *et al*., 2020). Between 1990 and 2017, the number of Disability Adjusted Life Years (DALYs) worldwide attributable to DM increased dramatically by 116.7%, from 31.3 million to 67.9 million (Lin *et al*., 2020).

According to the World Bank's standard for determining socioeconomic position, the majority of African nations are low-income or middle-income nations (Guttmacher, 2022). This suggests that poverty is widespread throughout Africa. T2DM and socioeconomic position are closely related (Bird *et al*., 2015; Funakoshi *et al*., 2017). The claim that age-standardized mortality and DALYs for T2DM were markedly high in low-middle-income countries provides more evidence for this (Lin *et al*., 2020). Africa is predicted to have the highest increase in the number of adult patients in the age range of 20-79 years between 2021 and 2045, accounting for 80.6% (432.7 million) of DM patients (Sun *et al*., 2021).

Poor patient care as a result of resource shortages (Pinchevsky *et al*., 2017), lack of health education due to limited access to healthcare facilities and Public Health educators (Godman *et al*., 2020), disinterest in prescribed dietary patterns, the stigma attached to public use of glucometers, and sociocultural factors (Sonmez *et al*., 2022), lack of specialists preventing patients from choosing the best medications (Alsairafi *et al*. 2016).

Moreover, Sub-Saharan Africa is seeing an increase in the prevalence of DM (Lubaki *et al*., 2022), with Nigeria registering over 6 million (5.8%) persons with DM (Uloko *et al*., 2018). T2DM accounts for 90% of DM cases worldwide and has been acknowledged as a serious health hazard in Nigeria (Onu *et al*., 2021). However, a study found that nearly two-thirds of DM cases in Nigeria—particularly in the adult population (18–60 years)—remain undiagnosed (IDF, 2017). Further evidence that T2DM may not be well controlled in Nigeria comes from the estimated low ratio of 1:600,000 representing diabetic experts to the country's population (Ugwu et al., 2020). Hence, it is essential to research the factors that affect T2DM management in Nigeria.

This present study seeks to provide answers to the following research questions.

1 What are the factors that influence the management of T2DM among adults in Nigeria?
2 How do these factors affect the impact of T2DM patients' health outcomes?

In addressing these research questions, the following objectives shall be pursued in this study: (i) exploring the current literature on the factors that influence the management of T2DM among adults in Nigeria; (ii) ascertaining the impact of these factors on the health outcome of T2DM patients in Nigeria; and (iii) recommending how these factors can be handled to ensure proper management of T2DM among adults in Nigeria

2. Survey of Diabetes Mellitus

Diabetes mellitus is a chronic disease characterized by either insufficient insulin production by the pancreas or the body's ineffective use of insulin (WHO, 2021; Nall, 2021; Watson, 2020b). Insulin, a hormone responsible for regulating blood glucose levels, is produced by the pancreas (WHO, 2019). As an organ with both exocrine and endocrine functions, the pancreas releases digestive enzymes into the duodenum via the pancreatic duct to break down carbohydrates and fats (WHO, 2019; WHO, 2021). In 2018, it was estimated that around 327 million people with diabetes worldwide are of working age, and diabetes accounts for 14% ($727 billion) of all health spending worldwide (International Diabetes Federation 2018). In 2021, an estimated 537 million persons worldwide were living with diabetes (International Diabetes Federation, 2021). Some early signs and symptoms of diabetes include thirst, exhaustion, weight loss, slow wound healing, frequent urination, constant hunger, and disorientation (Figure 1). Later on in the disease, blurred vision can cause eye problems (IDF, 2013).

Diabetes mellitus is one of humanity's most ancient diseases (Viswanathan and Ranton, 2016). A condition of glucose metabolism known as diabetes mellitus is caused by a mix of inherited and environmental factors. Inadequate insulin production or use, increased urination, elevated blood, and urine sugar levels, as well as thirst, hunger, and weight loss, are frequent symptoms (Pouwer *et al*., 2010). Diabetes Mellitus is brought on by the interaction of genetic, environmental, and psychological factors (Chen *et al*., 2011). Environmental factors, such as a sedentary lifestyle, have an impact on the likelihood of developing diabetes, while psychological factors, such as depression, general emotional stress and anxiety, sleeping issues, anger, and hostility, increase the risk of developing diabetes. Genetic consequences refer to the prevalence of a family history of diabetic patients, which is frequently inherited (Pouwer *et al*., 2010).

2.1.1 Diabetes Mellitus Type 2

The occurrence of hyperglycemia as a consequence of inadequate, inefficient, or both insulin activity characterizes the metabolic state known as diabetes mellitus (ADA, 2010). Diabetes mellitus type 2 (T2DM) is characterized by pathophysiological abnormalities such as insulin resistance and malfunctioning beta cells (Wilcox, 2005). Glucose is the main factor that stimulates insulin release. Insulin and glucagon, are two important hormones that control glucose homeostasis and perform a counter-regulatory role (Wilcox, 2005). However, the kind and structure of the carbohydrates consumed impact insulin secretion (Parillo and Riccardi, 2004). High-carbohydrate diets may cause the release of more insulin from certain carbs, which may ultimately result in hyperinsulinemia and insulin resistance (Stumvoll *et al*., 2005; Mokdad *et al*., 2003; Hu *et al*., 2003, Parillo and Riccardi, 2004). Reduced physiological responsiveness of the target peripheral tissue to the insulin produced by the beta cells is the hallmark of insulin resistance (Palicka, 2002). Beta cell activity steadily deteriorates when the target tissue's physiological sensitivity to insulin declines and persistent hyperglycemia takes hold (Parchman and Franz, 2014). Furthermore, insufficient glucose-induced insulin release is referred to as "glucotoxicity," which is also used to indicate beta cell dysfunction (Ashwood and Bruns, 2001). The degree of beta cell dysfunction is associated with the glucose level and the length of hyperglycemia (Ashwood and Bruns, 2001). Insufficient insulin response leads to the characteristic condition of diabetes mellitus patients, hyperglycemia (Parchman and Franz, 2014).

Given how type 2 diabetes affects a person's biological, psychological, and social life, it is understandable why managing the condition may be difficult due to a variety of intricate psychosocial factors (Berry *et al*., 2015; Walker *et al*., 2014). Emotional distress (Cummings *et al*., 2014), self-efficacy (Sarkar *et al*., 2006), social support (Walker *et al*., 2015), insurance status (Garfield *et al*., 2015; Zhang and Meltzer, 2016), and geography are the factors that are most often highlighted (Zhang and Meltzer, 2016).

2.2 Complications Arising from T2DM among Patients

Diabetes is a progressive condition that increases the risk of long-term microvascular complications such as retinopathy, nephropathy, as well as macrovascular illnesses (Figure 2) if it is not properly managed (International Diabetes Federation, 2018). Patients who have diabetes are frequently at risk for contagious illnesses such as pneumonia, bacteremia, and other NCDs like cardiovascular diseases (Hall, 2011). An acute myocardial infarction and increased blood sugar levels are significantly correlated, according to a population-based cohort study (Tancredi, 2019).

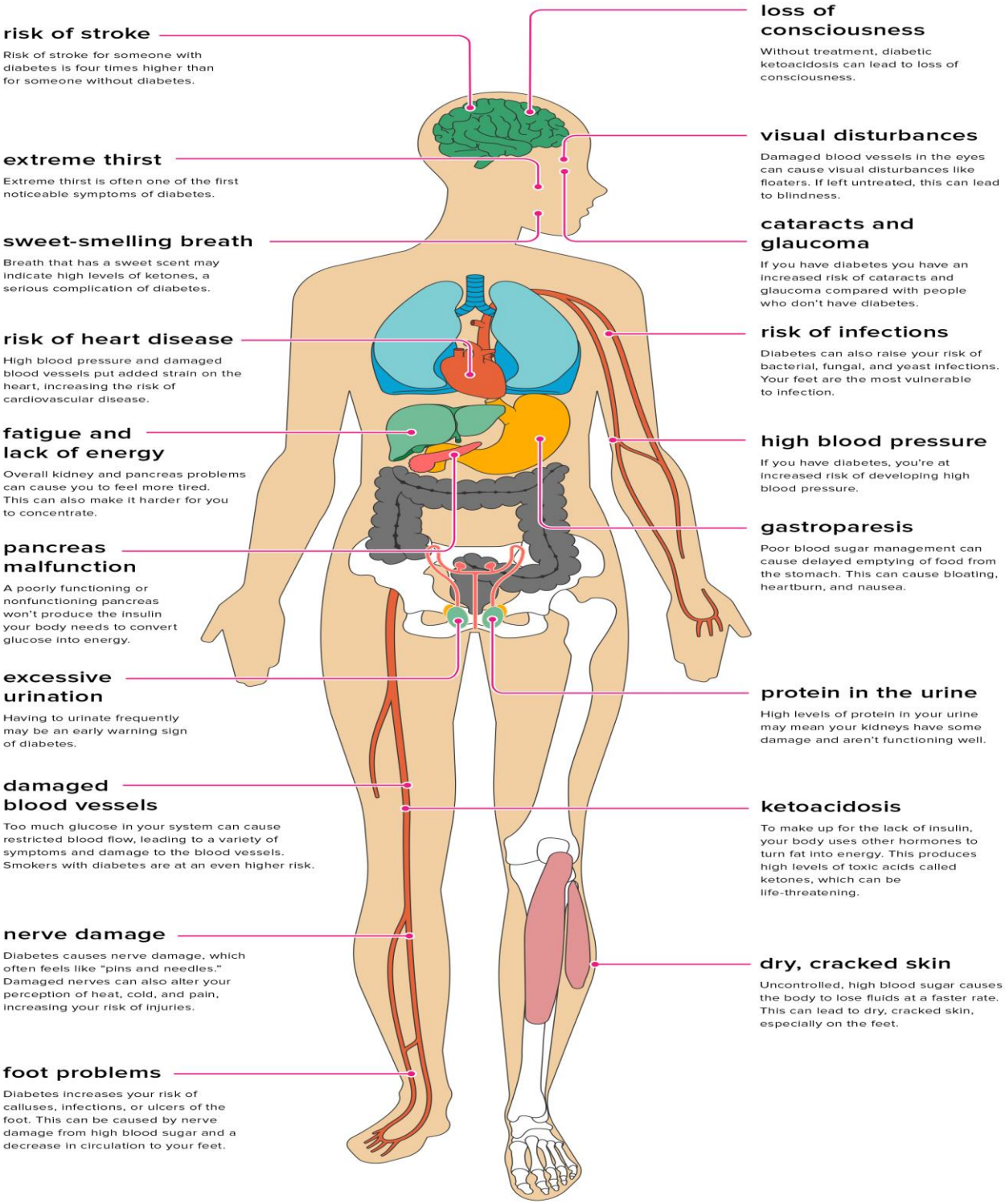

Figure 1: Symptoms of diabetes mellitus.
Source: Casteillo and Pietrangelo (2021).

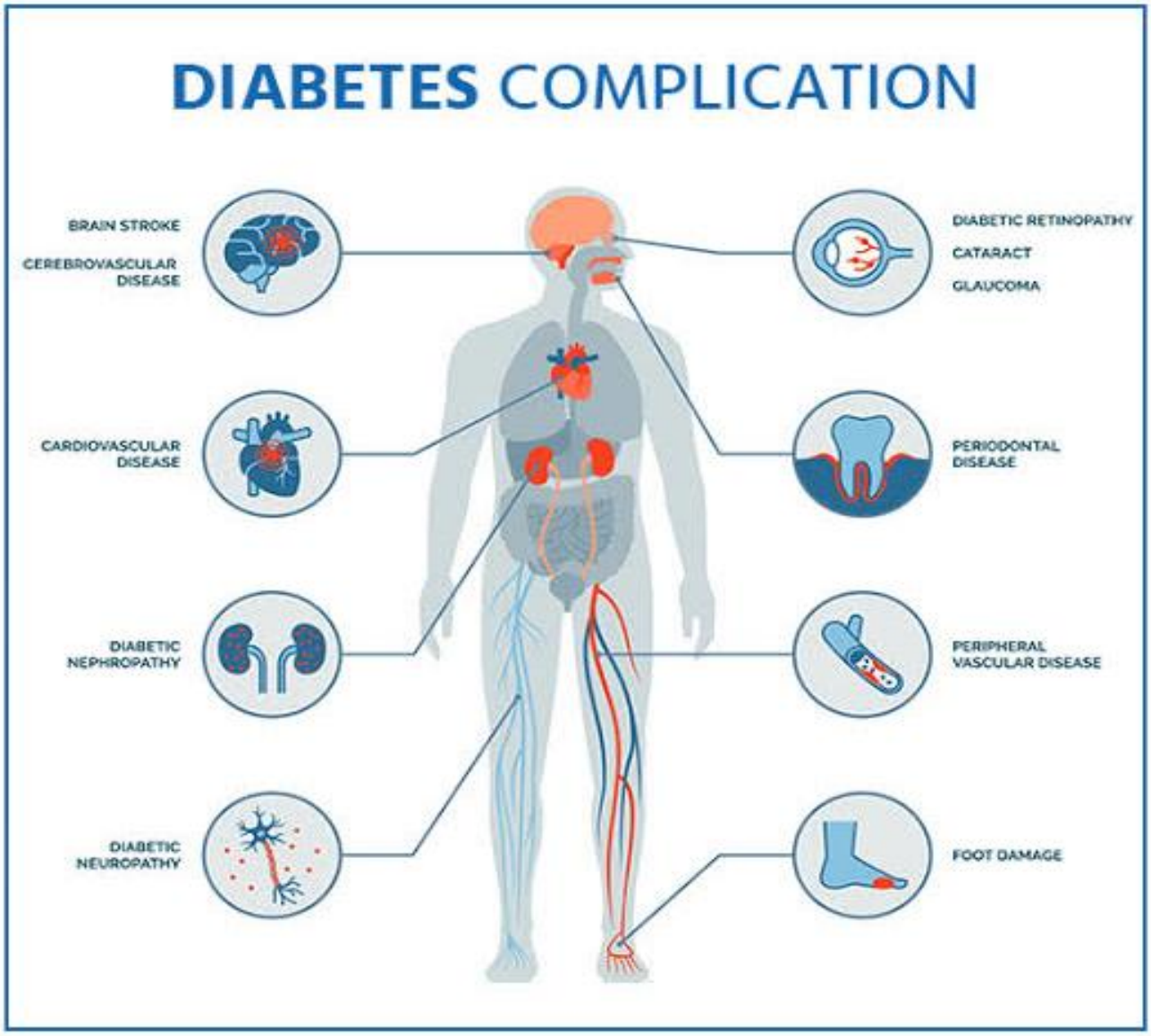

Figure 2: Complications associated with diabetes mellitus.
Source: Jasti (2011).

The most frequent cause of kidney failure is diabetes, which causes patients to endure lifelong dialysis therapy if it is available or more severe outcomes including death in low-resource environments. The documented microvascular damage is mostly caused by blood sugar accumulation (Ashwood and Bruns, 2001). Foot ulceration may lead to lower limb amputation, and diabetic foot ulceration is a typical cause of hospital admissions (Hall, 2011). In certain cultures, patients who are not used to wearing shoes may develop significant ulcers that, if left untreated without access to sufficient medical facilities, might necessitate amputation. Between 1999 and 2011, the five-year mortality rates for diabetic patients in Sub-Saharan Africa varied from 5 to 57% (Hall, 2011). Also, there is increase in DM prevalence yearly in Sub-Saharan Africa (WHO, 2016). A prospective cohort study of diabetes patients at Muhimbili Hospital in Tanzania indicated that 70% of lower limb amputations and 50% of diabetic patient deaths result from foot ulcers (Gulam-Abbas, 2002). Adults with type 2 diabetes who are untreated face the risk of kidney failure, heart disease, stroke, amputations, blindness, and a 50% increased risk of dying young (CDC, 2014; Parchman and Franz, 2014).

2.3 Treatment and Management Guidelines for Diabetes Mellitus

2.3.1 ADA Standards of Care

Research-based recommendations for the management and treatment of diabetes are provided by the ADA standards of care. The ADA Professional Practice Committee is composed of healthcare professionals from various specialties and levels (Chamberlain *et al*., 2016). The Professional Practice Committee thoroughly explores the literature for new evidence before grading each piece of information. After gathering comments all year, the committee creates the care standards (Chamberlain *et al*., 2016). These standards of care address (a) diabetes diagnosis, (b) recommendations for glycemic targets, (c) medical treatment of diabetes, (d) risk management for

cardiovascular disease, (e) management of microvascular diseases, and (f) diabetic care in hospitals (Chamberlain *et al*., 2016).

2.3.2 Blood Glucose Levels Related to Pharmacological Management

Glycemic goals have been established for diabetic patients by the ADA (ADA, 2016; ADA, 2018). Each patient should have their own specific glycemic goals. HgA1C levels should range from 6 to 8%. Most non-pregnant persons should aim for A1C levels under 7 percent. A1C levels in pregnant women should be kept under 6.5 percent. A1C goals can be lowered to 8% for people with numerous coexisting conditions, a high risk of hypoglycemia, falls, and a brief life expectancy (ADA, 2019). For most persons, fasting levels should be kept under 100 mg/dL, and daily glycemic readings between 70 and 180 mg/dL (ADA, 2019).

2.3.3 Lifestyle management

The first step in controlling diabetes is changing one's lifestyle (Enujiugha, 2020). In the past, when Type 2 diabetics were initially diagnosed, it was recommended that lifestyle changes take precedence over medicine (ADA, 2019). Lifestyle management includes things like maintaining a low-carb diet appropriate for diabetes, doing regular exercise, quitting smoking, and getting help with one's mental health (ADA, 2019). The primary goals of lifestyle management should be physical activity and medical nutrition treatment (ADA, 2019; Bobadoye and Enujiugha, 2016). Medical nutrition treatment is nutrition therapy performed by a licensed dietician, and it may help diabetic patients with their weight reduction objectives, glycemic management, blood pressure control, cholesterol levels, and avoiding diabetes complications (Franz *et al*., 2014). The social cognitive theory's importance in public health is emphasized by lifestyle management for T2DM. A wide theory of behavior called social cognitive theory (SCT) seeks to explain how individuals form and maintain habits in a social environment (Bandura, 1998). To start a goal-directed activity that can be maintained over time, it especially aims to "understand how people adjust their behavior via self-control and reward" (Thojampa and Sarnkhaowkhom, 2019).

Research has regularly evaluated the efficacy of SCT for explaining or predicting the success of diabetic behavior modification activities to better support and promote its usage in developing diabetes management strategies (Bandura, 1986; Bandura, 1989; Plotnikoff *et al*., 2008; Thojampa and Sarnkhaowkhom, 2019). Reciprocal determinism, which asserts that environmental, social, and behavioral factors continually and dynamically interact to promote or inhibit a particular behavior, is the core principle of SCT (Schunk and Usher, 2012). The social cognitive theory explains in relation to this research how behavior modification and healthy lifestyle choices may be used to control patients' T2DM (Bandura, 2001).

2.3.4 NICE Guidelines for Diabetes Mellitus Management

Home *et al*. (2008) summarized the NICE guidelines for the management of diabetes to include the following;

- It is recommended to offer structured education to individuals shortly after receiving a diabetes diagnosis and to periodically emphasize its importance to both the patient and their caregivers. Structured education should include a standardized curriculum, a qualified team of educators, predetermined educational materials, and an evidence-based approach tailored to the needs of each individual
- Nutritional guidance ought to be provided. It should be tailored to cultural needs, given by a healthcare provider with specialized nutrition knowledge, and backed by pertinent educational resources. Dietary recommendations ought to be based on the same principles as those for healthy eating that are given to the general public.
- For individuals who have recently been diagnosed with type 2 diabetes, it is recommended that self-monitoring of plasma glucose levels is a vital aspect of self-care education. It is important to also guide how to properly interpret the results. It is advisable to review the objective and efficacy of this practice annually with the diabetic patient.
- Engage the individual with diabetes in the process of setting personalized objectives for their HbA1c, blood pressure, and lipid levels. The desired HbA1c level may differ from the recommended 6.5 percent target for type 2 diabetes patients. Monitoring HbA1c levels is necessary every 2-6 months, and supportive care must be given to aid in accomplishing the established goals.

2.4 Health parameters monitoring, record keeping, and medication adherence in T2DM management

The difficulties in managing T2DM in Nigeria have been linked to patient and healthcare worker issues (Ezeani *et al*., 2017). According to Adisa and Fakeye (2016), self-blood glucose monitoring and medication compliance received below-average scores, whereas in the south-west, glycemic control was poor in 79.5% and 76.0% of cases, respectively (Eze *et al*., 2022). Approximately 50.8% of people in the southeast reportedly self-monitor their blood sugar levels (Ezeani *et al*., 2017). In the south-south region, irregularities in the monitoring of health indices including blood pressure, lipid profiles, activities of daily living (ADL) and body mass index (BMI) have been recorded (Nwose *et al*., 2020). In addition, 48% of people in the north-west had poor glycemic control, with women reporting worse medication adherence and glycemic control than males (Sada *et al*., 2021).

A lack of protocol-inspired treatment strategies (Adisa and Fakeye, 2016) and the absence of health education on adherence to oral therapy (Eze *et al*., 2022) were found in the south-west, while healthcare personnel factors such as a lack of blood sugar screening, poor record keeping, and postpartum follow up were identified in the south-south (Nwose *et al*., 2019). Sada *et al*., (2021) observed biased treatment in the north-west, favoring the use of medications over non-pharmacological approaches to controlling T2DM. For a curious and analytical mind, these discoveries should leave a lot to be desired (Nwose *et al*., 2019).

2.5 Ethnobotanical approach to T2DM management in Nigeria

Medicinal plants appear to be promising therapeutic agents against T2DM due to insulin resistance and various side effects associated with existing drugs (Lee *et al*., 2021; Aderinola *et al*., 2022). Researchers from southwestern Nigeria seem to be the arrowhead of the "herbal battle" against T2DM with Olasehinde *et al*. (2022) reporting the antioxidant and antidiabetic potentials of the methanolic extract of *Annona muricata* leaves. Earlier on, Irondi *et al*. (2014) reported the antidiabetic qualities of the seeds of *Mangifera indica* and *Mucuna uriens*. When will medicinal plants products offer keen commercial competition with their synthetic counterparts? Again, it is difficult to answer because ethnobotanical researches are not immediately beneficial: promising bioactive agents need to undergo clinical trials after being formulated into drugs and that will take some years (Abbott *et al*., 2013; Williams *et al*., 2020). How do we manage this challenge? Rojas and Gomes (2013) opined that the tolerability of metformin could be optimized with correct dose titration, commencing with a lower limit. Despite the literature capturing issues of T2DM among Nigerian adults, the gap remains on how some influencing factors and behaviour change can help in the management of T2DM.

3. Methodology

This systematic review follows the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) standards. Literature was sourced from databases including Science Direct, PubMed, Google Scholar, Embase, and MEDLINE. The Critical Appraisal Skills Programme (CASP) tool was employed to validate the review's narrative and descriptive aspects, ensuring rigorous evaluation based on criteria such as title, abstract, introduction, methodology, results, discussion, and geographical focus.

3.1 Research Design and Philosophy

This review employs a mixed methods research design, integrating both qualitative and quantitative approaches to provide a comprehensive understanding of the research question. Research philosophy guides the methodological choices, drawing from positivism, interpretivism, realism, and pragmatism (Creswell, 2014; Saunders et al., 2016).

3.2 Search Strategy

A thorough search was conducted using predetermined keywords: "Type 2 Diabetes Mellitus," "management," "Nigeria," and "factors." Boolean operators were applied to optimize the search. The databases MEDLINE (EBSCO Host), PubMed, and Science Direct were searched for articles published between 2012 and 2022, in accordance with Aveyard *et al*. (2016) recommendation to search particular and pertinent databases, in order to optimize the identification of relevant material. The PEO (Population, Exposure, Outcome) framework, as outlined in Table 1, guided the search strategy (Conklin, 2022).

3.3 Inclusion and Exclusion Criteria

The PEO framework, language, time range, and geographic location/classification were used to develop the inclusion and exclusion criteria for choosing articles, which are shown in Table 2. Analysis pertinent to adults in Nigeria between the ages of 18 -60 who have cases of T2DM had to be included in every article (Van Nes *et al*., 2010).

Table 1: The Adopted Search Strategy

Key concepts based on the PEO framework	Associated synonyms
Population: Adults in Nigeria	Man, woman, 18-60-year-old
Exposure: Patients are exposed to both pharmaceutical and non-pharmacological therapies at all stages of T2DM management.	T2DM control
Outcome: Medication compliance, blood pressure, self-management abilities, and patterns of mortality are all factors.	Lifestyle management, diet adjustment, low compliance to treatment, Body Mass Index (BMI), HbA1c

Table 2: Inclusion and Exclusion Criteria

	Inclusion criteria	Exclusion criteria
Population	Adults	New-born, infants, middle age and elderly above 60
Exposure	Type 2 Diabetes Mellitus	High Sugar Level
Geographical location	Nigeria	Countries that are not Nigeria
Species	Humans	Animals
Language	English	Articles that are not written in English
Time frame	2012-2022	Articles earlier than 2012
Accessibility	Open-access journals, free texts, and available journals	Available for purchase
Quality	Peer-reviewed articles	None peer-reviewed articles
Content of literature	Primary Studies	Systematic reviews, scoping reviews, and meta-analysis

3.4 Screening and Selection

Screening involved reviewing titles and abstracts to ensure eligibility, utilizing the PRISMA flowchart (Page *et al.*, 2021) for transparency and to minimize bias (Figure 3) This helped in eliminating irrelevant studies at an early stage (Levett, 2022), and offered transparency and accountability in the study selection process (Moher *et al.*, 2010).

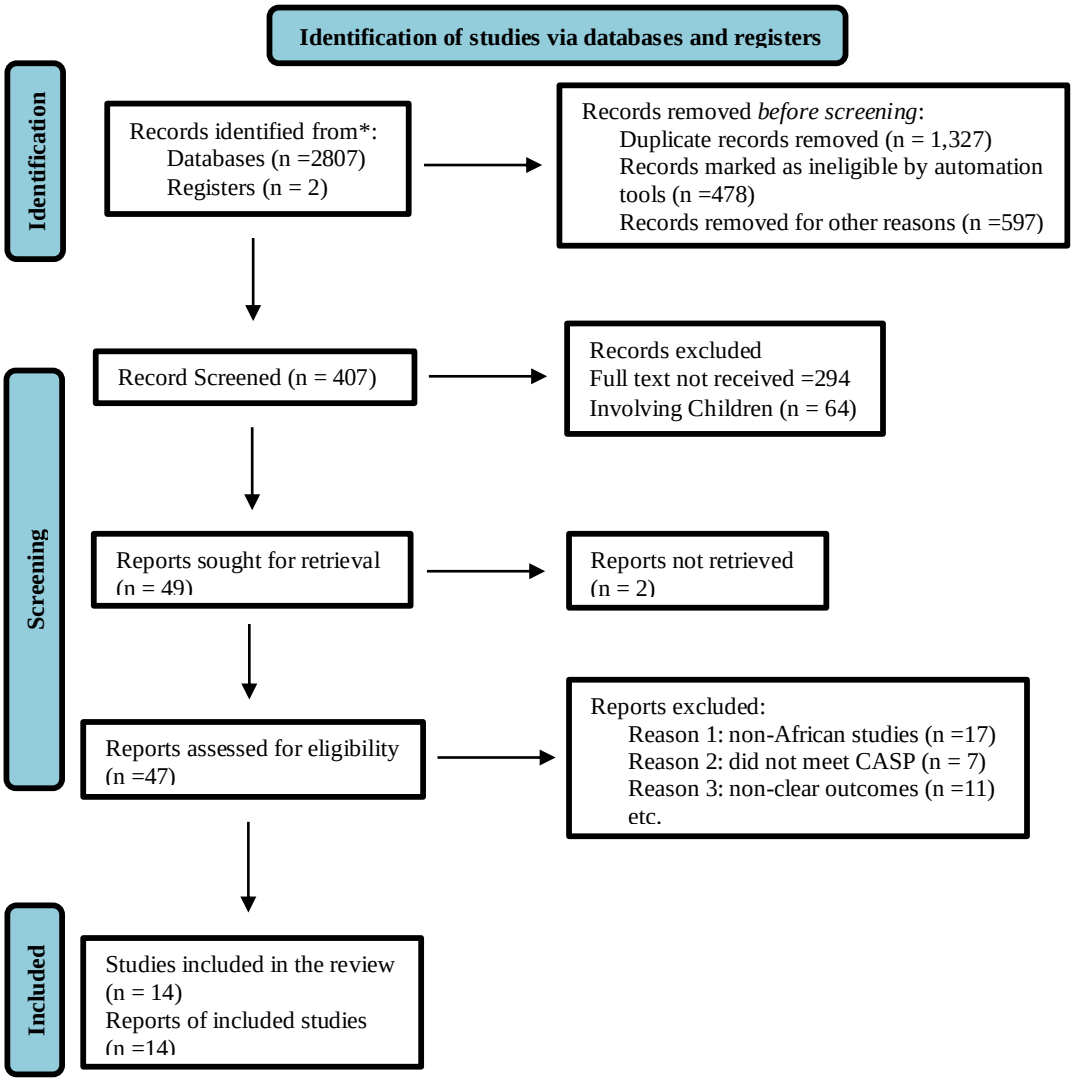

Figure 3: PRISMA flow chart of the factors influencing the management of type 2 diabetes management in Nigeria.

3.5 Critical Appraisal and Data Extraction

The CASP (2020) tool was used for critical appraisal, focusing on methodological quality. Data extraction followed a pro-forma table to ensure consistency and reliability, capturing key elements such as study design, sample characteristics, and outcomes (Higgins and Green, 2011; Whiting *et al.*, 2016).

3.6 Data Synthesis and Management

Data synthesis employed qualitative thematic synthesis, identifying patterns and organizing themes for comprehensive understanding (Thomas and Harden, 2008; O'Cathain *et al.*, 2015), as well as following a highly structured process for collecting and merging data from various sources (Chang *et al.*, 2004). Zotero reference manager was used for literature management due to its capabilities in organizing and synchronizing references (Kern and Hensley, 2011).

3.7 Ethical Considerations

Ethical considerations adhered to guidelines and approved standards to avoid plagiarism and ensure the integrity of the review. All data sources and literature were properly cited, and no conflicts of interest were reported among the authors (Devereaux *et al.*, 2014).

4. Results

This study focused on the data reviewed from the fourteen (14) eligible papers which met the requirements of the critical appraisal tool. The results of these articles were synthesized and reported in various thematic subheadings such as lack of adherence and compliance to recommended management directives; inadequate self-care; psychological and mental factors.

Evidently from a critical appraisal of the papers, it was observed that consulted studies were of importance to the focus of this systematic review. All fourteen eligible articles (Nwaokoro *et al*., 2014; Jackson *et al*., 2014; Olamoyegun *et al*, 2015; Awodele and Osuolale, 2015; Adeniyi *et al*., 2015; Iwuala *et al*, 2015; Adeniyi *et al*., 2012; Odume *et al*., 2015; Emmanuel and Otovwe, 2015; Iloh *et al*., 2015; Ogbonna *et al*., 2014; Okurumeh *et al*., 2022; Bosun-Arije *et al*., 2020; Iregbu *et al*., 2022) met the aim of this study which systematically reviewed the current knowledge on the factors that influence management strategies of T2DM among adults in Nigeria. Beyond exploring the current knowledge in the literature concerning the management of T2DM in Nigeria, all fourteen studies unraveled various factors that affect the management of T2DM in various zones in the country. Similarly, the selected kinds of literature interrogated the impact of these factors on the management of the condition.
The methodology employed in these studies was clearly stated and the nature of these studies was discussed in these selected kinds of literature. The research methodology and research design were justified by the authors of these articles. The study locations and nature participants were equally justified in these studies as well and clearly stated. The pattern or method of selecting participants was clearly stated which met the requirements for this systematic review. The method of data collection was also identified and justified in these studies. For studies that had multiple authors, there was no conflict of interest identified in these articles.

4.1 Values of selected articles
The selected articles proved to be impactful on the already existing body of knowledge on issues that affect the management of T2DM. All fourteen articles played a crucial role in conducting a comprehensive systematic review of the factors affecting the management of T2DM among adults in Nigeria. The values of articles for this review and meta-analysis can be summarized as follows:

1. Evidence-based information: Articles provided a wealth of evidence-based information on the various factors affecting the management of T2DM among adults in Nigeria. These include demographic, socioeconomic, cultural, and health system-related factors, as well as the effectiveness of various interventions and strategies.

2. Current understanding: Articles provided the most current understanding of the factors affecting T2DM management in Nigeria, including the latest research findings, trends, and gaps in knowledge. This is essential for identifying areas that require further research and intervention.

3. Comparative perspective: Reviewing articles from multiple sources and different periods provided a comparative perspective on the factors affecting T2DM management in Nigeria. This can help to identify changes in the disease burden, treatment approaches, and the effectiveness of interventions over time.

4. Identification of best practices: Reviewing the articles was helpful in identifying best practices for T2DM management among adults in Nigeria, including effective interventions, strategies, and policies that have been tested and shown to be effective in the local context.

5. The basis for recommendations: The findings from the review of articles provided the basis for recommendations for future research and interventions aimed at improving the management of T2DM among adults in Nigeria.

4.2 Presentation of findings and data synthesis
This section elaborates the conclusions and findings drawn from the fourteen publications that were chosen. This information includes the setting of the research, the participants, the variables that were identified as affecting the management of T2DM, and the effects of these factors on the treatment of the condition (Table 3).

In this systematic review, the data analyzed was sourced from 14 studies, which included cross-sectional studies, mixed approach studies, quantitative studies and qualitative studies. Both rural and urban locations, especially public hospitals throughout Nigeria, were used for these investigations. It is important to note that the evaluation excluded research from the northeastern and northwestern parts of the nation since none of them met the criteria for inclusion. The majority of the studies reviewed were conducted in the southwestern (Adeniyi *et al*., 2015; Adeniyi *et al*, 2012; Awodele and Osuolale, 2015; Olamoyegun *et al*, 2015; Iwuala *et al*, 2015; Okurumah *et al*. 2022; Bosun-Arije *et al*. 2020), southeastern (Ogbonna *et al*., 2014; Nwaokoro *et al*., 2014; Iloh *et al*., 2015; Iregbu *et al*. 2022), south-southern (Jackson *et al*., 2014; Emmanuel and Otovwe, 2015), and north-central (Odume *et al*., 2015) regions of Nigeria. The main factors identified as impacting diabetes management among adults aged 18-60 in Nigeria in the selected studies were mostly non-compliance and non-adherence to T2DM management programs or treatment (Nwaokoro *et al*., 2014; Jackson *et al*., 2014; Olamoyegun *et al*, 2015; Awodele and Osuolale, 2015; Adeniyi *et al*., 2015; Iwuala *et al*, 2015; Adeniyi *et al*., 2012; Odume *et al*., 2015; Emmanuel and Otovwe, 2015; Iloh *et al*., 2015; Ogbonna *et al*., 2014), lack of self-care (Adeniyi, 2015; Awodele *et al*., 2015), psychological factors such as emotional distress, trauma and low self-esteem (Awodele *et al*., 2015; Okurumah *et al*. 2022), biosocial factors such as a family history of the prevalence of the diseases or related diseases (Iloh *et al*., 2015), cost factors such as cost of drugs or treatment (Iwuala *et al*, 2015; Jackson, *et al*., 2015; Okurumah *et al*. 2022), drug-related factors (Ogbonna *et al*., 2014; Emmanuel and Otovwe, 2015) and illiteracy and ignorance (Jackson *et al*., 2014; Emmanuel and Otovwe, 2015). These factors were instrumental in the negative impact on patient health outcomes, such as high blood sugar levels, poor self-management skills, and an increased risk for microvascular and macrovascular complications, as well as high mortality rates (Jackson *et al*., 2014; Olamoyegun *et al*, 2015; Awodele and Osuolale, 2015; Adeniyi *et al*., 2015; Iwuala *et al*, 2015).

4.2.1 Lack of adherence and compliance to T2DM management medications or practices

This section reviews those factors in the selected articles that portray knowledge about those factors that limit or negate the adherence to T2DM management among adults in Nigeria. It explores the variables that influence adherence to medications and behavior modifications for the management of diabetes mellitus, a condition that requires intentional management efforts to avoid complications.

The words non-adherence and noncompliance are used interchangeably in this review since they were both used consistently by the writers of the publications under consideration. According to the research, patient management was significantly impacted by non-adherence. Eight of the fourteen studies that were analyzed used these phrases to describe patients who disobeyed the therapy and regimen recommended by their doctors. Additionally, these phrases were used in three of the chosen articles to describe how the support system for the patients fell short of expectations.

Three studies (Odume *et al*., 2015; Adeniyi *et al*., 2012; Nwaokoro *et al*., 2014) attributed poor adherence to T2DM therapy to a lack of family and social support. For instance, in a study of type 2 diabetes patients receiving general tertiary care, Odume *et al*., (2015) found a clear correlation between the family's function and social support, among other crucial family aspects, and blood glucose management. This result may be appreciated by considering the important function that families play in patient care, especially for chronic diseases like diabetes that are prevalent in our society. In certain cases, the influence of this employment might be either positive or negative. In terms of illness care, a patient in a dysfunctional relationship is unlikely to benefit much from such a family (Odume *et al*., 2015).

Lack of education, ignorance, and access to care (Jackson *et al*., 2014; Ogbonna *et al*., 2015; Emmanuel and Otovwe, 2015; Okumurah *et al*., 2022; Iregbu *et al*., 2022). According to one study (Emmanuel and Otovwe, 2015), the biggest challenge for diabetes patients is their ignorance about their illness. This highlights the need of increasing access to information regarding the condition, which is essential for its effective care. Additionally, the problem of ignorance contributes to nonadherence to dietary treatment as diabetic patients consumed foods that should be avoided due to the disease in the least number of cases (OR = 12.010, 95% CI = 7.422-19.435) and in large amounts when they should be consumed in small amounts (OR = 6.286, 95% CI = 3.919-10.083) (Emmanuel and Otovwe, 2015). Similarly, Jackson *et al*., (2014) listed the following factors as affecting knowledge of managing diabetes mellitus: (1) Lack of time to read about diabetes or attend diabetes education programs; (2) Lack of access to regular updates and education for diabetics; and (3) Inadequate training on managing diabetes on one's own. One of the studies attributed the absence of financial aid (Iwuala *et al*., 2015). Patients find it challenging to buy medications, have frequent checkups, and maintain healthy eating habits due to financial inadequacies. In contrast, Okurumah *et al*., (2022) found that participants adhered to their management instructions and medicine consumption despite a variety of variables, including financial restrictions and psychological suffering that may negate the adherence to management directions.

4.2.2 Self-care factors that affect the management of Type 2 diabetes mellitus

This review centers on the subject of self-care as a factor that influences how individuals in different regions of Nigeria manage their T2DM. In the research analyzed, self-care was ranked as the second most important factor influencing the treatment of T2DM patients. Five studies out of the total evaluated revealed that patients' limited capacity for self-care hampered their treatment of type 2 diabetes. These five investigations were carried out throughout Nigeria in a number of different areas, including the South-South (Emmanuel and Otovwe, 2015), South West (Adeniyi *et al*., 2015; Awodele, and Osuolale, 2015), and South East (Ogbonna *et al*., 2014; Nwaokoro *et al*., 2014). Additionally, each of the five research employed the same assessment techniques to determine how self-care affected the treatment of T2DM. The following reasons are to blame for the unfavorable patient outcomes in the treatment of T2DM in individuals in the nation between the ages of 18 and 60 in the selected articles. Three research recognized ignorance and illiteracy as a lack of self-care (Jackson *et al*., 2014; Nwaokoro *et al*., 2014; Ogbonna *et al*., 2015); one study blamed insufficient self-monitoring of glycemic control. For instance, Jackson *et al*., (2014) found that having a negative attitude about diabetes mellitus impairs one's degree of knowledge to assure adequate care of the illness (see Table 3).

Similarly, according to Emmanuel and Otovwe's (2015) study, an individual's lack of awareness of the health implications of diabetes, which could result in a negative attitude towards the condition, is a factor that can impact their knowledge of self-care. This negative attitude may reflect an unconscious dismissal of the potential risks associated with diabetes. Table 4 provides evidence supporting this finding.

Other factors that may have contributed to the research participants' poor glycemic control include a bad attitude about body changes (Adeniyi *et al*., 2015), poor self-care practices (Adeniyi, 2015; Awodele *et al*., 2015), poor compliance and adherence with follow-up visits and medications, and more (Odume *et al*., 2015). All of these studies revealed a strong correlation between the degree of glycemic control and patient self-care.

Iloh, (2015) found that individuals who took their anti-diabetic medicine consistently had much better blood glucose control than those who did not. Out of 120 patients, 87 (72.5%) were adherent, compared to 33 (27.5%) who were not. 68 (91.9%) of the 74 patients with target blood glucose control were adherent, whereas six (8.1%) were not. When compared to non-adherent patients, individuals who use anti-diabetic medicine consistently had a better rate of blood glucose control (2=5.06, df=1, Pvalue=0.025) (Iloh *et al*., 2015).

Table 3: Relationship between responses to factors affecting knowledge and knowledge level of Diabetic self-care practices (N=303)

S/N	Factors affecting diabetic knowledge	Response	X *(%)	Knowledge level: n (%) Low	Knowledge level: n (%) High	p-Value
1	Unavailability of time to study about diabetes or to attend diabetes enlightenment programme	Yes No	173 (51.7) 130 (42.9)	39 (22.5) 23 (17.7)	139 (77.5) 107 (82.3)	0.003
2	Lack of regular update on diabetes and access to diabetic education	Yes No	193 (63.7) 110 (36.3)	43 (22.3) 19 (17.3)	150 (77.7) 91 (82.7)	0.299
3	Lack of access to adequate training on diabetes self-management	Yes No	176 (58.1) 127 (41.9)	35 (19.9) 27 (21.3)	141 (80.1) 100 (78.7)	0.770
4	The length of time spent of patients by doctors in healthcare centers	Yes No	150 (49.5) 153 (50.5)	25 (16.7) 37 (24.2)	125 (83.3) 116 (75.8)	0.105
5	Reckless and carefree attitude towards disease	Yes No	160 (52.8) 143 (47.2)	24 (15.0) 38 (26.6)	136 (85.0) 105 (73.4)	0.013

X= Total of response in the study population
*(%) = Percent of response in the study population
Significant at $p < 0.05$

Table 4: Major challenges confronting diabetes patients

S/N	Challenges	Frequency	Percentage
1	Burden of drugs intake and injection in-take	89	25.4
2	Lack of awareness on the importance of treatment adherence	132	37.7
3	Patient's belief	121	34.6
4	Unhealthy Practices by Patients	92	26.3
5	Financial Difficulty	76	21.7
6	Eating and drinking restriction	118	33.7
7	Age of patients and what they feel and go through	126	36.0
8	Stigma in mixing with friends and relations	73	20.9

4.2.3 Psychological and mental factors

In addition to controlling glucose levels by dietary changes, medication, and monitoring, the therapy of T2DM takes into account psychological and emotional issues. The treatment of T2DM as a whole, medication adherence, and glycemic control have all been proven to be strongly impacted by emotional stress, sadness, and anxiety, according to research (Okurumah *et al*., 2022). This section looked at the influence of psychological or mental aspects on how T2DM is managed among adults in Nigeria. These psychological variables make it difficult for a patient to effectively control the metabolic disease, which may sometimes raise blood sugar levels and, in extreme situations, end in mortality. Out of all the publications evaluated, six studies showed that psychological variables had an impact on patient care. In 150 adult T2DM patients, clinical and psychological aspects impacting self-care management were examined (Adeniyi *et al*., 2015). Their research revealed that emotional distress has a direct bearing on the patient's glycemic control and self-care practices (P = 0.012). The research disregarded the association between stress and the length of type 2 diabetes, patients' ages, and anthropometric measurements (Adeniyi *et al*., 2015). In addition, forgetfulness and omission (Jackson *et al*., 2014), fear of hypoglycemia (Nwaokoro *et al*., 2014), poor self-efficacy and emotional discomfort (Adeniyi *et al*., 2012), and low Quality of Life (QoL) are all factors that negatively impact general well-being of adults (Adeniyi *et al*., 2015). Age, marital status, and employment were shown to be the three main sociodemographic factors that were linked to poor quality of life in people (Adeniyi *et al*., 2015).

Table 5 presents the results of the regression analysis that examines the association between physical activity, clinical variables, and sociodemographic factors with the likelihood of having a suboptimal quality of life. The findings suggest that individuals aged 50 and over are at a higher risk of

experiencing a decreased quality of life compared to younger individuals (OR = 2.5; 95% CI =1.21–3.67) (Adeniyi *et al*., 2015). Additionally, Figure 4 illustrates the negative impact of physical inactivity on the management of T2DM in Nigeria, further underscoring the importance of physical activity in the treatment of this condition (Adeniyi *et al*., 2015)

Table 5: The distribution of participants' responses to specific questions on quality of life items

S/N	Question	Responses
1	Satisfaction with knowledge about diabetes	82 (36.1)
2	Satisfaction with time for checkups	137 (60.4)
3	Concern about passing out due to diabetes	131 (57.7)
4	Daily activity limitation due to diabetes	84 (37.0)
5	Eating to hide diabetes	102 (44.9)
6	Frequently feeling ill	49 (21.6)
7	Diabetes-related absenteeism is a source of concern.	163 (71.8)
8	Burden on family due to diabetes	37 (16.3)
9	Poor night sleep because of diabetes	107 (47.1)
10	Frequent pain from needles and finger sticks	178 (78.4)
11	Satisfaction with exercise time	154 (67.8)
12	Diabetes treatment satisfaction	156 (68.7)
13	satisfaction with the timing of the blood sugar test	156 (68.7)
14	Satisfaction with diabetes management time	159 (70.0)
15	Satisfaction with sex life	42 (18.5)

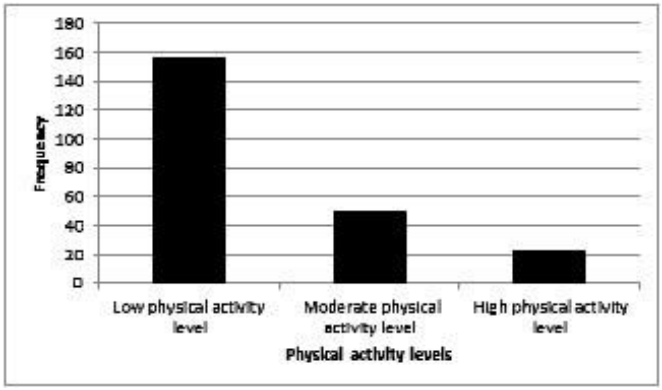

Figure 4: Distribution of physical activity levels of participants

4.2.4 Biosocial-related factors affecting T2DM management

An estimated 415 million individuals worldwide are thought to have T2DM, with a predicted rise to 642 million by 2040 (International Diabetes Federation, 2019). There are an estimated 3.9 million T2DM sufferers in Nigeria, and by 2045, that number is expected to rise to 6.3 million (Ogbera *et al*., 2013). T2DM treatment is a challenging procedure that calls for a multidisciplinary strategy, which takes into account both biological and social aspects. This review investigated bio-social variables that might influence how individuals in Nigeria are managed for T2DM. There are biosocial elements that impact glycemic control, according to the research by Ogbera *et al*. (2013). The topic of age and DM duration as a factor impacting the treatment of the illness was only addressed in one of the studies (Olamoyegun, *et al*, 2015). According to the research (Olamoyegan, *et al*., 2015), microvascular issues were much more common in persons with T2DM. Almost half of the 90 T2DM patients had some type of microvascular complication, with diabetic neuropathy being the most common (69.6%), followed by nephropathy (54.5%) and retinopathy (48.9%). Age, long-term diabetes, high blood pressure, dyslipidemia for nephropathy and neuropathy, and dyslipidemia for nephropathy were all risk factors for developing these issues.

Age and gender were also identified as factors affecting diabetes management in the articles (Awodele and Osuolale, 2015), as well as educational level and monthly income (Jackson *et al*., 2014). Odume *et al*. (2015) reported a significant correlation between socioeconomic status and diabetes (p = 0.737). It has been found that people living in low-income areas have higher rates of chronic disease-related morbidity and mortality, and the poorest individuals generally experience the worst health outcomes globally. Low socioeconomic status has consistently been linked to poor health outcomes (Odume *et al*., 2015).

Additionally, two studies (Emmanuel and Otovwe, 2015; Awodele and Osuolale, 2015) found that the other biosocial factor affecting the management of T2DM was using alternative traditional treatments (herbs) to address the ailment. In one of the studies (Emmanuel and Otovwe, 2015), the perceived ineffectiveness of conventional medicine and the simple availability of traditional herbs—which are typically purchased from local herb sellers and traditional healers—could both contribute to the usage of alternative traditional medicine. In the other study (Awodele and Osuolale, 2015), herbal drugs have been found to interact with conventional medications; depending on the agent involved, these interactions can be useful or dangerous.

Additionally, one research (Iloh *et al*., 2015) discovered that a family history of hypertension, which is connected to the development of T2DM, is one bio-social factor. Iloh *et al*. (2015) noted that 35 of the 750 people who had diabetes mellitus were matched by age and sex with 35 non-diabetic, non-hypertensive patients to ascertain the connection with

family biosocial factors. The research found a high association between type 2 diabetes and a family history of hypertension (P=.006) and diabetes mellitus (P=.048). A much higher percentage of diabetes patients had a family history of hypertension as compared to respondents who were neither diabetic nor hypertensive (see Table 6).

Table 6: Family biosocial factors as related to T2DM among adults

Variables	**Type 2 Diabetes Mellitus**	**Type 2 Diabetes Mellitus**	**X^2**	**P- value**
	Yes number (%)	**No number (%)**		
Type of marriage				
Monogamous	29(82.9)	26(74.3)		
Polygamous	6(17.1)	9(25.7)	2.06	.491
Type of household family				
Nuclear household family	33(94.3)	31(88.6)		
Extended household family	2(5.7)	4(11.4)	4.13	.705
Family size				
1 - 4	28(80.0)	30(85.7)		
>4	7(20.0)	5(14.3)	3.15	.097
Family history of hypertension				
Yes	28(80.0)	17(48.6)		
No	7(20.0)	18(51.4)	16(45.7)	.006*
Family history of diabetes Mellitus				
Yes	19(54.3)	11(31.4)		
No	16(45.7)	24(68.8)	5.62	0.48

Table 6 reveals that diabetic individuals are 1.5 times more likely to have a family history of hypertension than their non-diabetic and non-hypertensive counterparts (Iloh *et al*., 2015). This proves that genetics is a factor that affects the management of the disease. Also, in spite of the fact that the majority of them had been diagnosed for more than five years, a study of type 2 diabetes patients from outpatient clinics at the two biggest hospitals in Ibadan, Southwest Nigeria, revealed that about three out of every four of them had low levels of physical activity (Adeniyi *et al*., 2015).

4.2.5 Drug-related issues and cost of drug purchase

The availability of healthcare experts, the price of drugs, and access to pharmaceuticals are all drug-related variables that have an impact on the treatment of T2DM in Nigeria. Low health literacy and socioeconomic variables may restrict access to drugs, which can result in poor illness management. Three research revealed patient management influencing variables that were cost-related. Money issues (Awodele and Osuolale, 2015; Olameyagan *et al*., 2015; Jackson *et al*., 2014) In Nigeria, Jackson *et al*., (2014) found a strong correlation between financial stability and type 2 diabetes mellitus treatment. Patients are more likely to be able to afford their medicines, glucose meters, blood pressure monitors, and other disease-management tools if their monthly income is higher. Olameyagan *et al*. (2015) state that the majority of patients must pay out of pocket for their medical management, including drug purchases, blood sugar testing, and other laboratory procedures, at a price that is significantly higher than the price of the same medications in other parts of the world.

Medication side effect and the suggested polypharmacy's perceived inefficiency was reported by Ogbonna *et al*. (2014). The investigation by Ogbonna *et al*. (2014) also discovered the usage of unneeded medications .The respondents in the article used drugs that weren't essential for treating the illness. It was discovered that certain drugs were given out without a clear reason, which is concerning since these drugs have been associated with higher pill loads, polypharmacy, and non-adherence. Additionally, it was found that the same condition was being treated with two different analgesics at the same time (Ogbonna *et al*., 2014).

4.2.6 The influence of specified factors on patient health outcomes

This evaluation focused on how specified factors affected or had an effect on how the condition was managed among adults in Nigeria. A chronic metabolic illness marked by elevated blood sugar levels is type 2 diabetes mellitus (T2DM). Poor T2DM control may have a number of detrimental implications on a person's health. An increased risk of long-term problems is one of the primary consequences of inadequate T2DM treatment. Cardiovascular disease, neuropathy, retinopathy, and nephropathy are a few of these problems that may cause death and disability (Olamoyegun *et al*., 2015).

Ineffective glucose management and an elevated risk of problems may result from non-adherence to treatment plans (Iwuala *et al*., 2015). According to one research (Olamoyegun *et al*., 2015), one of the effects of variables that influence the treatment of the illness is the development of early complications, which may include foot ulceration and even higher morbidity and death rates for certain of these individuals.

Awodele and Osuolale (2015) and Odume *et al*. (2015) both found that inadequate glucose management often leads to problems. Odume *et al*. (2015) for instance, discovered that

research participants had poor glycemic control and an average HBA1c of 8% (4.8-14%). The quality of life is bad (Adeniyi *et al*., 2015), there is a high HbA1c and inadequate blood glucose monitoring (Iwuala *et al*., 2015), and there is the problem of poor efficiency level in terms of behavior modification (participating in exercise) (Adeniyi *et al*., 2012; Ogbonna *et al*., 2014).

5. Discussion of the findings

With a growing frequency in recent years, Type 2 Diabetes Mellitus (T2DM) has emerged as a serious public health concern in Nigeria. In order to avoid difficulties and enhance the quality of life for persons with T2DM, effective treatment is essential. However, T2DM management in Nigeria is challenging and impacted by a wide range of variables, such as socioeconomic position, cultural values, and access to healthcare. The results of this systematic analysis shed light on the difficulties of T2DM on patients in Nigeria. Studies have emphasized the value of diabetes education and self-management programs in enhancing glycemic control, as well as the effects of cultural beliefs and socioeconomic level on the treatment of T2DM (Weinger and Carver, 2008; Nicolucci *et al*., 2013; Chinenye and Young, 2011; Nash, 2013). The researchers also cited low finances and inadequate access to effective treatment as major obstacles to addressing T2DM in Nigeria (Diabetes Association of Nigeria, 2013).

5.1 Factors that affect the management of T2DM among adults in Nigeria

The standard of therapy for type 2 diabetes mellitus (T2DM) among adults in Nigeria differs from that of developed countries (such as the United Kingdom, United States and France) due to Nigeria's enormous cultural, religious, socioeconomic, and political variety (Bosun-Arije *et al*., 2019). In Nigeria, patients with T2DM usually experience lengthy hospital stays, high medical costs, and early development of comorbidities (Ogbera *et al*., 2006; Arogundade, 2013). According to the research by Jackson *et al*. (2014), patients' adherence to therapy and understanding of self-care for their illness may both be improved by having access to high-quality T2DM management. One of the major challenges in treating T2DM in Nigeria is non-compliance and non-adherence to management guidelines, prescription medicine consumption, and physical activity that might aid with the condition's therapy (Nwaokoro *et al*., 2014; Jackson *et al*., 2014; Emmanuel and Otovwe, 2015). Patients' adherence to treatment may be impacted by things including their degree of education, monthly income, and the length of their diabetes (Olamoyegun *et al*., 2015; Jackson *et al*., 2015). However, research by Pascal *et al*. (2012) raises the possibility that patients' adherence rates might be raised with focused treatments. Lack of understanding of how to treat T2DM has been connected to negative patient attitudes regarding the disorder (Jackson *et al*., 2014; Nwaokoro *et al*., 2014). According to comparable research by Adekanmbi *et al*. (2016), only 36% of persons with T2DM in Nigeria had sufficient understanding of the disease. This ignorance may cause poor self-management and a delay in starting therapy.

However, Awodele and Osuolale (2015) did not discover a connection between a patient's low level of education and noncompliance or nonadherence with T2DM therapy among adults in Nigeria. According to the research, patients in Nigeria may have low adherence rates due to a lack of healthcare facilities, poor health education, and ineffective provider counseling (Awodele and Osuolade, 2015). Similar findings from previous research suggest that little or insufficient healthcare practitioners' education and insufficient healthcare resources are to blame for patients' deficient understanding of T2DM in Nigeria (Jackson *et al*., 2014). The treatment of T2DM in a clinical environment among adults in Nigeria is influenced by factors linked to the patient, healthcare practitioner, and healthcare organization (Jackson *et al*., 2014; Bosun-Arije, *et al*., 2020).

Inadequate healthcare infrastructure and limited access to healthcare services are additional factors that have a detrimental influence on the treatment of T2DM in Nigeria (Jackson, *et al*., 2014). According to Ogbera *et al*. (2016), 30% of persons in Nigeria with T2DM have access to diabetes-specific healthcare treatments. Delay in diagnosis, ineffective treatment adherence, and subpar health outcomes may all result from this lack of access to healthcare services (Jackson *et al*., 2014; Ogbera *et al*., 2016).

Chinenye and Ogbera (2013) claim that economic hardships force many Nigerians to consume high-calorie meals, which has restricted the adoption of good eating habits. These high-calorie diets are often seen as being highly accessible and economical (Chinenye and Ogbera, 2013). It is crucial to keep in mind, however, that a high Glycaemic Index (GI) has been linked to high-calorie diets (Iloh *et al*., 2015). On the GI scale, which spans from 1-100, 70 is regarded as high and 56–69 as medium. It has been shown that eating foods with medium-high GI values may increase appetite and postprandial hyperglycemia, which can lead to obesity and an increased risk of T2DM (Umeadi and Chinenye, 2014). Postprandial hyperglycemia is the term used to describe a large rise in blood sugar levels after eating (Umeadi and Chinenye, 2014).

Additionally, it seems that in certain Nigerian societies, being somewhat overweight is seen as a symbol or signal of prosperity, riches, or luxury as well as feminine attractiveness (Enang, 2009). According to Enang (2009), some women in these cultures who think that being overweight is a sign of beauty put women who are getting married in fattening rooms where they are fed a lot of food in order to achieve a desired weight that is considered to be attractive for womanhood in advance of their weddings. The aforementioned serves as more evidence that healthcare professionals in Nigeria must comprehend that traditional, religious, family, and community leaders have a huge impact on people's decisions, especially when it comes to health-related issues (Chinenye and Ogbera, 2013).

5.2 Outcome of factors that affect management of T2DM among adults in Nigeria

In Nigeria, type 2 diabetes mellitus (T2DM) is a progressively worsening health issue among people. According to the World

Health Organization (WHO, 2016a), Nigeria has an estimated 12.8% prevalence of T2DM. Compared to the earlier estimate of 7.5% from 2000, this is a considerable increase (WHO, 2016b). Since T2DM is linked to a number of detrimental health effects, including cardiovascular disease, renal failure, and blindness, its rising prevalence in Nigeria is concerning (WHO, 2016a).

The emergence and development of problems linked to type 2 diabetes mellitus (T2DM) must be prevented with proper care of the condition. In Nigeria, where T2DM incidence is fast rising (WHO, 2016a, 2016b), improper therapy may result in a number of life-threatening consequences. Cardiovascular disease is one frequent consequence of T2DM that may happen as a result of improper therapy (Olamoyegun, 2015). In Nigeria, people with T2DM have a greater risk of acquiring cardiovascular diseases such as hypertension, coronary artery disease, and stroke, according to a research by Onakpoya *et al*. (2010). This is probably brought on by a trifecta of unfavorable glycemic control, elevated cholesterol, and hypertension, all of which are prevalent in people with T2DM who are not getting the proper care (Iwuala *et al*., 2015; Odume *et al*., 2015; Awodele *et al*., 2015).

5.3 Handling the factors that affect management of T2DM among adults in Nigeria

The Diabetes Management Association of Nigeria (2013) states that in order to prevent complications and enhance the patient's quality of life, Type 2 Diabetes Mellitus (T2DM) management in hospitals across the nation should involve a thorough and detailed evaluation of the condition and management procedure to be used, including a detailed medical evaluation for the classification of the disease (Diabetes Management Association of Nigeria, 2013). Patients who have been diagnosed with T2DM should be the center of the management or treatment procedures or strategy, and patients and healthcare professionals (such as nurses or care providers) should work together to achieve glycemic control. Additionally, diabetes self-management education (DSME), which enables patients to actively participate in their own self-care management plan, is regarded as a critical and essential element for efficient glycemic control (Weinger and Carver, 2008; Nicolucci *et al*., 2013). The psychological, biosocial, and cultural effects of T2DM on patients in Nigeria are also crucial to take into account, since many people with the illness may suffer emotions including guilt, shock, rage, fear, and sadness (Nash, 2013). Consequently, it might be helpful to provide an adequate self-care strategy for the treatment of the condition to prevent problems or a rise in blood sugar level to have a critical awareness of the psychological, cultural, and economic backgrounds of people with T2DM in Nigeria (Chinenye and Young, 2011; Iwuala *et al*., 2015).

The expense of diabetes-specific drugs and healthcare services was also identified in two studies by Iwuala *et al*. (2015) and Jackson *et al*. (2014) to be a substantial barrier to the treatment of T2DM among adults in Nigeria. Poor treatment adherence and unfavorable health outcomes may result from this financial strain. According to Jackson *et al*. (2014), lowering the cost of T2DM care is essential for improving T2DM management among adults in Nigeria. This may be accomplished by providing funding for diabetes drugs and healthcare services as well as by putting in place regulations that encourage businesses to pay costs associated with diabetes (Jackson *et al*., 2014).

According to Emmanuel and Otovwe (2015), it's essential to raise public awareness about T2DM. This may be done by launching diabetes education initiatives at educational institutions and community centers, as well as via public relations efforts (Emmanuel and Otowve, 2015). These educational initiatives must be culturally suitable and suited to the local people. The initiatives to raise awareness and understanding of T2DM should include involve healthcare professionals and local authorities (Adisa, *et al*., 2009; Emmanuel and Otowve, 2015). Secondly, to better manage T2DM in Nigeria, access to healthcare services tailored to people with diabetes must be increased. This may be done by expanding the nation's network of diabetic clinics and medical professionals with the necessary training. To lessen the financial strain on patients, the government should also provide financial help for diabetic drugs and healthcare services (Ogbera *et al*., 2006). Additionally, it is crucial to incorporate traditional, religious, family, and community leaders in the process to enhance the management of T2DM in Nigeria (Chinenye and Ogbera, 2013). These decision-makers have a great deal of sway over the public, particularly when it comes to concerns of health, therefore their backing may be essential to encouraging healthy habits and treatment compliance (Chinenye and Ogbera, 2013). The management of T2DM in Nigeria has to be studied further in order to pinpoint the unique care obstacles and facilitators. This study may help with the creation of culturally competent interventions to enhance T2DM management in Nigeria.

There are three tiers of health policy in Nigeria to deal with non-communicable diseases: macro, meso, and micro (Federal Ministry of Health, 2011). The legislation, financing, national policy, and national initiatives that are implemented at the federal government level are referred to as macro-level policy (Federal Ministry of Health, 2011). Meso-level policy relates to the organizational and programmatic frameworks in place for state administration. Moreover, micro-level policy includes the conduct of medical professionals, especially nurses, who treat diabetes in hospitals (Okoye, 2019). In Nigeria, non-communicable diseases (NCDs) including diabetes, cancer, and heart disease have grown to be a significant public health issue. In Nigeria, managing NCDs requires a multifaceted strategy that incorporates both programmatic and policy interventions. For Nigeria to effectively manage NCDs, appropriate policies must be developed and put into place.

The creation of laws and financing for national programs is a crucial component of policy for the management of NCDs in Nigeria. Both the National Strategic Foundation for the Prevention and Control of Non-Communicable Diseases (Federal Ministry of Health, 2011) and the National Health Act (Federal Ministry of Health, 2014), which provides the legislative framework for the management of NCDs in Nigeria, serve as examples of this. The creation of

programmatic and organizational infrastructures at the state level is a crucial component of policy for the management of NCDs in Nigeria. This entails the creation of state-specific NCD management plans and the creation of NCD management committees at the state level (Okoye, 2019). Micro-level policies and interventions are as crucial for the management of NCDs in Nigeria as these macro- and meso-level strategies. These include educating and preparing healthcare workers, especially nurses, for the management of NCDs (Okoye, 2019). In general, managing NCDs in Nigeria requires a thorough, multi-level strategy that involves the creation and application of efficient laws at the federal, state, and healthcare provider levels.

5.4 Limitations and Strengths of the Research

This study focused on a systematic review of factors that affect the management of T2DM among adults in Nigeria. The study discovered some relevant factors that affect the management of this condition by the adult population (18-60 years), however there were some limitations to this study findings and conclusions.

Firstly, the papers used in the systematic review have a small sample size, which affects the generalizability of the study findings. For instance, some studies have a sample size of less than 100 participants (Okurumah *et al*., 2022; Bosun-Arije *et al*., 2020; Iregbu *et al*., 2022; Nwaokor *et al*, 2014), which may not be representative of the larger population. In addition, some studies have limited geographical coverage, which affects the external validity of the study findings. For example, some studies only focus on participants from a single hospital (Okurumah *et al*., 2022; Adeniyi *et al*, 2012; 2015; Iregbu *et al*., 2022), which may not be representative of the broader population of adults with T2DM in Nigeria.

Secondly, the papers used in the systematic review have selection bias, which affects the internal validity of the study findings. For instance, all the studies only included participants who attended the hospitals for treatment, which may not capture individuals who do not seek medical care for T2DM. In addition, all the studies only included participants who have been diagnosed with T2DM which may exclude individuals who have not been diagnosed with the disease.
Also, the papers used in the systematic review have publication bias, which affects the representativeness of the study findings. For instance, the systematic review only includes published studies, which may exclude relevant studies that have not been published. In addition, the systematic review only includes studies published in English, which may exclude relevant studies published in other languages.

Furthermore, the systematic review encompassed studies that have different populations, making it difficult to compare results and draw general conclusions. There were researches from different states in the regions included in the studies which possess particular cultural traits and beliefs that may influence people's behaviour towards the management of their diabetic condition. This heterogeneity limits the strength of the study findings. Also, there is the issue of bias in study design. The included studies have different methods of recruitment, measurement, and data analysis, leading to potential bias in results. Furthermore, the systematic review included studies that have been published in peer-reviewed journals, potentially excluding important studies that have not been published. Additionally, some factors affecting T2DM management may be unique to the cultural context in Nigeria, and may not be fully captured in the systematic review.

It is important to note the limitations of a systematic review when interpreting and applying the results to inform clinical and public health practices. Further research, including randomized controlled trials and studies with larger sample sizes, is needed to better understand the factors affecting T2DM management among adults in Nigeria.

Despite the above-mentioned research's limitations, it is clear from the study's findings that public health practitioners, politicians, and healthcare professionals may still benefit greatly from it. There are various advantages to the systematic evaluation of the elements influencing the treatment of T2DM among adults in Nigeria: The systematic review offers an exhaustive and detailed synthesis of the data that is currently accessible within the context of this study. This makes it possible to indicate important variables and their effects on T2DM treatment in Nigeria. Rigorous techniques were utilized in the systematic review to reduce bias and improve the validity of the results. By doing this, the outcomes become more trustworthy and reliable. This systematic review further expands the sample size and generalizability of the findings by combining data from several research. This enables more confident inferences about the elements influencing T2DM management in Nigeria. The systematic review procedure is also open, enabling others to examine and question the methodology. As a consequence, the findings are more credible and simpler to reproduce in subsequent research. Finally, the systematic review's findings may influence practice and policy by providing a solid evidence framework for the creation of interventions and plans to enhance T2DM management in Nigeria.

5.5 Implications of findings

The results of this systematic review's analysis of the variables influencing T2DM treatment among adults in Nigeria have important significance for a variety of reasons. The systematic review's findings may help shape future policies and initiatives targeted at Nigeria's better diabetes management. This can include encouraging healthy lifestyles, expanding access to healthcare services, and offering T2DM patients support and information. Additionally, Nigerian healthcare practitioners might create customized T2DM treatment plans using the systematic review's results to guide their clinical practice. This might include frequent monitoring of the disease's course, patient education, and early detection and management. The results of the systematic review may have wider significance for public health by illuminating the underlying causes of T2DM treatment in Nigeria and laying the groundwork for future investigations and interventional projects. Additionally, a deeper understanding of the variables influencing T2DM care may result in better glucose control, decreased rates of

complications, and higher quality of life for patients with T2DM in Nigeria.

6. Recommendations for policy, practices and Research

6.1 Recommendation for Policy

Especially in rural regions where access to high-quality healthcare is scarce, the government should make investments in enhancing Nigeria's healthcare system. By doing this, there will be a greater chance that T2DM will be identified early and managed. Additionally, the government may promote healthy living choices via public awareness campaigns, academic curricula, and rewards for companies that support employees' participation in physical exercise and a balanced diet. Additionally, knowledge and self-management abilities are necessary for the efficient treatment of T2DM. Resources should be made available by the government to teach T2DM patients and their families how to manage the condition. Additionally, the government should collaborate with pharmaceutical firms to make sure that Nigerians can easily get high-quality, cheap diabetic treatments. The government should also work with stakeholders to promote efficient management techniques and enhance knowledge of T2DM, such as healthcare professionals, patient groups, and local authorities.

6.2 Recommendation for Health Practices

Several suggestions may be made to enhance T2DM management among adults in Nigeria based on the systematic review's results. First and foremost, healthcare professionals have to concentrate on raising public knowledge of T2DM, its risk factors, and the value of early detection and efficient treatment. Public health initiatives, community-based education initiatives, and health literacy resources might all help with this. Secondly, health care providers should focus on improving access to health care services, including diabetes clinics and educational programs, for adults with T2DM. This can be done by increasing the availability of resources, such as medications, diagnostic tests, and equipment, and by improving the quality of health care services.

In addition, health care providers should work towards changing cultural beliefs and attitudes about T2DM and its management. This can be done by involving traditional healers and community leaders in education programs and by incorporating traditional remedies into the management of T2DM. Furthermore, health care providers should also focus on improving the knowledge of adults with T2DM about their condition and its management. Programs for patient education and the provision of written information and resources may accomplish this.

6.3 Recommendation for future research

A research suggestion following this systematic review on the factors affecting T2DM management in Nigeria could be to conduct a randomized controlled trial to evaluate the effectiveness of an intervention aimed at improving diabetes self-management practices among adults in Nigeria. This intervention could include components such as education on diabetes management, regular monitoring and support, and behavioral modifications to improve diet and physical activity habits. The trial could measure outcomes such as HbA1c levels, blood pressure, and body weight, as well as self-reported behaviors related to diabetes management. This study would provide valuable insight into the impact of targeted, comprehensive interventions for improving T2DM management in Nigeria and inform future public health efforts in this area.

7. Conclusion

According to the review's findings, T2DM management in Nigeria is affected by multiple factors, with a primary focus on patient-related factors rather than the role of clinical providers in preventing T2DM progression. Non-adherence is often interpreted as ineffective management, rather than being acknowledged as a deliberate hindrance. Several negative factors, such as lack of knowledge and awareness, inadequate healthcare infrastructure, poor access to healthcare services, and financial constraints, adversely impact the management of T2DM among Nigerian adults. Improving T2DM management in Nigeria requires increasing awareness and knowledge of the condition, enhancing access to healthcare services, and reducing the financial burden associated with managing T2DM.

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Conflict of Interest

The authors declare that there is no conflict of interest.

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