THE ASSESSMENT OF THE USE OF HERBAL MEDICINE AMONG DIABETES MELLITUS PATIENT AT UNIVERSITY OF BENIN TEACHING HOSPITAL [UBTH] BENIN CITY, EDO STATE.

BY

ADEBUSOYE ADETAYO PETER

MAT NUMBER; PHA1908440

SUPERVISED BY

DR. ISABEL NAOMI AIKA

DEPARTMENT OF CLINICAL PHARMACY AND PHARMACY PRACTICE,

FACULTY OF PHARMACY,

UNIVERSITY OF BENIN,

BENIN CITY.

NOVEMBER,2025.

THE ASSESSMENT OF THE USE OF HERBAL MEDICINE AMONG DIABETES MELLITUS PATIENT AT UNIVERSITY OF BENIN TEACHING HOSPITAL [UBTH] AND SOME COMMUNITY PHARMACY IN BENIN CITY, EDO STATE.

BY

ADEBUSOYE ADETAYO PETER

PHA1908440

A DISSERTATION SUBMITTED TO THE DEPARTMENT OF CLINICAL PHARMACY AND PHARMACY PRACTICE,

FACULTY OF PHARMACY,

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DOCTOR OF PHARMACY (PHARM.D) DEGREE OF THE UNIVERSITY OF BENIN,

BENIN CITY, EDO STATE, NIGERIA.

NOVEMBER, 2025

CERTIFICATION

This is to certify that this work was done by ADEBUSOYE ADETAYO in the Department of Clinical Pharmacy and Pharmacy Practice, Faculty of Pharmacy, University of Benin, Benin City, Nigeria, in partial fulfillment for the award of Doctor of Pharmacy (Pharm. D) degree of the University.

__________________________ ______________________

Dr. Isabel Naomi Aika **Date**

(Project Supervisor)

__________________________ ______________________

Dr. M.I Osarenmwinda **Date**

(Head of Department)

__________________________ ______________________

Adebusoye Adetayo Peter **Date**

ACKNOWLEDGEMENT

I give all glory, honour, and adoration to Almighty God for His infinite mercies, grace and wisdom throughout the course of my study at the University of Benin, and for seeing me through the completion of this project. Without His guidance, this achievement would not have been possible.

I wish to express my sincere gratitude to my supervisor, Dr. Mrs. Isabel Naomi Aika, for her invaluable guidance, patience, encouragement, and constructive criticism throughout the course of this research. Your dedication to excellence and attention to detail have greatly enriched this work and contributed immensely to my academic growth.

My sincere appreciation also goes to the Dean of the Faculty of Pharmacy, University of Benin, and all members of staff academic, technical, and administrative for their relentless effort, support, and commitment to ensuring the conducive learning environment for students.

I am extremely grateful to my parents, Mr. and Mrs. Adebusoye, and my beloved brothers for their prayers, support, and unending love. Your sacrifices, encouragement, and belief in my potential have been my greatest source of motivation.

To my colleagues and friends in the Department of Pharmacy, Class of 2025 (Golden set), thank you for the cooperation, teamwork, and memorable experiences we shared throughout this academic journey. Your companionship made the challenging moments worthwhile.

Finally, I also extend my gratitude to everyone who contributed directly or indirectly the likes of Bro Israel Jesurinde, Igbineweka Emmanuel, Slyvester, Bro Ire Olukayode, to the success of this research, including respondents, laboratory staff, and my fellow project colleagues Mama Vicky, Mesham, Jonathan and Favour. Your support and input are sincerely appreciated.

TABLE OF CONTENT

ABSTRACT

Background: - Herbal medicine, defined as the therapeutic use of plants and plant-based products, has long played a vital role in African healthcare systems. In Nigeria, where approximately 70–80% of the population depends on traditional remedies, medicinal plants such as Vernonia amygdalina, Azadirachta indica, Moringa oleifera, and Ocimum gratissimum are commonly used for managing diabetes mellitus (DM). Despite their popularity, concerns remain regarding their clinical efficacy, safety, dosage standardization, and possible interactions with conventional anti-diabetic drugs.

Objectives:- This study was conducted to assess the prevalence and pattern of herbal medicine use among diabetic patients and to evaluate their knowledge regarding these therapies.

Methods:- A prospective cross-sectional study was carried out at the University of Benin Teaching Hospital (UBTH), specifically in the Consultant Outpatient Department (COPD) and Consultant Outpatient Department–National Health Insurance Scheme (COPD–NHIS). A total of 205 diabetic patients participated through structured interviews and questionnaires. Data were analyzed to determine the prevalence of herbal medicine use and the level of awareness among respondents.

Results:- It shows that the majority of participants (93.2%) were diagnosed with Type 2 diabetes mellitus. About one-fifth (20%) of the respondents reported using herbal medicines alongside conventional therapy, while 14.6% were currently combining both forms of treatment at the time of the study. Only a small proportion demonstrated adequate knowledge regarding the efficacy, safety, and potential interactions of herbal products with prescribed medications.

Conclusion: - the study revealed a moderate prevalence of herbal medicine use among diabetic patients, often in combination with standard anti-diabetic drugs. These findings highlight the need for enhanced patient education, improved regulation, and strengthened pharmacovigilance to ensure the safe and effective integration of herbal medicine into diabetes management in Nigeria.

CHAPTER ONE

INTRODUCTION

Background

Herbal medicine, defined as the use of plants or plant-based products for therapeutic purposes, has been practiced in Africa for centuries. In Nigeria, an estimated 70–80% of the population relies on traditional medicine, either solely or alongside modern treatment (World Health Organization [WHO], 2013). Several medicinal plants—such as Vernonia amygdalina (bitter leaf), Azadirachta indica (neem), Moringa oleifera, and Ocimum gratissimum—have been traditionally used to manage diabetes symptoms. Scientific studies have suggested that some of these herbs may exert antidiabetic effects through mechanisms such as enhancing insulin secretion, improving insulin sensitivity, promoting glucose uptake, and inhibiting carbohydrate-digesting enzymes (Eddouks et al., 2012; Yakubu et al., 2019).

Despite widespread usage, the clinical efficacy, safety profiles, pharmacokinetics, and potential herb-drug interactions of many herbal remedies remain poorly understood or under-researched. Clinical pharmacy plays a critical role in bridging the gap between traditional medicine and evidence-based practice by promoting rational drug use, conducting pharmacovigilance, and evaluating the effectiveness and safety of herbal products. Moreover, there is a lack of standardized formulations, dosage recommendations, and regulatory oversight for many herbal antidiabetic products in Nigeria (Owolabi et al., 2020). This makes it difficult to ensure consistent therapeutic outcomes and patient safety.

Persistent hyperglycemia brought on by deficiencies in insulin secretion, action, or both is a hallmark of diabetes mellitus (DM), a chronic metabolic disease. It remains one of the most common endocrine diseases globally, with type 2 diabetes accounting for more than 90% of all cases (American Diabetes Association [ADA], 2024). The global burden of diabetes continues to rise, with an estimated 537 million people affected in 2021, a figure projected to reach 783 million by 2045 (International Diabetes Federation [IDF], 2021). In Nigeria, the prevalence of diabetes mellitus is increasing due to urbanization, lifestyle changes, and a growing aging population, with current estimates placing the national prevalence at around 5.77% (Uloko et al., 2018).

The management of diabetes traditionally relies on lifestyle modifications, oral hypoglycemic agents, and insulin therapy. However, these conventional treatments have limitations, including adverse effects such as hypoglycemia, gastrointestinal disturbances, and weight gain, as well as the high cost and limited accessibility of medications in low- and middle-income countries like Nigeria (Ogurtsova et al., 2017; Awodele et al., 2014). Consequently, many diabetic patients in Nigeria and other African countries turn to herbal medicine as a complementary or alternative approach to glycemic control.

In recent years, there has been a renewed global interest in herbal medicine, particularly for chronic diseases like diabetes mellitus. This interest is partly driven by the growing dissatisfaction with the side effects and limitations of synthetic drugs. In Nigeria, where access to affordable healthcare and conventional antidiabetic medications remains a challenge, the use of medicinal plants is often driven by necessity, cultural beliefs, and the perception that natural products are safer and more effective. Furthermore, many traditional healers and local communities have developed indigenous knowledge systems surrounding the use of specific herbs for diabetes management, often passed down through generations without formal scientific documentation (WHO, 2013).

Studies have shown that certain plant-based compounds, such as flavonoids, alkaloids, terpenoids, saponins, and polyphenols, possess hypoglycemic properties. These bioactive constituents may exert antidiabetic effects by targeting multiple pathways, including enhancing insulin receptor sensitivity, protecting pancreatic β-cells, inhibiting alpha-glucosidase and alpha-amylase enzymes, and modulating glucose transporters (Eddouks et al., 2012; Yakubu et al., 2019). However, while preclinical and in vitro studies support these mechanisms, clinical validation in humans remains limited, often due to poorly designed studies, small sample sizes, or lack of standardization.

Another concern is the lack of regulatory oversight for herbal products in Nigeria. Many herbal formulations are sold over-the-counter without adequate information on dosage, safety, or potential interactions with conventional drugs. This poses a significant risk of toxicity, adverse drug reactions, and therapeutic failure. Pharmacovigilance efforts focused on herbal medicine are still underdeveloped in Nigeria's healthcare system.

Given the increasing use of herbal medicine among diabetic patients in Nigeria, there is an urgent need for scientific validation, improved regulation, and public awareness. A deeper understanding of the pharmacodynamics, clinical trial outcomes, and safety monitoring of these herbal products will help integrate them into modern clinical practice more effectively. Thus, this study seeks to explore the use, efficacy, and pharmacovigilance of herbal medicine in the management of diabetes mellitus from a clinical pharmacy perspective.

1.2 LITERATURE REVIEW

Diabetes mellitus (DM) is a major non-communicable disease with increasing prevalence worldwide, including in sub-Saharan Africa. The limitations of conventional antidiabetic therapies have led to growing interest in alternative and complementary treatment options such as herbal medicine. In Nigeria, traditional medicine plays a significant role in healthcare delivery due to its cultural acceptance and accessibility. This literature review aims to examine the use of herbal medicines in diabetes management, focusing on their pharmacodynamics, mechanisms of action, clinical evidence, and safety within the context of clinical pharmacy practice.

2. Theoretical and Conceptual Framework

The review is guided by principles of clinical pharmacology, ethnopharmacology, and rational drug use. Ethnopharmacology provides the cultural and historical context for herbal use, while clinical pharmacology ensures focus on pharmacokinetics, pharmacodynamics, and pharmacovigilance. The WHO Traditional Medicine Strategy (2014–2023) also informs this review, emphasizing the integration of traditional medicine into national health systems.

3. Overview of Diabetes Mellitus

Diabetes mellitus is characterized by chronic hyperglycemia resulting from defects in insulin secretion, insulin action, or both. It is associated with serious complications, including cardiovascular disease, nephropathy, retinopathy, and neuropathy. According to the IDF (2021), 537 million adults live with diabetes globally, with projections estimating 783 million by 2045. In Nigeria, the prevalence is approximately 5.77% (Uloko et al., 2018), driven by urbanization, sedentary lifestyle, and unhealthy diets.

Conventional treatment includes lifestyle changes, oral antidiabetics (e.g., metformin, sulfonylureas), and insulin therapy. However, side effects, cost, and poor accessibility have led patients to seek herbal alternatives.

4. Use of Herbal Medicine in Diabetes Management

In Nigeria, herbal medicine is deeply rooted in indigenous health practices. Over 70% of the population uses herbal remedies either alone or alongside orthodox medicine (WHO, 2013). Many patients self-medicate with herbal formulations believed to improve blood sugar control. Commonly used herbs include:

Vernonia amygdalina (bitter leaf), Azadirachta indica (neem), Moringa oleifera, Ocimum gratissimum (scent leaf), Gongronema latifolium, Allium sativum (garlic)

These herbs are used in various forms—decoctions, infusions, powders, or capsules. However, most preparations are unstandardized, and doses vary widely.

A survey by Owolabi et al. (2020) in Ondo State revealed that over 60% of diabetic patients use herbal medicines regularly, with 35% not informing their healthcare providers. This poses risks of herb-drug interactions and complications.

Clinical Trials and Evidence-Based Analysis

Several clinical studies have investigated the efficacy of herbal medicines in diabetic patients, though many suffer from limitations such as small sample sizes, lack of controls, and short durations. Eddouks et al. reported significant glucose-lowering effects of V. amygdalina in diabetic rats, suggesting insulinotropic and antioxidant properties. A randomized controlled trial by Akinmoladun et al. (2020) using M. oleifera in 60 diabetic patients showed significant reductions in fasting blood glucose and HbA1c over 12 weeks.

Owolabi et al. (2020) found that patients using herbal medicine alongside oral hypoglycemics had better subjective symptom control but faced higher risks of adverse effects.

However, few studies have long-term safety or pharmacovigilance monitoring. There is a clear need for well-designed, large-scale clinical trials evaluating standardized herbal preparations in diverse Nigerian populations.

Pharmacodynamics and Pharmacokinetics

Pharmacodynamics of herbal medicines refers to the biological effects and mechanisms of the active phytochemicals. For example, flavonoids in Ocimum gratissimum act on β-cells to stimulate insulin, while saponins from Gongronema latifolium improve insulin sensitivity.

Pharmacokinetics (absorption, distribution, metabolism, and excretion) remains poorly characterized for most Nigerian herbs. This limit the understanding of effective dosing, onset of action, and duration of effect. Variability in bioavailability due to preparation method (e.g., boiling vs. alcohol extraction) further complicates clinical application.

Moreover, these herbs may affect cytochrome P450 enzymes, altering the metabolism of co-administered drugs, including metformin or sulfonylureas. A clinical pharmacist must be aware of these potential interactions and monitor therapeutic drug levels where applicable.

Pharmacovigilance and Safety Concerns

One of the major challenges of herbal medicine use is safety. Adverse effects such as hepatotoxicity, nephrotoxicity, and gastrointestinal irritation have been reported in some cases.

For instance, high doses of neem can cause liver damage, and V. amygdalina has been associated with hematologic changes when consumed excessively (Awodele et al., 2014).

There is also risk of: Herb-drug interactions, Lack of standard dosing, Unknown contaminants, Delayed medical treatment due to faith in herbal remedies

Nigeria's pharmacovigilance system is still developing. Many adverse events from herbal use go unreported. The National Agency for Food and Drug Administration and Control still monitors, but there is still limited laboratory testing and product registration for many traditional remedies.

Clinical Pharmacy Implications

Clinical pharmacists can play a critical role in addressing these challenges by:

- Educating patients on safe and effective herbal use
- Identifying and preventing herb-drug interactions
- Participating in clinical trials and drug monitoring
- Advocating for quality control, standardization, and registration of herbal products
- Collaborating with traditional practitioners and researchers

By integrating herbal medicine into evidence-based care, pharmacists can support improved diabetes outcomes and reduce risks associated with unregulated use.

Existing Knowledge Gap

Although a variety of medicinal plants are used for diabetes management in traditional medical systems, much of the current knowledge remains anecdotal or based on animal models and in vitro studies. The clinical translation of these findings is limited due to the absence of robust human-based evidence. Specifically, there is a critical lack of:

Well-designed, large-scale randomized controlled trials (RCTs) assessing the efficacy and safety of these herbal remedies in real-world diabetic populations. Most clinical studies conducted so far are either observational or lack rigorous methodology, thus undermining the strength of the evidence (Ferdous et al., 2019).

Standardized herbal formulations: The bioactive compounds in plants can vary due to differences in cultivation, harvesting, extraction techniques, and dosage forms. Without standardized dosages and identification of active constituents, reproducibility of clinical outcomes is problematic (Yakubu et al., 2019).

Pharmacokinetic and pharmacodynamic profiles: Very few studies address how these herbs are absorbed, distributed, metabolized, or excreted in humans, making it difficult to predict therapeutic windows or potential toxicities (Akinmoladun et al., 2020).

Long-term safety monitoring: There is a dearth of data regarding the chronic use of herbal antidiabetic agents, especially in patients with coexisting organ dysfunction or polypharmacy. For instance, hepatotoxic and nephrotoxic effects of commonly used herbs like Azadirachta indica and Vernonia amygdalina have been reported in animal studies but rarely studied in human populations (Awodele et al., 2017; Oboh et al., 2021).

Clinical integration models: The absence of structured frameworks for integrating herbal medicine into conventional practice creates a fragmented care model where patients often use herbal remedies without informing their healthcare providers. This gap undermines continuity of care and holistic treatment planning (WHO, 2019).

These limitations not only affect the scientific community's ability to validate traditional treatments but also place patients at risk of suboptimal therapy, delayed intervention, and preventable complications.

Clinical Pharmacy Approach

From a clinical pharmacy perspective, the use of unregulated herbal products without clear clinical guidelines introduces several pharmacotherapeutic challenges:

Polypharmacy and Drug-Herb Interactions: Diabetic patients frequently have comorbid conditions requiring multiple medications such as antihypertensives, statins, and antiplatelet agents. The addition of herbs with unknown pharmacological activity can lead to interactions that enhance toxicity or diminish therapeutic efficacy. For example, some herbs may inhibit or induce cytochrome P450 enzymes, altering drug metabolism (Owolabi et al., 2020; Ibewuike et al., 2021).

Lack of Therapeutic Drug Monitoring (TDM): Unlike synthetic drugs, herbal medications lack defined pharmacokinetic parameters. Clinical pharmacists are equipped to monitor drug levels and optimize dosages based on plasma concentration-time curves, but the absence of such data for herbal agents makes monitoring nearly impossible (Onyeka et al., 2022). These compromises individualized therapy and safety.

Patient-Centred Counselling Deficit: One of the pillars of clinical pharmacy is patient education. However, a major barrier is the underreporting of herbal medicine use by patients, either due to cultural beliefs, fear of judgment, or lack of awareness. Moreover, many clinicians do not routinely ask about herbal use during consultations. This communication gap limits pharmacists' ability to provide accurate information and design effective treatment regimens (Nwankwo et al., 2020).

Pharmacovigilance and Safety Surveillance: The lack of structured pharmacovigilance systems for herbal medicine in Nigeria is a critical issue. Many adverse effects go unrecognized or unreported. Clinical pharmacists should advocate for the inclusion of herbal medicine in national pharmacovigilance programs and lead efforts in adverse drug reaction (ADR) reporting and risk mitigation (WHO, 2019; Ezeuko et al., 2021).

As experts in drug therapy and medication safety, clinical pharmacists are uniquely positioned to evaluate herbal products within an evidence-based framework, collaborate with traditional healers, and develop protocols for safe integration into standard care.

In summary, the widespread and often unregulated use of herbal medicines in diabetes mellitus, particularly in Nigeria, presents a significant public health concern. While these remedies may offer therapeutic benefits rooted in centuries of indigenous knowledge, the scientific evidence supporting their efficacy and safety remains incomplete. Without standardization, clinical validation, and safety monitoring, herbal use may expose patients to treatment failure, adverse effects, and herb-drug interactions (Akinmoladun et al., 2020; Oboh et al., 2021).

A clinical pharmacy approach is vital to bridge the gap between traditional and modern medical practices. Through medication review, therapeutic drug monitoring, pharmacovigilance, and patient-centred counselling, pharmacists can ensure safer and more effective use of herbal antidiabetic agents. Furthermore, clinical pharmacists can contribute to research by participating in the design and implementation of clinical trials that evaluate herbal medicines in local populations (Onyeka et al., 2022; Ezeuko et al., 2021)

Given the cultural acceptance of herbal medicine in Nigeria, integrating it responsibly into diabetes care requires collaboration among researchers, clinicians, regulatory bodies, and community stakeholders. This study contributes to this goal by highlighting the clinical and pharmaceutical considerations necessary for the rational use of herbal medicine in diabetes care.

Herbal medicine plays a prominent role in diabetes management in Nigeria, driven by cultural practices and limited access to conventional care. While several herbs show promising antidiabetic effects through well-understood pharmacological mechanisms, the evidence from clinical trials remains insufficient. Pharmacovigilance and safety monitoring are also underdeveloped. A clinical pharmacy approach grounded in evidence, patient safety, and pharmacological insight is essential to evaluate and integrate herbal remedies into modern diabetes care. More research is needed, especially large-scale trials, standardization of preparations, and improved regulation to ensure the safe use of herbal medicine among diabetic patients in Nigeria.

1.3 PROBLEM STATEMENT

In Nigeria, there has been a significant rise in the availability and use of herbal preparations, dietary supplements, and various forms of traditional medicine claiming to treat or manage chronic illnesses such as diabetes mellitus (DM). These products are often promoted through unregulated channels and are widely accepted due to cultural beliefs, accessibility, and the perceived safety of "natural" remedies (Owolabi et al., 2020; WHO, 2019).

Diabetes mellitus, particularly type 2 diabetes, represents a growing public health burden in Nigeria, with a prevalence rate of approximately 5.77% among adults and increasing yearly due to urbanization, lifestyle changes, and poor access to healthcare (Uloko et al., 2018). Unlike acute illnesses, diabetes is a lifelong condition that requires continuous pharmacological and lifestyle management. While conventional antidiabetic drugs are the mainstay of therapy, their cost, availability, and side effects have prompted many patients to turn to herbal and alternative remedies, often without professional guidance (Awodele et al., 2017).

This growing trend raises serious concerns about the safety, efficacy, and rational use of herbal medicines among diabetic patients. Most of these herbal products are not standardized or clinically validated, and their active components and pharmacokinetic profiles remain poorly understood. Furthermore, concurrent use of herbal and orthodox medications increases the risk of drug-herb interactions, which can lead to subtherapeutic effects, toxicity, or hypoglycemic episodes (Oboh et al., 2021; Ibewuike et al., 2021). The lack of disclosure by patients to their healthcare providers further complicates this issue, reducing the ability of clinicians—particularly clinical pharmacists—to ensure medication safety and optimize therapy.

Therefore, it is crucial to document and evaluate the pattern of herbal medicine use among diabetic patients in Nigeria. Such documentation will help identify knowledge gaps, inform policy, and facilitate the safe integration of complementary therapies into mainstream healthcare using an evidence-based, clinical pharmacy approach.

1.4 JUSTIFICATION OF STUDY

Diabetes mellitus remains a significant and escalating public health concern in Nigeria and globally. As of 2021, the International Diabetes Federation (IDF) estimated that over 24 million people in sub-Saharan Africa are living with diabetes, with Nigeria contributing one of the highest national burdens in the region (IDF, 2021). Despite advances in conventional antidiabetic therapy, many patients experience treatment challenges such as side effects, cost of medications, limited access to healthcare facilities, and poor adherence to long-term therapy (Uloko et al., 2018).

In response to these limitations, there has been a noticeable increase in the use of herbal medicines and traditional remedies by diabetic patients in Nigeria (Owolabi et al., 2020). These herbal products are often used without clinical guidance, and their concurrent use with conventional medications can pose risks such as adverse reactions, herb-drug interactions, and unpredictable therapeutic outcomes (Oboh et al., 2021). Despite the popularity of herbal therapies, there is limited empirical data on their safety, efficacy, and patterns of use among diabetic patients.

Moreover, the role of clinical pharmacists in monitoring and integrating herbal medicine use into evidence-based diabetes care has been largely underexplored in the Nigerian healthcare setting. Clinical pharmacists are uniquely positioned to provide medication reviews, identify potential drug-herb interactions, conduct pharmacovigilance, and educate patients on rational drug use. However, the lack of standardized documentation and structured integration frameworks limits their ability to intervene effectively (Ezeuko et al., 2021). This study is therefore justified on several grounds:

Public Health Relevance: With the increasing prevalence of diabetes and the widespread use of herbal remedies, there is an urgent need to understand how these products are being used and their implications for patient safety and disease outcomes.

Clinical Impact: Identifying the patterns, reasons, and risks associated with herbal medicine use among diabetic patients will support clinical pharmacists and healthcare providers in offering better counselling, monitoring, and individualized care.

Policy and Regulation: The findings of this study can inform national policies and regulatory frameworks on the use of complementary and alternative medicine (CAM), particularly in chronic disease management.

Research Gap: There is a paucity of local data, especially in Nigeria, regarding the pharmacovigilance, pharmacokinetics, and therapeutic monitoring of herbal remedies used alongside conventional antidiabetic therapies. This research will help bridge that knowledge gap.

Cultural Sensitivity and Integration: Understanding the cultural drivers behind herbal medicine use can promote respectful, patient-centred care and facilitate the integration of beneficial traditional practices into mainstream healthcare.

In conclusion, this study is timely and essential for improving the safety and effectiveness of diabetes management in Nigeria. It will contribute to the optimization of therapeutic outcomes through the appropriate involvement of clinical pharmacists and promote the rational use of herbal medicine in a culturally relevant context.

1.5 Research Significance

This study will provide valuable insights into the use of herbal medicines among diabetes mellitus patients in Benin City. It aims to inform healthcare professionals about prevailing usage patterns. The findings will serve as a foundation for regulatory actions, professional counselling guidelines, and safer integration of herbal products into diabetes care in Nigeria. This research will also contribute to ongoing discussions on the rational use of complementary medicine in chronic disease management in sub-Saharan Africa.

1.6 Scope of the Study

This study will focus on adult diabetic patients attending outpatient clinics in University of Benin Teaching Hospital.

It will evaluate the frequency, type, and rationale behind herbal medicine use, explore patient knowledge and attitudes, and assess the role of clinical pharmacy services in monitoring and counselling.

The study will specifically investigate: Patterns of herbal medicine usage, Co-use of conventional antidiabetic medications and herbs, Awareness of potential drug-herb interactions, Clinical pharmacists' involvement in patient care..

1.7 Objectives of the Study

Main Objective

To assess the use of herbal medicines among diabetic patients in Nigeria.

Specific Objectives

To determine the prevalence of herbal medicines used by patients with diabetes mellitus.

To assess patients' knowledge of herbal medicine that is used for diabetic patient.

CHAPTER TWO

METHODOLOGY

2.1 Study Design

A prospective cross-sectional study design aimed at assessing the use of Herbal Medicine among Diabetic Mellitus patient in a hospital.

2.2 Study Setting

The Consultant Outpatient Department (COPD) and Consultant Outpatient Department-National Health Insurance Scheme (COPD-NHIS) at the University of Benin Teaching Hospital (UBTH) will be the sites of this study. One of Nigeria's top teaching hospitals, UBTH is connected to the University of Benin. The hospital is a federal health facility that is ideally situated in Benin City, Nigeria's South-South geopolitical zone. It is a major site for the training of undergraduate and graduate physicians as well as clinical training for other health care professionals, including chemists, nurses, physiotherapists, medical laboratory scientists and other medical support staff, as well as in other prestigious community pharmacy

2.3.1 Study Population

The study population will consist of adult patients diagnosed with diabetes mellitus who attend the University of Benin Teaching Hospital (UBTH) during the study period. Participants will include both male and female patients aged 18 years and above, more than 6 month. The study will target individuals who are currently using or have previously used herbal remedies, either alone or in combination with conventional antidiabetic medications. patient with co-morbidities patient are excluded.

2.3.2 Sampling Technique

A systematic random sampling technique will be used to recruit participants. Attendance registers at outpatient clinics and pharmacy records will serve as the sampling frames. After estimating the total number of diabetic patients attending the selected sites within the data collection period, a sampling interval (k) will be calculated by dividing the total number of eligible patients by the desired sample size. Every k-th eligible patient will be approached and invited to participate until the required sample size is reached.

In cases where patient attendance is low (e.g., in community pharmacies), consecutive sampling may be employed to ensure sufficient participant recruitment.

2.4 Inclusion and Exclusion Criteria

Inclusion Criteria

- Adult patients aged 18 years and above.
- Clinically diagnosed with Type 1 or Type 2 diabetes mellitus.
- Patients who visit the selected study sites (COPD and COPD-NHIS) during the study period.
- Patients who use or have used herbal medicines for diabetes management.
- Patients who provide informed consent to participate in the study.

Exclusion Criteria

- Patients who decline consent.
- Patients with cognitive impairments or severe illness that prevent meaningful participation or completion of the questionnaire.
- Patients who do not use herbal medicine in any form for diabetes management.

- Co-morbid patient

2.5 Sample Size Determination

Population Size (N): 485

Confidence Level: 95% (Z = 1.96)

Margin of Error (e): 5%

Estimated Proportion (p): 0.30

Attrition Rate: 5%

Using the formula:

n = Z2 x N x p(1−p) / (N−1) x e2 + Z2 x p(1−p)

Substituting values:

Z2 =3.8416

1−p = 0.701

Numerator: 3.8416 \times 450 \times 0.30 \times 0.70

0.30 \times 0.70 = 0.21 450 \times 0.21 = 94.5 3.8416 \times 94.5 = 362.7312

Denominator: (450 - 1) \times 0.0025 + 3.8416 \times 0.30 \times 0.70 = 449 \times 0.0025 + 3.8416 \times 0.21 = 1.1225 + 0.8067 = 1.9292

Final Sample Size = 188.05 + 9.4025 = 197.452

Approximately 197 participants are required.

Study Period

The study evaluates the use of herbal medicine among Diabetes Mellitus Patient. The total active study duration spans two months, including the time allocated for comprehensive data analysis, interpretation, and reporting of findings. This timeline ensures a robust assessment of immediate outcomes for effective research dissemination..

2.6 Data Collection Instrument and Method

A structured, interviewer-administered questionnaire will be used to collect data from eligible diabetic patients. The questionnaire will be developed through a comprehensive review of relevant literature and adapted from validated instruments used in previous studies on herbal medicine use and diabetes management (Owolabi et al., 2020; Ibewuike et al., 2021).

The questionnaire will be divided into five main sections:

1. **Section A: Sociodemographic Characteristics**

   (e.g., age, gender, marital status, education level, occupation, and income)

2. **Section B: Clinical History**

   (e.g., type and duration of diabetes, no comorbid conditions, medication history)

3. **Section C: Herbal Medicine Use**

   (e.g., types of herbal remedies used, duration of use, sources of information, frequency of use)

Data was collected through face-to-face interviews to ensure completeness and to assist respondents who may have limited literacy levels.

2.6.1 Pretesting

The questionnaire will be pretested on approximately 10% of the intended sample size (about 25–30 participants).Pretesting will help ensure the questionnaire is clear, culturally appropriate, reliable, and valid. Based on the feedback from the pretest, necessary modifications and refinements will be made before final deployment.

2.7 Data Analysis

Data collected from the completed questionnaires will be cleaned, coded, and entered into IBM SPSS Statistics version 27 for analysis.

Descriptive Statistics

- Frequencies and percentages will be used to summarize categorical variables such as gender, types of herbal medicines used, disclosure to healthcare providers, and sources of information.

- Means and standard deviations will be used for continuous variables such as age and duration of diabetes.

Inferential Statistics

- Chi-square tests will be applied to assess associations between categorical variables such as herbal medicine use and sociodemographic characteristics (e.g., age group, education level).

- Binary logistic regression will be employed to identify significant predictors of herbal medicine use, awareness of herb-drug interactions, and likelihood of disclosure to healthcare providers. A p-value < 0.05 will be considered statistically significant.

2.8 Ethical Considerations

Prior to data collection, ethical approval will be obtained from the Ethics and Research Committee of the University of Benin Teaching Hospital (UBTH).

The following ethical principles will be observed:

- Informed Consent: Participants will receive detailed information about the study's objectives, procedures, risks, and benefits. Written informed consent will be obtained before enrollment.

- Confidentiality: Personal identifiers will not be collected. Data will be anonymized and used solely for academic and research purposes.

- Voluntary Participation: Participants will be informed that their participation is entirely voluntary and that they may withdraw from the study at any time without any impact on their medical care or relationship with healthcare providers.

- Data Security: All collected data will be securely stored in password-protected digital files and locked storage for physical copies. Access will be restricted to the research team only.

CHAPTER THREE

RESULTS

3.0 Results

A total of 205 respondents participated in the study, which majority of them (72.2) were female, and 98% was above the age of 35 years which 99% of them were married. Majority of the respondent 62.9% has their last fasting blood sugar below 126mg\dl while 32.7%of the study participant have their last fasting blood sugar within 200mg\dl – 400mg\dl. On family history majority of the study participant 64.9% responded positively and 34.1% has no family history.

Duration when diabetes mellitus was diagnosed among the study participant 33.7% was within 1-5 years and 34.6% was within 5-10 years and 5.9% was within 10-15 years and 24.9% was above >16 years. Other characteristics of the study participants are as shown in table 3.1

Variables	Frequency (%) N(205)

Table 3.1

Sociodemographic Characteristics of Participants

FACILITY	
University Of Benin teaching hospital	
Age Group (years)	
18-24years	2 (1%)
35-65years	203 (99%)
Gender	
Male	55 (26.8%)
Female	148 (72.2%)
Marital status	
Single	2 (1%)
Married	203 (99%)
Employment status	
Employed	82 (40%)
Unemployed	42 (20.5%)
Retired	79 (38.5%)
Education level	
No formal education	22 (10.7%)
Primary school	69 (33.7%)
Secondary school	30 (14.6%)
Post-secondary school	82 (40%)
Monthly income	
#71,000- #100,000	48 (23.4%)
#101,000- #150,000	13 (6.3%)
#151,000- #200,000	98 (47.8%)
># 200,000	39 (19.0%)
Last Fasting Blood Sugar	

<126mg\dl	129 (62.9%)
200mg\dl- 400mg\dl	67 (32.7%)
>400mg\dl	5 (2.4%)
Family history	
Yes	133 (64.9%)
No	70 (34.1%)
Duration of Diabetes Mellitus	
1- 5years	69 (33.7%)
5- 10years	71 (34.6%)
10- 15years	12 (5.9%)
>16years	61 (24.9%)

The study participants are 205 and there are considerable more patients who have Type 2 Diabetes Mellitus 191 (93.2%) and only 33 (16.1%) of the study participant uses combination of treatment i.e both the drug prescribed by the Doctor with Herbal Medication. Study participant who uses herbal medication is 41 (20.0%) while 162 (79%) does not use herbal medication this reveals that there's about one- fifth of the study population who uses herbal medicine with the drug prescribed by the doctor. 30 (14.6%) were currently using herbal medicine with conventional drugs. Majority of the respondent 160 (78%) has other chronic diseases which 136 (66.3%) has hypertension and 7 (3.4%) has eye neuropathy and 2 (1.0%) has neuropathy. Only 17 (8.3%) has diabetes complication which 9 (4.4%) has eye neuropathy and 8(3.9%) has neuropathy. These are shown in table 3.2.

Some respondent in the study population 8 (3.9%) uses bitter leaf and 6 (2.9%) uses ginger, turmeric, bitter leaf and scent leaf together and 6 (2.9%) uses Osu\Abere and 2(1%) uses scent leaves and 18 (8.8%) of the are not aware of the herbal medicine they are using which illustrates the ignorance of the respondent who takes herbal medicine. These are shown in table 3.3.

Table 3.2: Medical History:

Variables	**Frequency (%)** N(205)
Type of Diabetes Mellitus	
Type 1	12 (5.9%)
Type 2	191 (93.2%)
Current treatment method	
Oral medication	170 (82.9%)
Combination of treatment	33 (16.1%)
Other chronic diseases	
Yes	160 (78%)
No	43 (21%)
Responses of the chronic disease	
Eye neuropathy	9 (4.4%)
Hypertensive	136 (66.3%)
Nil	58 (28.3%)
Diabetes complication	
Yes	17 (8.3%)
No	186 (90.7%
Response of diabetic complication	
Eye neuropathy	9 (4.4%)
Neuropathy	8 (3.9%)
Nil	185 (90.2%

Table 3.3: Use of Herbal Medicine (Prevalence and Patterns)

Variables	Frequency (%) N(205)
Used herbal medicine for diabetes mellitus	
Yes	41 (20%)
No	162 (79%)
Those who are currently using herbal medicine	
Yes	30 (14.6%)
No	173 (84.4%)
How often the herbal medicine was taken	
Daily	8 (3.9%)
Weekly	14 (6.8%)
Occasionally	18 (8.8%)
Nil	165 (80.5%)
Duration of when herbal medicine commences	
< 6months	6 (2.9%)
6--12months	12 (5.9%)
1--3years	2 (1.0%)
> 3years	20 (9.8%)
Form of herbal medicine used	
Fresh herbs	18 (8.8%)
Powder	0 (0%)
Decoction\Tea	20 (9.8%)
Capsules\Tablet 2 (1%)	0 (0%)
Nil	165 (80.5%)
List of herbal medicine used	

Bitter leaf	8 (3.9%)

Variables	**Frequency (%)** N(205)
Scent leaf	2 (1%)
Osu\Abere	6 (2.9%)
Combination of ginger,turmeric,bitter leaf and scent leaf	6 (2.9%)
Unidentified	18 (8.4%)
Where the herbal medicine was obtained	
Traditioner healer	7 (3.4%)
Pharmacy	1 (0.5%)
Home preparation	22 (10.7%)
Friends\Relatives	12 (5.9%)
Source of Recommendation of the herbal medicine	
Herbal practitioner	8 (3.9%)
Family\Friends	12 (5.9%)
Self decided	22 (10.7%)

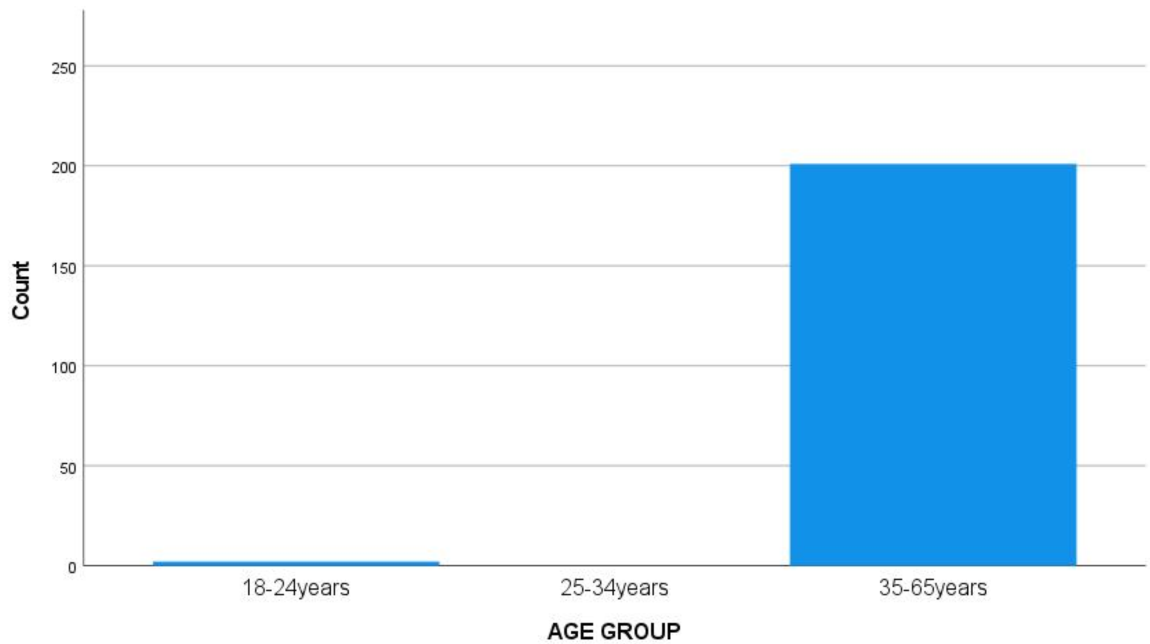

Fig 3.1: Age Group

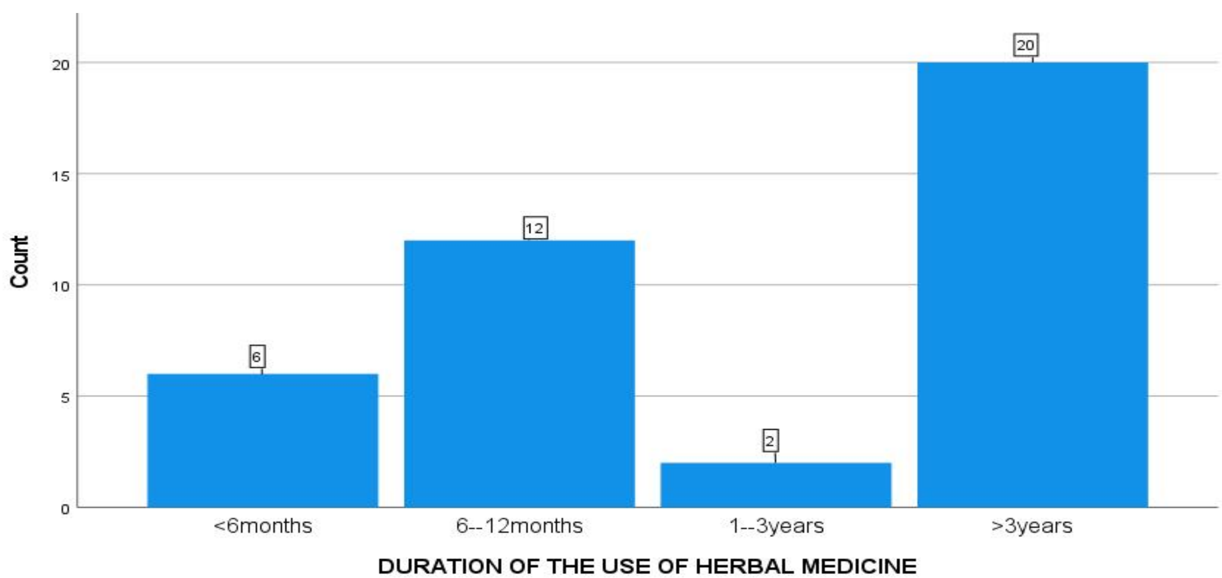

Fig 3.2: Duration of the use of herbal medicine

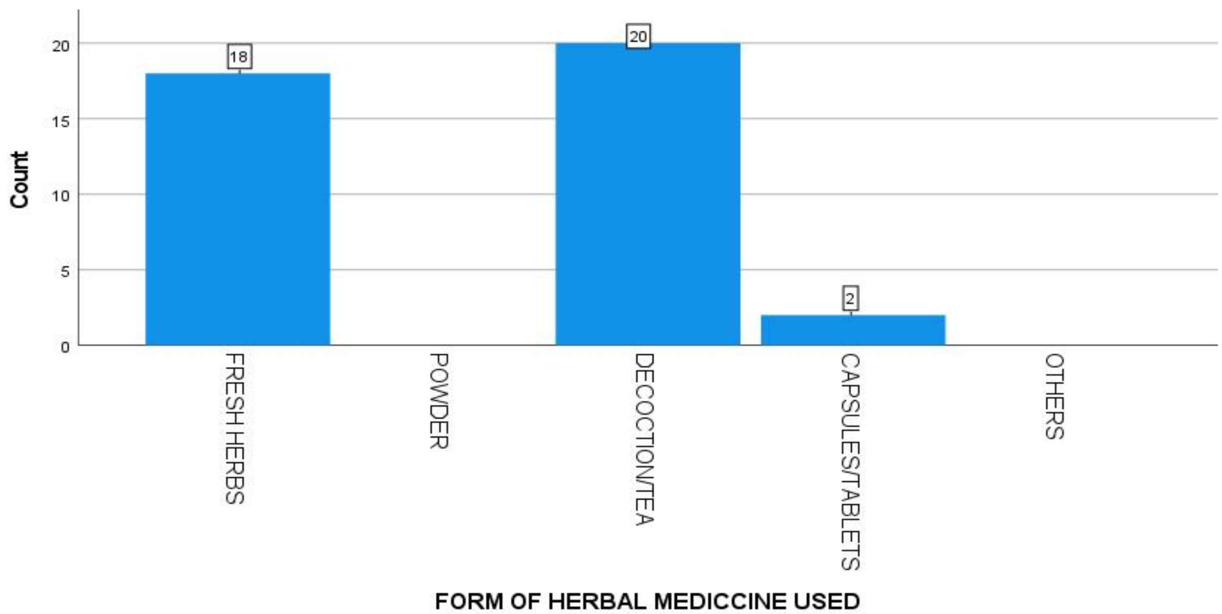

Fig 3.3: Form of Herbal Medicine Used

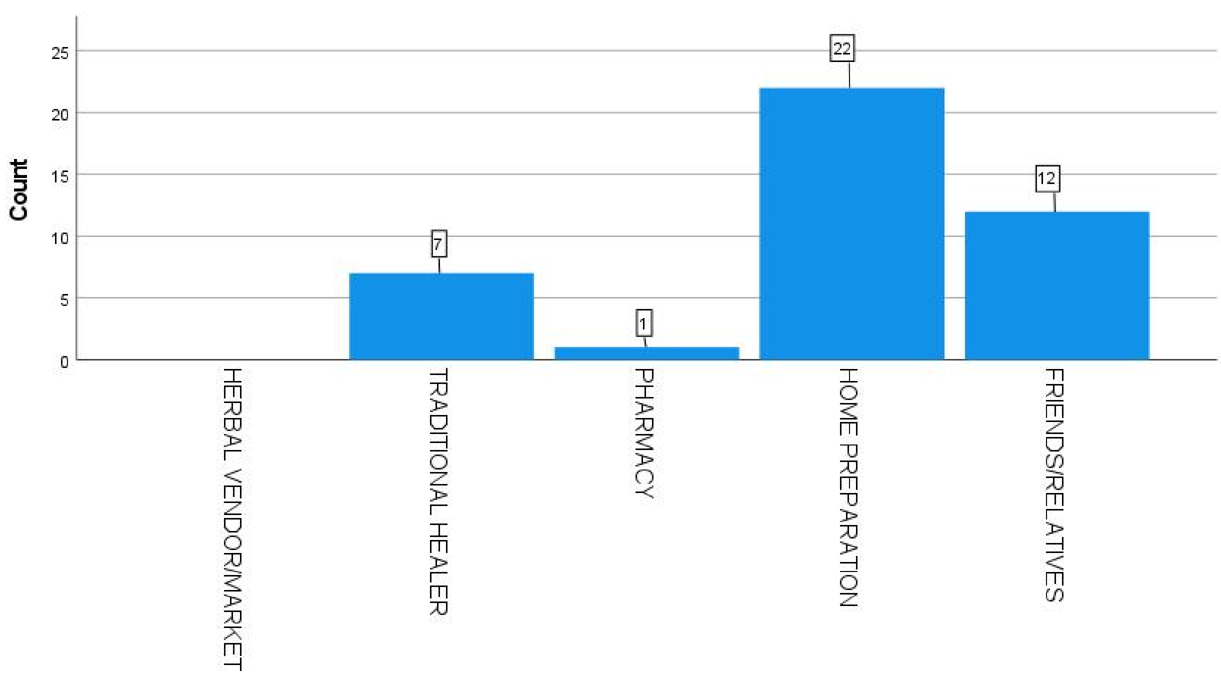

Fig 3.4: Where herbal medicine was obtained.

AGEGROUP * SEX Crosstabulation

				SEX		
				male	female	Total
AGEGROUP		Count	2	0	0	2
		Expected Count	.0	.5	1.4	2.0
	18-24 years	Count	0	0	2	2
		Expected Count	.0	.5	1.4	2.0
	35-65 years	Count	0	55	146	201
		Expected Count	2.0	53.9	145.1	201.0
Total		Count	2	55	148	205
		Expected Count	2.0	55.0	148.0	205.0

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	205.758[a]	4	<.001
Likelihood Ratio	23.771	4	<.001
N of Valid Cases	205		

a. 7 cells (77.8%) have expected count less than 5. The minimum expected count is .02.

Table 3.4: Association between the use of herbal medicine and Socio-demographics and Clinical Characteristics

Variables	If yes, how often do you use herbal medicine			P-Value
	Daily	**Weekly**	**Occasionally**	
Age(years)				**0.986**
18-24	0(0.0)	0(0.0)	0(0.0)	
25 and above	8(20.0)	14(35.0)	18(45.0)	
Sex				**0.248**
Male	0(0.0)	6(75.0)	2(25.0)	
Female	8(25.0)	8(25.0)	16(50.0)	
Marital Status				
Single	0(0.0)	0(0.0)	0(0.0)	**0.921**
Married	8(3)	14(6.9)	8(8.9)	
Employment Status				**0.002**
Employed	0(0.0)	6(30.0)	14(70.0)	
Unemployed	0(0.0)	2(100.0)	0(0.0)	
Retired	8(44.4)	6(33.3)	4(22.2)	
Educational Level				**0.004**
No formal education	8(30.8)	8(30.8)	10(38.4)	
Formal education	0(0.0)	6(42.9)	8(57.1)	
Monthly income				**<0.001**

#70,000-#150,000	0(0.0)	2(33.3)	4(66.7))	
#151,000-#200,000	8(30.8)	6(23.0)	12(46.1)	
>#200,000	0(0.0)	6(75.0)	2(25.0)	
Last FBS Level				**<0.001**
≤126mg/dL	0(0.0)	2(25.0)	6(75.0)	
≥200mg/dL	8(25)	12(37.5)	12(37.5)	
Family history of Diabetes Mellitus				**0.002**
No	0(0.0)	0(0.0)	12(100.0)	
Yes	8(28.6)	14(50.0)	6(21.4)	
Duration of Diabetes Mellitus				**0.005**
1-5years	0(0.0)	0(0.0)	6(100.0)	
>5 years	8(23.5)	14(41.2)	12(35.3)	

Table 3.4 shows the association between Socio-demographic and clinical variables and the frequency of herbal medicine use among respondents. The result indicates that there was a significant association between employment status, educational level, monthly income, last fasting blood sugar level, family history of Diabetes mellitus, and duration of Diabetes mellitus ($p < 0.05$), implying that these factors influenced how often respondents used herbal medicine. However, there was no significant association between age, sex, or marital status and herbal medicine use ($p > 0.05$), suggesting that these variables did not affect respondents' frequency of herbal medicine use.

CHAPTER FOUR

DISCUSSION

Patients with chronic diseases continuously seek complementary and alternative ways to manage their disease conditions and improve their health. When it comes to managing Type 2 Diabetes Mellitus, the usage of herbal medicine is crucial.

In our study population, 41 people (20%) reported using herbal medicine. Reports from comparable investigations conducted both domestically and internationally revealed varying prevalence. In Nigeria, the prevalence of complementary and alternative medicine usage among diabetic patients was found to be higher at 46%, indicating a rise in the use of herbal medicine over time. Similar research conducted in Saudi Arabia and northern Africa revealed that 52% and 25.8% of patients with Type 2 Diabetes Mellitus, respectively, used herbal medicines. Additionally, lower incidence rates for diabetic patients were noted in Guinea, Saudi Arabia, Kenya, and Morocco. The prevalence of CAM use in patients with diabetes and type 2 diabetes ranged from 61% to 76% in other research. Herbal medicine was the most often reported CAM type in these research. This uneven prevalence rate may be explained by variations in various environments, geographic locations, and the degree of population reliance on herbal treatments. Despite the varying incidence of herbal medication among diabetic patients, it is clear that herbal medicine plays a significant role in the global management of diabetes.

16.1% of users in our sample population took both prescription and herbal medications at the same time. Patients with diabetes and other illnesses have been shown to exhibit similar behaviour in other studies. Despite using complementary and alternative medicine, diabetic patients in a prior Nigerian study continued to take their prescribed orthodox medications. Herb-drug interactions (HDIs) are more likely to occur in patients who use both conventional and herbal treatments concurrently. HDIs may cause serious side effects or lessen the benefits of prescription medications. The majority of African-origin medicinal herbs lack pharmacokinetic and safety data that could be utilised to avoid possibly clinically significant HDIs. Patients and society may suffer as a result of such HDIs, particularly in the context of many developing countries' inadequate health care systems.

The herbal remedies that our respondents utilised the most frequently were Vernonia amygdalina (bitter leaves), Ocimum gratissimum (scent leaves), herbal mixes, and Hunteria umbellata, also known as Abere/Osu in Yoruba. In Nigeria, these natural remedies are common household remedies for diabetes. There is little information on how these plants interact with conventional medications, despite the fact that their hypoglycemic action has been demonstrated in both humans and animals, supporting their traditional usage in the treatment of diabetes mellitus. Combinations of different medicinal plants are frequently employed for their synergistic effects, which raises the possibility of herb-herb interactions.

The findings of this study are in line with a related study that found that the most common justification for using herbal medicines was their perceived affordability and safety. Because they are "natural," herbal remedies are often marketed as having no negative effects in Nigeria and most other African nations. Although we did not try to find out why the patients withheld such important information, other studies of this kind indicate that patients are either not asked by their doctors or do not trust them enough to disclose the use of herbal medicines.

Additionally, doctors with Western training frequently lack sufficient understanding of the effects of herbal medicines and may not feel comfortable discussing this with their patients. Age, education level, occupation, a longer duration of diabetes, the type of diabetes management, a positive family history of diabetes, and diabetes complications (neuropathy) are the factors that our study found predict the use of herbal medicines. Patients with diabetes have been shown to use alternative medicines more frequently as they get older. This can be explained by the elderly's varied disease states and co-morbidities, such as hypertension, and their subsequent urge to look for different treatment alternatives in order to better manage their health. The association between Socio-demographic and clinical variables and the frequency of herbal medicine use among respondents. The result indicates that there was a significant association between employment status, educational level, monthly income, last fasting blood sugar level, family history of Diabetes mellitus, and duration of Diabetes mellitus ($p < 0.05$), implying that these factors influenced how often respondents used herbal medicine. However, there was no significant association between age, sex, or marital status and herbal medicine use ($p > 0.05$), suggesting that these variables did not affect respondents’ frequency of herbal medicine use.

Our respondents' use of herbal medicines was positively impacted by their educational attainment. Because those with formal education are more likely to be literate, this may indicate a greater understanding and awareness of herbal therapy. Our findings corroborate earlier findings linking the use of herbal medicines to a longer duration of diabetes. Herbal medicine is used by people who have had diabetes for a longer period of time. The existence of a diabetic complication indicates the severity of the condition and the increased need for additional treatment options. The usage of herbal remedies was substantially correlated with the management of diabetes by diet, insulin, and oral hypoglycemic medications. Compared to those on insulin and diet, respectively, patients on oral hypoglycemic medications were more likely to take herbal medicine. This may be because hypoglycemic medications are expensive, as demonstrated by the usage of herbs by diabetic patients in the Consultant Out-Patient

Department (COPD) at the University of Benin Teaching Hospital (UBTH) due to the high expense of conventional therapies. In comparison to non-users, users thought herbal medicine was safe, effective, and useful. This resonates with the general belief that herbal remedies are natural and therefore, risk-free. These beliefs could also be culturally rooted

The non-users, on the other hand, might not use herbal medicines because they think it is dangerous to use both herbal and conventional medicines at the same time and that this should be reported to doctors. This study looked at T2DM patients since T2DM is responsible for the global burden of diabetes.

The following are some of the study's limitations: (1) Only patients who visited hospitals were surveyed; those who were either undiagnosed or received care outside of a hospital were not taken into account; private health facilities were excluded from our study; and the identity and quantity of prescribed medications used by the respondents were not asked because it was not one of the study's goals. However, these restrictions have no bearing on our conclusions.

CHAPTER FIVE

CONCLUSION

There are 41 (20%) respondents out of the total 205 study population, were obtained for herbal medicine use among Type 2 Diabetes Mellitus patients in Consultant Out-Patient Department (COPD) at University Of Benin Teaching Hospital (UBTH) in Edo State, Nigeria. One-fifth of the patients took herbal remedies in addition to their prescribed drugs, which increased the risk of herb-drug interactions and, ultimately, treatment failure. The research also captures the ignorance of some respondents in the study population not to know the name and standardization of herbal medicine used. There is a need for further research into the Pharmacokinetics and Standardization of herbal medicines to enable appropriate quantification of the dose and prediction and identification of potentially clinically relevant herb-drug interactions in diabetic patients. Health care providers should routinely inquire and discuss herbal medicine use with patients in a very caring and unbiased manner.

REFERENCES

Al-Garni, A.M., Al-Raddadi, R.M. & Al-Amri, T.A., 2016. Anti-diabetic activity of the leaves of *Moringa oleifera* Lam. growing in Sudan on streptozotocin-induced diabetic rats. *British Journal of Medical and Health Research*, 3(4), pp.48–57.

Awodele, O., Oreagba, I.A., Odunuga, O.J. & Kalejaiye, O.O., 2017. Evaluation of the safety profile of herbal products commercially available in Lagos, Nigeria. *Journal of Complementary and Integrative Medicine*, 14(2), pp.1–9. https://doi.org/10.1515/jcim-2016-0110

Awodele, O., Popoola, T.D., Amadi, K.C., Coker, H.A.B. & Akintonwa, A., 2014. Traditional medicinal plants used in the treatment of diabetes mellitus in Nigeria: A review. *Journal of Ethnopharmacology*, 152(3), pp.507–520. https://doi.org/10.1016/j.jep.2014.01.042

Eddouks, M., Maghrani, M., Lemhadri, A., Ouahidi, M.L. & Jouad, H., 2012. Ethnopharmacological survey of medicinal plants used for the treatment of diabetes mellitus, hypertension and cardiac diseases in the South-East region of Morocco (Tafilalet). *Journal of Ethnopharmacology*, 82(2–3), pp.97–103.

Ezeigbo, O.R., Barrah, C.S. & Ezeigbo, I.C., 2016. Phytochemical analysis and antidiabetic effect of aqueous and ethanolic extracts of *Moringa oleifera* leaves in alloxan-induced diabetic Wistar albino rats using insulin as reference drug. *International Journal of Diabetes Research*, 5(3), pp.48–53.

Ezeuko, V.C., Anazodo, U.C. & Nduka, S.O., 2021. The role of clinical pharmacists in pharmacovigilance and drug safety monitoring in Nigeria. *Journal of Pharmaceutical Policy and Practice*, 14(1), p.19. https://doi.org/10.1186/s40545-021-00303-2

Ferdous, M. et al., 2019. Natural products for the management of type 2 diabetes mellitus: A review of randomized controlled trials. *Frontiers in Pharmacology*, 10, p.830. https://doi.org/10.3389/fphar.2019.00830

World Health Organization (WHO), 2013. WHO Traditional Medicine Strategy: 2014–2023. Geneva: WHO. Available at: http://apps.who.int/iris/bitstream/10665/92455/1/9789241506090_eng.pdf (Accessed 20 March 2017).

Ibewuike, E.O., Ogbuagu, C. & Mbah, C.J., 2021. Evaluation of drug-herb interactions among Nigerian diabetic patients attending outpatient clinics. *Nigerian Journal of Pharmaceutical Sciences*, 20(1), pp.52–60.

International Diabetes Federation (IDF), 2021. IDF Diabetes Atlas, 10th ed. Available at: https://www.diabetesatlas.org

Nwankwo, C., Anyaehie, U. & Iroha, E.O., 2020. Disclosure of herbal medicine use among patients with type 2 diabetes attending tertiary hospitals in Southeast Nigeria. *International Journal of Health Sciences Research*, 10(4), pp.59–65.

Oboh, G., Olasehinde, T.A. & Ademosun, A.O., 2021. Antidiabetic effect of Nigerian medicinal plants and their interactions with common antidiabetic drugs: A mechanistic overview. *Clinical Phytoscience*, 7(1), p.91. https://doi.org/10.1186/s40816-021-00322-7

Ogurtsova, K. et al., 2017. IDF Diabetes Atlas: Global estimates for the prevalence of diabetes for 2015 and 2040. *Diabetes Research and Clinical Practice*, 128, pp.40–50.

Onyeka, P., Ndukuba, V. & Okoroafor, U., 2022. Perspectives on therapeutic drug monitoring and clinical pharmacy services in herbal drug use in sub-Saharan Africa. *African Journal of Pharmaceutical Sciences and Pharmacy*, 13(1), pp.14–22.

Owolabi, O.A., Akinmoladun, F.O. & Komolafe, T.O., 2020. Utilization of herbal medicine for the treatment of diabetes mellitus in Ondo State, Nigeria. *African Journal of Traditional,*