

**SCHOOL OF PUBLIC HEALTH  
COLLEGE OF HEALTH SCIENCES  
UNIVERSITY OF GHANA**



**CORRELATES OF COMPLEMENTARY AND ALTERNATIVE MEDICINE USE  
AMONG DIABETES MELLITUS OUTPATIENTS IN TAMALE METROPOLIS,  
GHANA, 2017**

**BY**

**BASIL BENDURI KABURI  
(10552479)**

**THIS THESIS IS SUBMITTED TO THE UNIVERSITY OF GHANA,  
IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE  
AWARD OF MPhil APPLIED EPIDEMIOLOGY AND DISEASE  
CONTROL**

**JULY, 2017**

**DECLARATION**

This work is the result of an independent study under the supervision of Professor Col. Edwin A. Afari (Rtd) and Dr. Abubakar A. Manu. Where my work is indebted to the works of others, I have made due acknowledgement. I declare, therefore that this thesis has not been presented elsewhere, either in part or in whole for another degree.

**SIGNATURE**.....

**DATE**.....

**BASIL BENDURI KABURI**

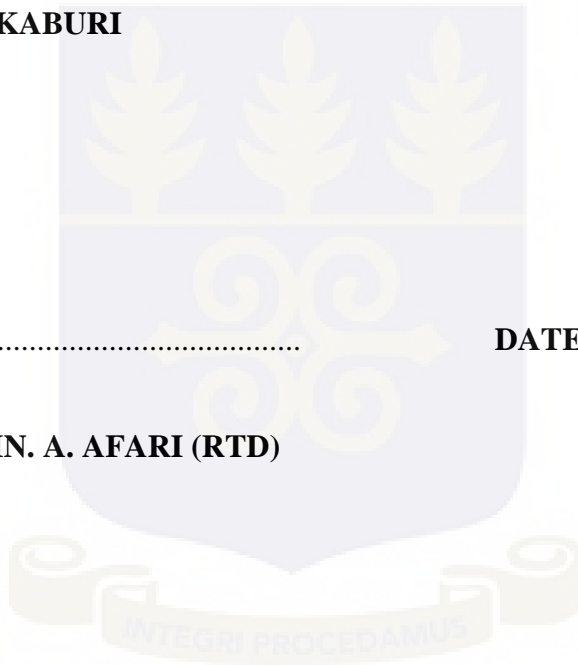
**(CANDIDATE)**

**SIGNATURE**.....

**DATE**.....

**PROF. COL. EDWIN. A. AFARI (RTD)**

**(SUPERVISOR)**



**SIGNATURE**.....

**DATE**.....

**DR. ABUBAKAR A. MANU**

**(CO-SUPERVISOR)**

**DEDICATION**

To my dear wife: Mama Ruth  
and  
“The boys”: Zim and Wemu



## ACKNOWLEDGEMENTS

Though this final work bears my name, it is a product of the painstaking contribution of faculty and many people; galvanized by the blessing of God.

Firstly, I wish to appreciate the patient support and mentorship received from my first supervisor, Prof. Col. Edwin A. Afari (Rtd). Your way of simplifying difficult research concepts right from the design to completion was simply amazing. I am privileged to have worked with you. My thanks also go to my co-supervisor; Dr. Abubakar A. Manu for his invaluable contributions to this thesis.

Dr. Patricia Akweongo did not spare the red ink in reading through a draft of this work. Her inputs on the science and art of writing results and discussion added quality to this thesis. Please, accept my gratitude.

To Dr Chrysantus Kubio, I am grateful for making time to assist in training my research assistants, reading through the drafts, and making splendid contributions. I am very grateful to Dr. Donne Kofi Ameme for his unwavering support and constant encouragement throughout my studies. The Viva presentation tips you shared with me came very handy.

Special thanks go to the managements of the Tamale Teaching Hospital, Tamale Central Hospital, and Tamale West Hospital for opening their doors widely to me and giving me moral support during the data collection. I am very indebted to the respondents who spared some time and effort for the interviews. Without their cooperation, this work would not have been possible.

I am very grateful to the Ghana Field Epidemiology and Laboratory Training Programme (GFELTP) and the department of Epidemiology for the tuition and technical support during the course of my studies. I wish to thank the GFELTP and West African Health Organization (WAHO) for providing critical financial support for my studies.

To my affable research assistants: Alhassan Dauda, Zeyinzuma Jacob, Kanola Salifu Njonam, Zakaria Fuseini, Yaro Alhassan, and Alhassan Ziblim, may God richly bless you.

## ABSTRACT

**Introduction:** More than ever, the use of complementary and alternative medicine for the management of diabetes mellitus has become a major public health challenge. Globally, the prevalence of this practice varies from 17% to 72.8%. Even though it is common practice among diabetes mellitus patients in Ghana also, its local prevalence is unknown. However, the use of CAM among persons living with diabetes mellitus is known to be associated with some sociodemographic factors, the severity of disease, and the state of prevailing healthcare delivery systems. This study sought to assess complementary and alternative medicine use and its correlates among diabetes mellitus outpatients in the Tamale metropolis of Ghana.

**Methods:** A cross-sectional descriptive study was conducted between January and April 2017 among 398 diabetes mellitus outpatients recruited from diabetic clinics of the three (3) major hospitals in the Tamale metropolis. In a face-to-face interview, participants completed a questionnaire eliciting data on their socio-demographic status, diabetes characteristics, types of complementary and alternative medicines they use, their modes of use, and associated costs. A checklist was used to review their medical records for details of diagnosis and management. Summary descriptive statistics, Chi-square test for categorical variables for associations, and multiple logistic regression were used to report results of the data.

**Results:** A total of 398 patients were interviewed. Their ages ranged from 16 to 89 years; with an average of  $57.1 \pm 13.0$  years. Females were the majority 289 (72.6%). Complementary medicine use was 32.7% (130/398) among respondents and 83.8% (109/130) of these did not disclose it to their doctors. About 78% of these patients used herbal concoctions, and these costed less (GH¢  $24.77 \pm 30.59$ ) than the orthodox

therapies (GH¢ 45.01 ± 29.58) [p = 0.0001]. Complementary and alternative medicine use was significantly predicted by: the practice of dietary modification, residence in urban centers, educational status, health insurance status, employment status, type of diabetes mellitus, and the presence of diabetes complications (p=0.001).

**Conclusion:** Complementary and alternative medicine use was common among diabetes mellitus outpatients of Tamale metropolis. Herbal concoctions were the most patronized, and these were significantly cheaper than the orthodox therapies. The co-administration of complementary and orthodox medicines poses dangers of drug-herb interactions, and poor adherence to proven therapies. The consequence of this practice is poor glycaemic control with its attending acute and long term complications. There is the need to institute awareness programmes on complementary and alternative medicine use for both patients and healthcare practitioners; and double efforts towards an evidence-based integrated healthcare system.

**Keywords:** Complementary and alternative medicine, Diabetes Mellitus, Correlates, Orthodox medicine, Ghana

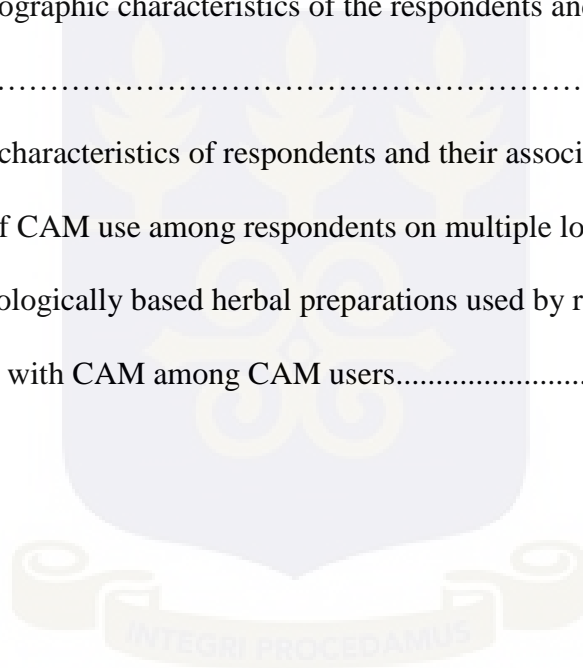
## TABLE OF CONTENTS

DECLARATION .....	i
DEDICATION .....	ii
ACKNOWLEDGEMENTS .....	iii
ABSTRACT .....	iv
TABLE OF CONTENTS .....	vi
LIST OF TABLES .....	viii
LIST OF FIGURES .....	ix
LIST OF ABBREVIATIONS .....	x
DEFINITIONS OF MEDICAL TERMS .....	xi
CHAPTER ONE .....	1
INTRODUCTION .....	1
1.1 Background .....	1
1.1.1 The Burden and Impact of DM .....	3
1.1.2 Management of DM .....	5
1.1.3 CAM in the Management of DM .....	6
1.2 Problem Statement .....	8
1.3 Justification of Study .....	9
1.4 Conceptual Framework .....	10
1.5 Study Objectives .....	11
1.5.1 General Objective.....	11
1.5.2 Specific Objectives: .....	11
CHAPTER TWO .....	12
LITERATURE REVIEW.....	12
2.1 Prevalence of CAM Use among Persons with Diabetes Mellitus.....	12
2.2 Socio-demographic Characteristics of CAM Users with DM.....	14
2.3 Benefits of CAM use to Persons Living with DM.....	17
2.4 Adverse Effects of CAM among Persons Living with DM .....	19
2.5 Reasons Persons living with DM Give for using CAM.....	21
2.6 Types of CAM .....	23
2.6.1 Biologically based therapies .....	23
2.6.2 Mind-Body Medicine .....	28
2.6.3 Manipulative and body based therapies .....	29
2.6.4 Energy Therapies .....	29
2.7 Costs Associated with CAM Use.....	30
CHAPTER THREE.....	32
METHODS .....	32
3.1 Study Design .....	32
3.2 Study Area.....	32
3.3 Study Variables .....	34
3.4 Sample Size Determination.....	35

3.5 Sampling Method .....	36
3.6 Quality Control .....	38
3.7 Data Processing and Analysis .....	38
3.8 Ethical Considerations .....	39
3.8.1 Ethical Approval for Study .....	39
3.8.2 Risks and Benefits.....	39
3.8.3 Respondents' Rights .....	39
CHAPTER FOUR.....	41
RESULTS .....	41
4.1 Prevalence of Complementary and Alternative Medicine use among DM Patients .41	
4.2 Socio-demographic characteristics of respondents and CAM use.....	41
4.3 History, Diagnosis, and Management DM among respondents.....	43
4.4 Correlates of CAM use among respondents.....	45
4.5 Types and Sources of CAM used by the Respondents .....	47
4.6 Biologically based CAM used by respondents .....	48
4.7 Diabetes Mellitus related Complications among the Patients.....	49
4.8 Attitudes and Experiences of Patients who used CAM .....	50
4.9 Cost Estimation of Orthodox Medicines and CAM Treatments.....	51
CHAPTER FIVE.....	52
DISCUSSION .....	52
5.1 Prevalence of Complementary and Alternative Medicine use among persons living with Diabetes Mellitus .....	52
5.2 Socio-demographic characteristics and CAM use .....	54
5.3 DM related characteristics and CAM use .....	57
5.4 Types and sources of CAM for DM.....	58
5.5 Reasons for using CAM.....	60
5.6 Cost of CAM therapies.....	61
5.7 Consequences of CAM use among Diabetes Mellitus Patients .....	61
5.8 Limitations of the Study.....	63
CHAPTER SIX .....	65
CONCLUSION AND RECOMMENDATIONS.....	65
6.1 Conclusion .....	65
6.2 Recommendations for policy and practice.....	65
REFERENCES.....	67
APPENDICES .....	80
Appendix 1: Questionnaire .....	80
Appendix 2: Informed Consent Request.....	85
Appendix 3: Respondent's Consent Form .....	86
Appendix 4: Common Herbal Medicines Used by Respondents.....	87

**LIST OF TABLES**

Table 1: Broad classification of CAM .....	23
Table 2a Common biologically based CAM therapies. ....	25
Table 2b Common biologically based CAM therapies .....	26
Table 2c Common biologically based CAM therapies .....	27
Table 3: Commonly patronized Dietary Supplements among CAM users.....	28
Table 4a: Socio-demographic characteristics of the respondents and their association with CAM use .....	42
Table 4b: Socio-demographic characteristics of the respondents and their association with CAM use.....	43
Table 5: DM related characteristics of respondents and their association with CAM use .	44
Table 6: Correlates of CAM use among respondents on multiple logistic regression.....	46
Table 7: Common biologically based herbal preparations used by respondents. ....	48
Table 8: Experiences with CAM among CAM users.....	50



**LIST OF FIGURES**

Figure 1: A conceptual framework for the use of CAM among DM patients .....10

Figure 2: Geographical Location of Tamale Metropolis in Ghana .....33

Figure 3: Map of Tamale Metropolis .....34

Figure 4 Sample Selection Process .....37

Figure 5: Status of CAM use among respondents.....41

Figure 6: Categories of CAM used by respondents .....47

Figure 7: Distribution of DM related complications/comorbidities among respondents....49



## LIST OF ABBREVIATIONS

<b>CAM</b>	Complementary and Alternative Medicine
<b>CI</b>	Confidence Interval
<b>CPD</b>	Continuous Professional Development
<b>DM</b>	Diabetes Mellitus
<b>GAMH</b>	Ghana Association of Medical Herbalist
<b>GHS</b>	Ghana Health Service
<b>GMA</b>	Ghana Medical Association
<b>GSS</b>	Ghana Statistical Service
<b>HIV</b>	Human Immunodeficiency Virus
<b>IDF</b>	International Diabetes Federation
<b>KNUST</b>	Kwame Nkrumah University of Science and Technology
<b>MDC</b>	Medical and Dental Council
<b>OM</b>	Orthodox Medicine
<b>OR</b>	Odds Ratio
<b>SES</b>	Socioeconomic Status
<b>TB</b>	Tuberculosis
<b>TCH</b>	Tamale Central Hospital
<b>TMPC</b>	Traditional Medicine Practice Council
<b>TTH</b>	Tamale Teaching Hospital
<b>TWH</b>	Tamale West Hospital
<b>USA</b>	United States of America
<b>WHO</b>	World Health Organisation

**DEFINITIONS OF MEDICAL TERMS**

<b>TERM</b>	<b>DEFINITION</b>
<b>Cystic fibrosis</b>	A congenital disease where a child's lungs, intestines, and pancreas fuse and become clogged with thick mucus resulting in the malfunction of these organs.
<b>Diabetic Ketoacidosis (DKA)</b>	An acute life-threatening complication of diabetes mellitus presenting with vomiting, deep gasping breathing, increased urination, fatigue, and occasionally coma.
<b>Diabetic nephropathy</b>	Damage to the kidneys caused by longstanding diabetes mellitus.
<b>Diabetic peripheral neuropathy</b>	This is a state of nerve damage associated with diabetes mellitus; manifesting as numbness and tingling, sensory losses, and muscle weakness.
<b>Diabetic retinopathy</b>	A disease state of the eye due to damage of the small blood vessels of the retina that can lead to blindness; caused by chronically high blood glucose levels in poorly controlled diabetes mellitus.
<b>Endocrinopathies</b>	Diseases of endocrine glands of the body.
<b>Gluconeogenesis</b>	The biochemical process by which glucose is generated from non-carbohydrate carbon substrates.
<b>Glycogenolysis</b>	The biochemical process by which glycogen (the storage form of glucose in the liver and muscle) is broken down to glucose for immediate use.
<b>Glycolysis</b>	The biochemical process that converts glucose to energy
<b>Glycosuria</b>	The presence of abnormally high levels of sugar in the urine.
<b>Haemochromatosis (bronzed diabetes)</b>	A disease in which dietary iron accumulates in tissues; characterized by bronzed skin, an enlarged liver, diabetes mellitus, and abnormalities of the pancreas and joints.
<b>Hyperglycaemia</b>	An abnormally high blood sugar level usually associated with diabetes mellitus.

<b>TERM</b>	<b>DEFINITION</b>
<b>Hypoglycaemia</b>	An abnormally low blood sugar level resulting from disease, drugs, poor diet or starvation.
<b>Insulin</b>	A hormone secreted by the pancreas; regulates storage of glucose in the form of glycogen in the liver and helps in the uptake and utilization of glucose by cells.
<b>Normoglycaemia</b>	A state of the normal level of blood sugar
<b>Osmotic diuresis</b>	Excessive urination in both volume and frequency, that is characteristic of poorly managed diabetes mellitus.
<b>Pancreas</b>	A large elongated gland situated behind the stomach; secretes insulin for blood glucose regulation and pancreatic juice for digestion.
<b>Phaeochromocytoma</b>	A tumour of the blood vessels of the adrenal gland that secretes excessive amounts of epinephrine resulting in intermittent or sustained hypertension.
<b>Polydipsia</b>	Excessive thirst requiring frequent drinking of water as in cases of diabetes mellitus and kidney dysfunction.
<b>Polyuria</b>	A kidney disorder characterized by the production of large volumes of pale dilute urine; often associated with diabetes mellitus.
<b>Postural hypotension</b>	A state of low blood pressure in some people that results when they assume the upright posture.

## CHAPTER ONE

### INTRODUCTION

#### 1.1 Background

Diabetes Mellitus (DM) is defined as a serious chronic disease that manifests either when the pancreas does not produce enough insulin (a hormone that regulates blood glucose), or when the body cannot effectively use the insulin it produces (WHO, 2016). Impaired glucose regulation is an intermediate state between normoglycaemia and hyperglycaemia that may eventually lead to DM if unchecked (American Diabetes Association, 2014). There are two main types of DM; type 1 and type 2 (Longmore, Wilkinson, Baldwin, & Wallin, 2014).

Type 1 DM was previously termed juvenile onset or insulin-dependent DM. It results from the lack of, or inadequate secretion of insulin caused by the autoimmune destruction of pancreatic  $\beta$ -cells (Porter & Kaplan, 2011). As a result, patients with type 1 DM always need insulin. Generally, type 1 DM develops in childhood and adolescence, but can also develop in adulthood on a few occasions due to latent autoimmune destruction of pancreatic  $\beta$ -cells that slowly progress to insulin dependence in later life (Longmore et al., 2014).

Type 2 DM was previously called adult-onset or non-insulin-dependent DM. It is caused by a combination of inadequate insulin secretion and peripheral insulin resistance; and generally develops in adults (Mabey et al., 2014)

It is associated with obesity, excess of calorie, and sedentary lifestyle (Longmore et al., 2014). Type 2 DM is prevalent to epidemic levels in many places, largely due to more westernized lifestyles, but also because of increased awareness, better diagnosis, and

longer life expectancies (Longmore et al., 2014). It is also becoming increasingly prevalent in children owing to the current epidemic of childhood obesity (Porter & Kaplan, 2011). Nearly one of every two new-onset DM in children is type 2 (Porter & Kaplan, 2011). Though no genes for the most common forms of type 2 DM have been identified, there are genetic determinants as evidenced by significant variation between ethnic groups, and strong family history (Mabey et al., 2014).

Miscellaneous types of DM exist at a very low prevalence. They are caused by gamut of pancreatic diseases, endocrinopathies, drugs, and toxins (Longmore et al., 2014). Pancreatic causes include: pancreatitis, haemochromatosis, cystic fibrosis, and pancreatic cancer. Endocrinopathies noted for causing DM include: Cushing's syndrome, hyperthyroidism, acromegaly, and phaeochromocytoma. Drug-induced DM have been documented for steroids,  $\beta$ -blockers, protease inhibitors, thiazides, and therapeutic doses of niacin (Longmore et al., 2014). The physiology of pregnancy causes peripheral insulin resistance, but only a few develop what is termed gestational DM as a consequence. (Porter & Kaplan, 2011).

Most initial clinical symptoms result from hyperglycaemia and glycosuria (Porter & Kaplan, 2011). Glycosuria causes osmotic diuresis which then presents as: urinary frequency, polyuria, polydipsia. The result is severe dehydration, episodes of postural hypotension, weakness, and varying degrees of altered consciousness. Hyperglycaemia also causes nausea, vomiting, unexplained weight loss, visual blurring, and also predisposes to infections such as oral and genital candidiasis (Longmore et al., 2014).

Late diagnosis and/or poorly managed DM results in serious complications (Mabey et al., 2014). These include: diabetic retinopathy leading to blindness, diabetic nephropathy

leading to chronic renal failure, and diabetic peripheral neuropathy leading to numbness, paraesthesias, and a painless loss of the senses of touch, vibration, and temperature. Hyperglycaemia also causes macrovascular diseases that manifest as hypertension, heart attacks, and strokes. The susceptibility of DM patients to both bacterial and fungal infections, and the attending poor wound healing can result in chronic foot ulcers termed diabetic foot which may warrant amputation of the lower extremities at various levels (American Diabetes Association, 2014).

### **1.1.1 The Burden and Impact of DM**

Notwithstanding the increased awareness and advances made in the management of DM, the International Diabetes Federation (IDF) confirms that the contribution of DM to the global disease burden is on the rise (Unwin, Gan, & Whiting, 2010). As at 2014, the estimated global prevalence of DM among adults aged 20 to 79 years was 8.2% (Guariguata et al., 2014). This translated to 387 million persons, and a rise of five (5) million newly diagnosed persons in the 2013. In 2014, the global prevalence of DM among persons 18 years and older stood at 8.5% (WHO, 2016). As at 2015, the global prevalence was estimated at 415 million among adults; and expected to rise by 54.7% by the year 2040 (Atlas IDF, 2015). Nearly two years ago, more than 500,000 children under 15 years were estimated to suffer from type 1 DM (Atlas IDF, 2015).

The Middle East, Sub-Saharan Africa, and India are the regions of the world with the highest disease burden (Shaw, Sicree, & Zimmet, 2010). Globally, five (5) million people die from DM each year; a number which is well in excess of the combined number of deaths per annum (3.6 million) caused by HIV, tuberculosis (TB), and malaria (Kesavadev et al., 2017).

The rise in prevalence of DM over the years translates directly to a rising financial burden from its management (Guariguata et al., 2014). In 2013, an estimated US\$ 548 billion was spent on DM globally. In 2014, DM accounted for about 11% (US\$ 612 billion) of total global expenditure and represented a 12% rise from the 2013 expenditure. Over half (50.7%) of this expenditure was made in North American and the Caribbean regions alone. Put together, South East Asia and the Africa regions spent only US\$ 12.24 billion (2% of the US\$ 612 billion) on diabetes despite the rising incidence and prevalence of DM in these regions (Guariguata et al., 2014).

The long-term complications and mortalities resulting from DM have many negative socioeconomic ramifications for both the immediate family of patients and the nation. Nearly half (46%) of persons living with diabetes remain undiagnosed and as a consequence, millions of people would develop serious complications from unmanaged DM (Beagley, Guariguata, Weil, & Motala, 2014). For example, the leading cause of blindness in adults is attributed to diabetic retinopathy (Jeppesen & Bek, 2004). Compared with non-DM patients, DM is also said to increase the risk of cardiovascular comorbidities up to 4 fold (Barr et al., 2007), and the risk of lower extremity amputation by 10 fold (Carmona et al., 2005). In the Netherlands, nearly half of all lower limb amputations result from diabetic peripheral vascular disease (van Houtum, Lavery, & Harkless, 1996).

The direct cost components of diabetes care include medications, supplies, inpatient care, and the management of long term complications such as kidney failure from nephropathy, visual impairment from retinopathy, strokes and cardiac failure from macrovascular disease, and limb amputations from chronic ulcers. In 2014, and for all types of diabetes, the United States of America (USA) spent 43% of total cost of diabetes care on inpatients and 18% on medications (Zhuo, Zhang, & Hoerger, 2013). For type 2 DM in particular,

high income and middle income countries spent about half of total budget for diabetes care on the aforementioned complications alone (Javanbakht et al., 2011). For all types of DM in the WHO Africa Region, about one half to two-thirds of DM related costs go into procuring medications, diagnostic equipment, and consumables for treatment (Kirigia, Sambo, Sambo, & Barry, 2009).

### **1.1.2 Management of DM**

The diagnosis and institution of appropriate treatment regimen for DM constitutes its management. There are two WHO criteria by which DM is diagnosed (Longmore et al., 2014). First, symptoms of hyperglycaemia and either a raised fasting venous glucose of at least 7mmol/L, or a random venous glucose of at least 11.1mmol/L measured on one occasion is diagnostic of DM. The second diagnostic criterion is, a raised fasting or random venous glucose as above on two separate occasions, or a 2-hour oral glucose tolerance test of at least 11.1mmol/L.

The orthodox treatment regimen for DM is based on a multidisciplinary approach broadly classified into two: pharmacological, and lifestyle modification (Longmore et al., 2014; Mabey et al., 2014). Pharmacological management involves the use of oral hypoglycaemic agents and/or insulin in appropriate combination tailored to the individual patient needs. Some commonly used oral hypoglycaemic agents include, metformin, glibenclamide, and glimiperide. Lifestyle modifications involve dietary restrictions, physical exercise, self-monitoring of blood glucose, patient education, and counseling (Longmore et al., 2014; Mabey et al., 2014). DM has also been managed in unorthodox ways using what is termed as complementary and alternative medicine (CAM).

### **1.1.3 CAM in the Management of DM**

Complementary and alternative medicine (CAM) refers to those categories of medical systems, practices, and products that are not usually an integral part of orthodox western healthcare systems (Barnes, Powell-Griner, McFann, & Nahin, 2004). Whereas complementary medicines are used alongside orthodox medicines, alternate medicines are used as substitutes instead (Kumar, Bajaj, & Mehrotra, 2006).

There are five well known types of CAM; with their popularity varying across various cultures. These are: biological based remedies such as herbal medications and nutritional supplements; medical systems like acupuncture or Ayurveda; manipulative body-based systems like chiropractic and massage; energy therapies like reiki; and body-mind interventions like yoga or tai chi (Barnes, et al., 2004). In some countries, practices such as herbal medicine, chiropractic, and acupuncture are professionally regulated (Warren, Canaway, Unantenne, & Manderson, 2013).

At the individual level, the patronage of CAM in many cultures has been associated with factors such as super-natural beliefs, recommendations from family and friends, length of time since diagnosis of DM, age of patient, educational status, severity of complications, and the presence of comorbidities (Coulter & Willis, 2004). At the national and continental level, poor accessibility to healthcare coupled with the inadequacies in orthodox healthcare services in developing countries contribute to the high patronage of CAM (Mendis et al., 2007).

Owing to its life-long course and associated complications, DM patients tend to seek additional care outside the orthodox healthcare systems that would guarantee them the best quality of life. In this effort they patronize CAM. CAM also comes in handy because, it is mostly free of the stringent management protocols such as adherence to medications, diet

modification, the maintenance of optimal weight, and frequent blood glucose monitoring so typical of orthodox approaches for maintaining normoglycaemia (Chang, Wallis, & Tiralongo, 2007).

In Ghana, popular CAMs include: herbs, dietary supplements, multivitamin and mineral supplements, and prayers. These practices are intended for prevention and management of diseases and are mostly meant to complement orthodox medicine by: “satisfying a demand not met by orthodoxy or by diversifying the conceptual frameworks of medicine” (Ernst, 2001).

Though the use of CAM among DM patients may be a common practice, there are concerns about their toxicities and efficacies. Additionally, the risk of CAM interacting with orthodox medicines and causing adverse effects is of grave concern. The patronage of CAM has also been reported to reduce the rate of compliance with proven orthodox medicines. Some studies however have reported positive contributions of CAM to glycaemic control among DM patients (Ernst, 2001).

In Ghana, efforts are well underway to integrate CAM to the healthcare system. As part of these efforts, the department of herbal medicine was established under the faculty of pharmacy at the Kwame Nkrumah University of Science and Technology (KNUST) in 2003. It has since trained hundreds of medical herbalists (with bachelor degrees) who are manning hospital-based CAM units in a nationwide pilot project involving 18 state owned hospitals. Though the CAM used in these units have been certified as non-toxic, the body of evidence on their efficacies is not yet compelling. This is largely because, they have not been subjected to clinical trials comparable to those conducted on orthodox therapies.

## 1.2 Problem Statement

Developing countries shoulder the highest burden of DM (Shaw et al., 2010). In Ghana, the prevalence of DM was estimated at 6.3% in the general population (Amoah, Owusu, & Adjei, 2002), and 9.1% among civil servants in Accra (Aikins, 2006). Globally, diabetes accounts for one death every 6 seconds (IDF, 2016), and over 80% of these deaths occur in developing countries (WHO, 2016). DM accounts for about 6.1% of deaths in Africa (WHO, 2016). This rising burden of DM comes with a rising patronage of CAM. Studies from several countries have reported between 17% and 72.8% prevalence of CAM use among persons living with DM (Chang et al., 2007). In Africa, the prevalence of CAM use for chronic conditions such as DM is estimated at 80% (Ogbera, Dada, Adeleye, & Jewo, 2010). I have practiced as a medical officer in the Northern region of Ghana since 2010; and have always been concerned about the ready availability and patronage of CAM by some DM patients.

CAM use has been attributed to: poor access to orthodox treatment (Antwi-Baffour, Bello, Adjei, Mahmood, & Ayeh-Kumi, 2014), dissatisfaction with orthodox treatments emanating from strict regimens, adverse reactions from orthodox drugs, coupled with patients' desire to have direct control over their disease contribute (Astin, 1998). Furthermore, patients desire to experiment with CAM, the presence of disease complications, and the belief that CAM use is compatible with their sociocultural values makes CAM attractive to them (Naja et al., 2014).

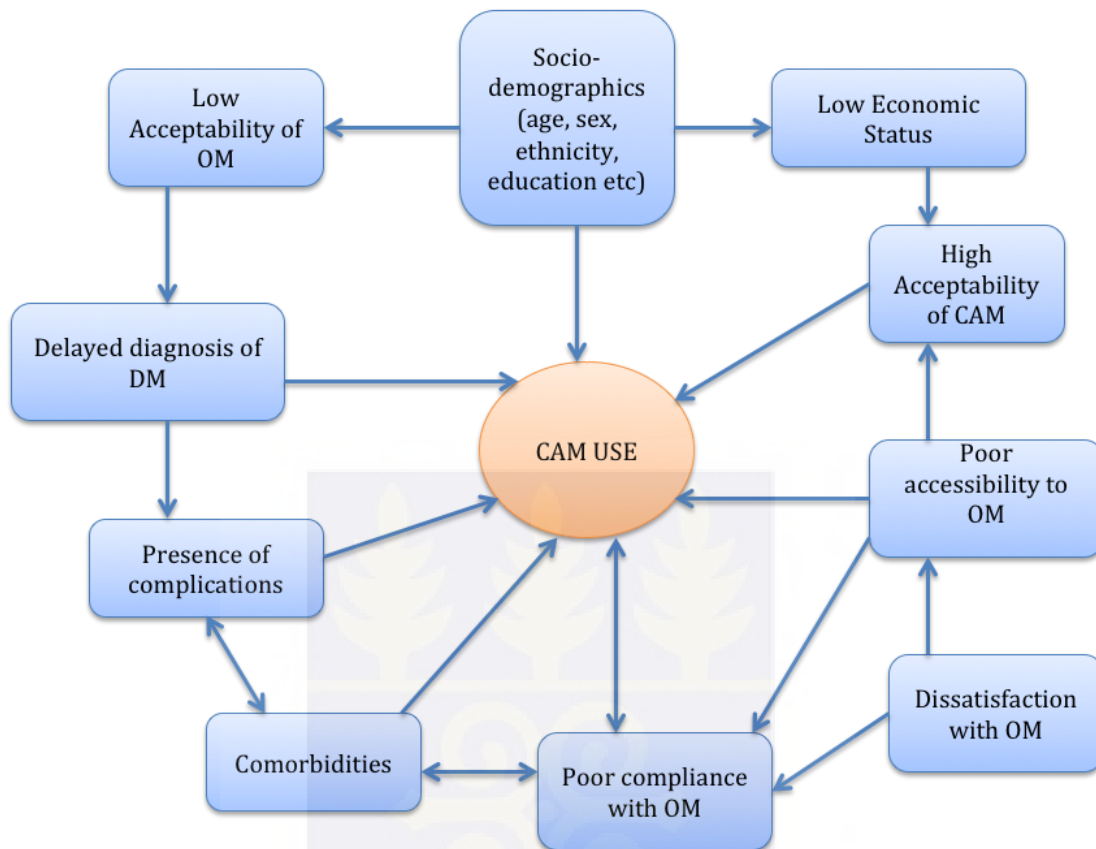
The use of CAM has led to adverse drug interactions and poor adherence to proven orthodox therapy (Matheka & Demaio, 2013). Whereas some CAM are intrinsically toxic, others contain toxic impurities such as lead, arsenic, and mercury (Ventola, 2010). CAM use can result in acute complications such as hypoglycaemic coma and diabetic

ketoacidosis (DKA). Long term complications that would result from poorly managed DM owing to CAM use include: blindness, kidney failure, stroke, chronic limb ulcers necessitating amputation, sexual dysfunction (Thorve et al., 2011), and depression (Nouwen et al., 2011). All these lead to poor quality of life (Spinks, Hollingsworth, Manderson, Lin & Canaway, 2013). As a step towards increasing the awareness of CAM use and mitigating these consequences, this study seeks to investigate CAM use and its socio-demographic correlates among persons living with DM in the Tamale metropolis.

### **1.3 Justification of Study**

The findings from this study may contribute to evidence that would inform decision making at the system, institutional, and individual level. The findings may also contribute to the baseline data in this subject area. In appraising the evidence that would emanate from this study, unanswered questions may arise. These questions may inform further research to validate and consolidate existing evidence that would ultimately help improve the quality of healthcare for persons living with DM in particular, and other similar chronic diseases in general.

### 1.4 Conceptual Framework



**Figure 1: A conceptual framework for the use of CAM among DM patients**

The socio-demographic factors such as age, sex, ethnicity, educational status, marital status, employment status etc. of DM patients are determinants of their economic status as well as predictors of the acceptability of orthodox medicine (OM) to them. Low economic status may make the use of CAM attractive because it is mostly cheaper. Inaccessibility (geographical or financial) of OM or dissatisfaction with orthodox medical services leads invariably to the use of CAM. For those who can afford both, the level of satisfaction offered by each type of care would determine the level of patronage. The use of CAM can reduce compliance to orthodox medicine, which in turn can lead to complications and comorbidities.

Socio-demographic factors of a patient can influence their choice of healthcare system. Thus, the acceptability or otherwise of orthodox medicine would influence how early they get diagnosed of their condition. Late diagnoses come with complications, just as poor treatment adherence does. Comorbidities can result from these complications and vice versa. The presence of complications as well as comorbidities tend to encourage the use of CAM as patients get desperate about their failing health.

## **1.5 Study Objectives**

### **1.5.1 General Objective**

To assess CAM use among DM outpatients in the Tamale metropolis of Ghana, 2017

### **1.5.2 Specific Objectives:**

To:

1. Determine the proportion of DM outpatients in the Tamale metropolis of Ghana who use CAM
2. Determine the socio-demographic and DM related factors associated with CAM use among respondents
3. Assess the types, sources, and reasons patients use CAM
4. Assess experiences of these respondents on benefits and adverse effects of CAM
5. Estimate and compare the costs of CAM and orthodox therapies used by DM patients in Tamale metropolis

## CHAPTER TWO

### LITERATURE REVIEW

#### 2.1 Prevalence of CAM Use among Persons with Diabetes Mellitus

The use of CAM is a global phenomenon. It transcends geographical, cultural, and religious barriers. Across countries, the prevalence of CAM use among persons living with DM varies widely from as low as 17% to as high as 72.8% (Chang et al., 2007). According to the WHO Traditional Medicine Strategy (2002), whereas the prevalence of CAM use in general in Africa stood at 80%, it was about 24% in United Kingdom. In the same report, the prevalence stood between 52% and 70% in Australia, 60% in Japan, 49% in France, 46% in Switzerland, 42% in the United States of America, 40% in China, and 31% in Belgium.

These variations in the prevalence of CAM use are partly attributed to differences in both the definitions of CAM use, and the study designs used by different researchers (Chang et al., 2007). Thus, estimates of CAM use varied depending on the scope of CAM therapies being considered in a given study. Some studies surveyed all types of DM among all ages whilst others focused only on type 2 DM among persons aged 18 years and older. For any given scope of CAM use defined too, studies defined a CAM user differently. A CAM user has been variously defined as one who has used CAM in the preceding three months (Ching et al., 2013; Sripa, 2005), or in the preceding year (Singh et al., 2004), or since the diagnosis of DM (Naja et al., 2014).

More fundamentally, however, attitudes towards CAM also differ widely across cultures. This also contributes to the wide variations in the prevalence of CAM use. In a review of 18 research-based papers spanning the period from 1990 to 2006 on the use of CAM among persons living with DM, Chang et al., (2007) found that about a half of all

respondents had used at least one form of CAM to complement orthodox medicines. Conversely, in one Indian study, 30% of DM patients used CAM as an alternative to orthodox medicine. About 42% of them reported some relief; with 62% reporting maximum relief that was attributed to the inclusion of dietary control and regular physical exercise to CAM (Kumar et al., 2006). Among persons living with type 1 DM, nearly 20% of respondents in a German study, and about 40% of respondents in a similar study conducted in the USA used herbal preparations, multivitamins, and dietary supplements without prescriptions from orthodox doctors (Lemay, Amin, & Pacaud, 2011).

The prevalence of the use of biologically based CAM among persons living with DM have been estimated at 23.6% in the Fremantle Diabetes Study-Australia (Clifford, Batty, Davis, & Davis, 2003). In similar studies, the prevalence of CAM use was 31.0% among respondents in Canada (Ryan, Pick, & Marceau, 2001), and about 33.3% among respondents residing in Mecca, Saudi Arabia (Al Saeedi, El Zubier, Bahnassi, & Al Dawood, 2003).

In one Thai study, the prevalence of CAM use stood at 47.8% (Sripa, 2005). A survey among persons living with type 2 DM in Mexico revealed that 62% patronized some form of CAM (Argáez-López et al., 2003). A cross-sectional survey among persons living with type 2 DM in Taiwan revealed a rise in the prevalence of CAM use among respondents from 22.7% before diagnosis of DM to 61% after diagnosis of DM (Chang, Wallis, & Tiralongo, 2010). Among South Koreans, the prevalence was estimated at 65% (Lee, Lim, & Moon, 2004). A hospital-based cross-sectional study among first attendants to a diabetic clinic in India reported a prevalence of 67.7% CAM use (Hasan, Ahmed, Bukhari, & Loon, 2009). In the Middle East region, the prevalence estimates of CAM use were 51.9% among a cross section of persons living with DM in Palestine (Ali-Shtayeh, Jamous &

Jamous, 2012), 38% in Lebanon (Naja et al., 2014), and 16.6% among a similar respondents of persons living DM in Jordan (Wazaify, Afifi, El-Khateeb, & Ajlouni, 2011). Studies that defined CAM to include the entire spectrum of CAM practices yielded higher prevalence as would be anticipated. For example, in one American survey where prayer was found to be a very popular form of CAM among respondents, a CAM prevalence of 72.8% was recorded (Bell, Suerken, Grzywacz, & Lang, 2006). As recent as 2014, about 76% of persons living with DM in Sri Lanka have been reported to rely on various forms of CAM for glycaemic control (Medagama, Bandara, Abeysekera, Imbulpitiya, & Pushpakumari, 2014).

In Africa, the use of CAM for various diseases is common place. However, estimates of the prevalence of CAM use that are specific to persons living with DM are hard to come by. However, one study reported that about eight of every ten patients patronized CAM for the management of chronic diseases such as DM (Ogbera et al., 2010). In a cross-sectional survey of DM patients attending the Lagos State University Teaching Hospital, Ogbera et al. found CAM use prevalence of 46%. Among the Indian community in South Africa, 38.5% of persons living with DM were found to patronize CAM (Singh, Raidoo, & Harries, 2004). The popularity of CAM use in Uganda competed so well with orthodox medicine, so much so that, stakeholders had to call for an open collaboration between traditional herbalist and the orthodox healthcare providers (Hjelm & Atwine, 2011).

## **2.2 Socio-demographic Characteristics of CAM Users with DM**

There is sufficient research evidence to the effect that, patients living DM tend to share certain socio-demographic characteristics relating to their attitude towards CAM use. Demographic characteristics such as sex, ethnicity, and culture influence the treatment choices patients with DM make.

By sex, women tend to use CAM more than men because women often have greater knowledge of their health and also show a greater concern for their health needs (George, 2001). Some studies have also reported that, being a female increase the chances of CAM use (Clifford et al., 2003). Young adult women are often more regular users of CAM therapies, compared with older adults (Najm, Reinsch, Hoehler, & Tobis, 2003).

Members of an ethnic group share belief systems and common experiences that influence their patronage of different forms of health care. Through their shared beliefs (culture) about what is desirable for maintaining health or what the basis for ill health is, their attitude towards CAM is defined. For example, Arcury et al. (2006) found that unpleasant experiences with orthodox health care by minority group members, such as discrimination, may discourage them from seeking orthodox healthcare and instead, endear them to the use of CAM. In their study of CAM use among older persons living with DM in the multiethnic counties of North Carolina, Arcury et al. also found that CAM use run along ethnic lines, with some ethnic groups patronizing CAM almost as part of their culture.

Personal resources, such as education, marital status, family support, and social network, have also been reported to influence the use of CAM. A number of studies have related higher levels of education to the use of CAM therapies (Astin, Pelletier, Marie, & Haskell, 2000; McMahan & Lutz, 2004; Najm et al., 2003). Educational status may be a proxy indicator of socioeconomic status (SES), access to information, and membership of a large social network. Persons of higher educational status tend to have more disposable income to afford some forms of CAM therapies. A higher educational level comes with more access to information on CAM and a better understanding of specific CAM therapies (Arcury, Quandt, Bell, & Vitolins, 2002). However, low educational status, financial hardship, and limited knowledge on CAM have also been found to promote the use of

home based category of CAM which are freely available or very cheap. (Arcury et al., 2002; Najm et al., 2003). A large social network facilitates information sharing about the existence, sources, and the perceived efficacy, of different CAM therapies.

Several studies have reported significant relationships between age, duration of disease, number and severity of complications and the patronage of CAM. Older patients tend to perceive benefit from CAM and so, they use it more regularly and over longer periods too (Bell et al., 2006; Lee et al., 2004). In one study, there was a threefold likelihood of patients older than 65 years to patronize CAM compared with their younger counterparts (Egede, Ye, Zheng, & Silverstein, 2002).

Just like orthodox medicines, CAM therapies can be used for either prevention or treatment of diseases. One's health status in terms of disease severity, and burden of comorbidities also influence the use of CAM therapies. However, people most often use CAM therapies to treat an illness (Barnes et al., 2004). Therefore, individuals with chronic health conditions may use more CAM therapies more than healthier individuals (Astin et al., 2000). This attitude arises from loss of confidence in orthodox medicines as well as a desperation to get the best treatment that would guarantee better quality of life. Conversely, too many disabilities or very severe complications may limit the use of some therapies such as yoga that require a certain minimum of physical fitness to patronize.

Some attitudes have also been identified in scientific studies that people perceive CAM as less dictatorial, more liberal, and as offering them more personal autonomy and control over their healthcare decisions (Astin, 1998). The findings strongly suggest that people actively engage in the use of CAM as a strategy for health self-help. Some also perceive CAM as better because, CAM practitioners tend to have more interpersonal relationships with their clients than in the orthodox settings (Astin, 1998).

### 2.3 Benefits of CAM use to Persons Living with DM

It is often thought that persons living with DM use CAM for glycaemic control only. This may not always be the case as suggested by some studies (Garrow & Egede, 2006; Egede et al., 2002). Beyond the control of blood glucose, they also use CAM to manage weight, remain active, manage pain, and improve mental health, reduce the risk, manage complications, prevent/manage inter-current sickness, manage stress, and improve general wellbeing (Dunning, 2014).

Forms of CAM that are known to reduce blood glucose include: diets, massage, some herbal medicines, vitamins and mineral supplements (Dunning, 2014). Some CAM diets are nutritionally related to approved orthodox diets and include supplements such as antioxidants, fish oils, and omega 3 (Dunning, 2014). In one study, Field et al. (1997) reported that massage lowered blood glucose in children receiving regular massage from their parents.

Many herbs have demonstrated hypoglycaemic and antilipid properties. The antidiabetic effects of American ginseng (*Panax quinquefolius*) among patients living with type 2 DM has been reported by Vuksan et al. (2000). Much earlier in 1990, the antidiabetic properties of the leaf extracts of Gymnema/gurmar (*Gymnema sylvestre*) was demonstrated (Baskaran, Ahamath, Shanmugasundaram, & Shanmugasundaram, 1990). The seed powder of fenugreek (*Trigonella foenum-graecum*) reduces blood glucose in both type 1 and 2 DM patients (Sharma et al., 1996). Among insulin-independent DM patients, Finney & Gonzalez-Campoy, (1997), reported the antidiabetic effects of dietary chromium. Other popular herbs known to induce hypoglycaemia are: *Coccinia indica*, *Momordia charantia*, *Opuntia streptacantha* and *Cinnamomum cassia* (Braun & Cohen, 2010).

In the control of infections, cranberry preparations are able to keep bacteria from sticking to the bladder wall and reduce urinary tract infections (UTIs) especially in women with recurrent UTIs (Gupta et al., 2007; Jepson, Williams, & Craig, 2012). Pre-probiotics and probiotics might have a role in a healthy diet and might reduce the gastrointestinal side effects of some orthodox oral hypoglycaemic agents such as metformin and acarbose (Dunning, 2014).

Persons living with DM may also use CAM for weight loss. The forms of CAM that are popular for weight loss include: selected CAM medicines like “diet pills”, a range of diets, yoga, meditation, acupuncture, massage, and eastern martial arts (Dunning, 2014) CAM medications for weight loss are mostly self-medicated and adverse effects including nephrotoxicity could result from overdose (Bent, Tiedt, Odden, & Shlipak, 2003).

Some types of CAM have proven analgesic and anxiolytic properties. In the short term, massage abates pain and allays anxiety in postoperative patients (Mitchinson et al., 2007). In the long term, acupuncture has shown significant effectiveness in the management of diabetic peripheral neuropathic pain (Abuaisha, Costanzi, & Boulton, 1998).

Like any other chronic disease, DM can lead to stress and depression (Nouwen et al., 2011). CAM practices such as biofeedback, relaxation, and counseling therapies reduce stress by minimizing the effects of increased autonomic activity and catecholamine production (Dunning, 2014). In a randomised controlled double blind non-inferiority trial, St John's Wort (*Hypericum perforatum*) was shown to improve mild-to-moderate depression and was also better tolerated than paroxetine and other orthodox antidepressants (Szegedi, Kohnen, Dienel, & Kieser, 2005).

#### **2.4 Adverse Effects of CAM among Persons Living with DM**

Healthcare, irrespective of its form, carries some risks commonly discussed as adverse effects. Whereas adverse effects of orthodox therapies are better documented, those of CAM therapies are less known. Some known adverse effects associated with herbal medicine use include: nephrotoxicity, hepatotoxicity, hypertension, hypotension, sedation, and electrolyte imbalances (Braun & Cohen, 2010; Ulbricht, 2012).

There are four (4) general mechanisms by which herbal medicines produce their adverse effects (Dunning, 2014). First, they reduce orthodox medicine bioavailability by inducing liver microsomal enzymes that quickly metabolize the orthodox medicines. Second, they also reduce bioavailability of orthodox medicines by inducing the production of intestinal D-glycoprotein which impairs the absorption and subsequent metabolism of orthodox medicines. Third, by stimulating neurotransmitter production such as serotonin which potentiate the effects of some orthodox medicines leading episodes of hypoglycaemia.

Fourth, herbal medicines compete for serum protein binding sites; resulting in toxic concentrations of orthodox medicines in the blood. Malnourished persons and the elderly who often have hypoalbuminaemia are especially at risk of drug toxicity from the ingestion of normal doses (Braun & Cohen, 2010).

The adverse effects associated with CAM use can arise solely from a particular CAM used alone, a combination of two or more CAM therapies, or a combination of CAM therapy and orthodox medicines. The adverse effects of some CAM are better known than others. Adverse effects arising from some CAM-orthodox medicine interactions are still more theoretical (Braun & Cohen, 2010) and unpredictable (Ulbricht, 2012). Many orthodox medicines such as metformin and the recently introduced sodium- glucose co-transporter-2 medicines share similar pharmacokinetic and pharmacodynamic profiles with some herbal

medicines because they take their common origin from the same plant sources (Dunning, 2014). This helps to explain some of the adverse effects associated with the lesser known herbal therapies. Neither herbal medicines nor orthodox ones may pose a problem if used alone. Their combination however poses threats of adverse effects through drug-drug interaction (Matheka & Demaio, 2013). Even though many herbs can cause hypoglycaemia by themselves, hypoglycaemia has also resulted from the contamination of herbal preparation with orthodox oral hypoglycaemic medicines such as the sulphonylureas (Dunning, 2014). Common examples of these sulphonylureas include glibenclamide, gliclazide, and glipizide.

Some general CAM- related adverse effects among persons living with DM have to do with substituting proven orthodox therapies like insulin for type 1 DM with CAM. This results in life threatening acute complications such as ketoacidosis (Gill, Redmond, Garratt, & Paisey, 1994). Moxibustion, a form of heat therapy in which dried plant materials called "moxa" are burned on or very near the surface of the skin with the intention to warm and invigorate the flow the body's vital life force (Qi) and dispel certain pathogenic influences, have led to ulcerations and neuropathic pain among some DM patients (Ewins, Bakker, Young, & Boulton, 1993).

Other more general ways by which herbal medicines produce adverse effects include the toxicity of their preservatives, colours, and impurities. The literature is replete with reports of allergies and poisoning from some traditional Chinese medicines found to contain toxic ingredients and heavy metals like mercury and arsenic (Espinoza Mann, & Bleasdell, 1995; Huang, Wen, & Hsiao, 1997). These have caused serious health complications in unwary clients (Gertner, Marshall, Filandrinos, & Potek, 1995). A 10 year analysis of the pharmacovigilance database of Singapore revealed that hypoglycaemia was associated

with some herbal medicines such as CQ-10, *Panax ginseng* and Saw palmetto which are used by men living with DM to heighten sexual performance through enhanced and balanced testosterone production (Patel et al, 2012).

Herbal medications which are generally considered safe could be unsafe for persons with certain underlying comorbidities to DM such as chronic kidney disease. Other herbs such as St. John's wort (a good antidepressant) cause bleeding and bruising, especially during surgical procedures (Braun & Cohen, 2010). So for persons who are on such herbs, treatment must be stopped some time prior to surgical operations or invasive surgical procedures to avoid excessive blood loss.

## **2.5 Reasons Persons living with DM Give for using CAM**

Various reasons have been reported in the literature on why persons with chronic disease in general patronize CAM. More generally, however, individual attitudes coupled with systemic failures of orthodox healthcare form the bases on which persons living DM seek CAM treatment. Commonly cited reasons for the use of CAM include: loss of trust in orthodox medicine, high costs of orthodox medicines, the desire to experiment with CAM, generational confidence in CAM yielding to the recommendation by a trusted persons such as fellow patients, close relations, and medical practitioners (Kanodia, Legedza, Davis, Eisenberg, & Phillips, 2010).

In his widely applauded paper, Astin (1998) proposed three theories to help explain why people in general may patronize CAM. These are: dissatisfaction, need for personal control, and philosophical congruence.

According to Astin, (1998) the theory of dissatisfaction suggests that patients are unhappy with orthodox medicine because it has proven ineffective, resulted in adverse effects, is

expensive, is impersonal or too technologically oriented. Patients' satisfaction with the care of their doctors and response to their health concerns, and confidence in their doctors' approach to work informed their satisfaction with orthodox healthcare.

The need for personal control emanates from patient's desire for autonomy regarding their health choices. They embrace CAM as less authoritarian, and more empowering. They are able to make key decisions on their treatment regimens and tend to have relaxed personal relationships with their CAM practitioners.

The theory of philosophical congruence stipulates that patients see CAM as more compatible with their personal values, perspectives on healthcare, religious or spiritual ideals, and their convictions on how to manage their illnesses.

In their survey of persons living with type 2 DM in Malaysia, it was found that almost half of the patients used CAM because they lost confidence in orthodox medicine owing to their adverse effects (Huri, Lian, Hussain, Pendek, & Widodo, 2009). In a systematic review report published in the bulletin of WHO, Ernst (2000) gathered that, dissatisfaction with orthodox medicine among persons living with DM influenced their decisions to use CAM. Experimentation was a popular reason for the use of CAM as reported by Barnes et al. (2004) in their survey of CAM use among adults living with DM in USA. Persons living with DM trusted that, adding unorthodox therapies would confer better health benefits.

On the basis of trusted relationships, Huri et al. (2009) revealed that family and friends of persons living with DM exert substantial influence on them to use CAM. Personal recommendations by friends and co-workers, the desire to avoid side effects of orthodox treatments, the failure of orthodox treatments to deliver satisfaction, and costs associated with orthodox care (Tu & Hargraves, 2004), are recurrent reasons patients give for patronizing CAM.

## 2.6 Types of CAM

Barnes et al. (2004) have classified CAM into five main categories: biological based remedies, alternative medical systems, manipulative body-based systems, energy therapies, and body-mind interventions as summarized on Table 1.

**Table 1: Broad classification of CAM (Barnes et al., 2004)**

<b>CAM Type</b>	<b>Description</b>	<b>Examples</b>
Biologically based therapies	preparations involving naturally occurring substances that have purported medicinal properties	herbs, and nutritional supplements such as vitamins, minerals, foods, oils
Mind-body interventions	Practices that make use of the relationship between the mind and body to enhance health or manage diseases	yoga, tai chi, meditation
Manipulative and body based therapies	Practices that involve the manipulation or use specific body parts or whole body	Chiropractic therapy, Osteopathic manipulation, hydrotherapy
Energy Therapies	Techniques based on beliefs in energy fields around and within the body that are manipulated for management of diseases	Acupuncture, massage, reiki, external gi gong, therapeutic touch
Whole medical systems	Complete and independent medical systems that either evolved earlier than, or separately from orthodox medicine	Homeopathy, naturopathy, Ayurveda (traditional Indian medicine), and traditional Chinese medicine

### 2.6.1 Biologically based therapies

The scope of biologically based medicines is very wide and varies between geographical locations, and across cultures. Most of these are part of traditional healing systems handed to successive generations as therapeutic remedies or prophylactic ingredients in staple foods. Common food spices and ingredients such as ginger, onions, and garlic have been shown to have antidiabetic effects (Akhani, Vishwakarma, & Goyal, 2004; Matheka &

Alkizim, 2012; Sheela Augusti, 1992). Extracts from many plant parts such as their leaves, barks, and root have also been found to be reduce blood glucose levels and improve glucose utilization as shown on Table 2. Some commonly patronized nutritional supplements among DM patients are summarized on Table 3.



**Table 2a Common biologically based CAM therapies (Extracted from Matheka, & Alkizim, 2012).**

Botanical name (Common name)	Parts used	Reported pharmacological profile	Reference
<i>Allium cepa</i> (Onion) and <i>Allium Sativum</i> (Garlic)	Bulb whole plant	Facilitates cellular uptake of glucose by inhibiting insulin breakdown	(Matheka & Alkizim, 2012; Sheela Augusti, 1992)
Alovera <i>Artemisia herba-alba</i> (Wormwood)	Bark and leaves	Increases insulin secretion by pancreatic $\beta$ cells	(Ajabnoor, 1990) (Al-Shamaony, Al-Khazraji, & Twaij, 1994)
<i>Azadirachta Indica</i> (Neem)	leaves	Increases insulin secretion by pancreatic $\beta$ cells and regenerates the insulin producing $\beta$ cells	(Jelodar, Maleki, Motadayen, & Sirus, 2005)
<i>Beta vulgaris</i> (Beet root)	root	Lowers blood glucose by unclear mechanisms	(Yoshikawa et al., 1996)
<i>Boerhavia diffusa</i> (tar vine)	leaves	Increases insulin secretion by pancreatic $\beta$ cells	(Satheesh & Pari, 2004)
<i>Brassica juncea</i> (mustard greens)	Whole plant	Improves glycaemic control by inhibiting the conversion of glycogen to glucose and the generation of glucose from non-carbohydrate carbon substrates	(Khan, Abraham, & Leelamma, 1995)
<i>Brassica nigra</i> (black mustard)	Seeds	Lowers blood glucose by unclear mechanisms	(Anand Murali, Tandon, Chandra, & Murthy, 2007)
<i>Bumelia sartorum</i>	Roots and bark	Increases insulin secretion by pancreatic $\beta$ cells	(Naik Barbosa Filho, Dhuley, & Deshmukh 1991)
<i>Camellia sinensis</i> (tea flower)	leaves	Contains epigallocatechin gallate which increases insulin sensitivity	(Ezike, Akah, Okoli, & Okpala, 2010)
<i>Carum carvi</i> (Caraway)	Fruits	Inhibits hepatic gluconeogenesis, increases peripheral glucose utilization and inhibits renal glucose reabsorption	Eddouks Lemhadri, & Michel 2004)
<i>Casearia esculenta</i> (Wild cowrie fruit)	Roots	Inhibits enzymes of gluconeogenesis (glucose-6-phosphatase and fructose-1,6-biphosphate) to reduce glucose synthesis, and facilitates the activity of hexokinase in the liver to increase glucose metabolism	(Prakasam Sethupathy, & Pugalendi, 2002)
<i>Catharanthus roseus</i> (Madagascar periwinkle)	leaves	Facilitates uptake of glucose into cells	(Singh et al., 2001)

**Table 2b Common biologically based CAM therapies (Extracted from Matheka, & Alkizim, 2012).**

<b>Botanical name (Common name)</b>	<b>Parts used</b>	<b>Reported pharmacological profile</b>	<b>Reference</b>
<i>Citrullus colocynthis</i> (bitter apple)	Roots	Stimulates residual pancreatic mechanism, facilitates peripheral uptake and utilization of glucose	(Agarwal, Sharma, Upadhyay, Singh, & Gupta 2012)
<i>Cinnamomum tamala</i> (bay leaves)	Leaves	Increases insulin secretion by pancreatic $\beta$ cells	(Bisht & Sisodia, 2011)
<i>Coccinia indica</i> (Ivy gourd)	Leaves	Inhibits gluconeogenesis and enhances glycolysis	Kamble, Kamlakar, Vaidya, & Bambole 1994)
<i>Cuminum nigrum</i> (kala zeera)	Seeds	Contains flavanoids which have insulin-like activity Inhibits the enzymes of gluconeogenesis to reduce glucose synthesis, and enhances the activity of hexokinase in the liver to increase glucose metabolism	(Jagtap & Patil, 2010)
<i>Eclipta alba</i> (False daisy)	Leaves	Inhibits $\alpha$ -amylase and $\alpha$ -glucosidase from breaking down starch and glycogen into glucose	(Ananthi, Prakasam, & Pugalendi, 2003)
<i>Emblica officinalis</i> (Gooseberry)	Fruits	Inhibits $\alpha$ -amylase and $\alpha$ -glucosidase from breaking down starch and glycogen into glucose	(Nampoothiri et al., 2010)
Eucalyptus Globulus (Blue Gum)	Bark and leaves	Increases peripheral glucose uptake, and increases insulin secretion by pancreatic $\beta$ cells	(Gray & Flatt, 1998a)
<i>Eugenia jambolana</i> (Java plum)	Seeds	Enhances glucose tolerance	(Ravi Ramachandran, & Subramanian, 2004)
<i>Ficus carica</i> (fig leaf)	Leaves	Increase cellular glucose uptake	Perez, Dominguez, Canal, Campillo, & Torres, 1991)
<i>Ficus bengalensis</i> (Banyan tree)	Bark	Inhibits insulin breakdown	(Kumar & Augusti, 1989)
<i>Garcinia kola</i> (bitter kola)	Seeds	Inhibits glucose-6-phosphatase required for gluconeogenesis	(Iwu, Igboko, Okunji, & Tempesta, 1990)
<i>Ginkgo biloba</i> (Maidenhair tree)	Leaves	Increases insulin secretion by pancreatic $\beta$ cells in type 2 diabetes Decreases intestinal carbohydrate absorption, increases glucose uptake by cells, increases synthesis and storage of glycogen, and enhances insulin secretion by pancreatic $\beta$ cells	(Kudolo, 2001)
Ginseng species	Roots	Increases insulin secretion by pancreatic $\beta$ cells	Yuan, Wu, Lowell, & Gu, 1998

**Table 2c Common biologically based CAM therapies (Extracted from Matheka, & Alkizim, 2012).**

<b>Botanical name (Common name)</b>	<b>Parts used</b>	<b>Reported pharmacological profile</b>	<b>Reference</b>
<i>Hibiscus rosa sinensis</i> (Hibiscus Flower)	Whole plant	Enhances insulin secretion by pancreatic $\beta$ cells, and increases tissue glucose uptake	(Sachdewa Nigam, & Khemani, 2001)
<i>Lantana camara</i> (lantanas)	Leaves	Lowers blood glucose through unclear mechanisms Contains $3\beta$ -taraxerol, which enhances insulin induced glucose uptake through translocation of the glucose transporter, GLUT 4	(Kazmi et al., 2012)
<i>Mangifera indica</i> (mango)	Leaves		(Sangeetha et al., 2010)
<i>Momordica charantia</i> (Bitter melon, karela)	Fruit, seeds	Promotes normoglycaemia through several mechanisms	(Chen, Nakashima, Kimura, & Kimura, 1995)
<i>Musa sapientum</i> (banana)	Fruits	Increases insulin secretion by pancreatic $\beta$ cells and enhances peripheral glucose utilization	(Ojewole & Adewunmi, 2003)
<i>Ocimum sanctum</i> (holy basil)	Leaves	Increases insulin secretion by pancreatic $\beta$ cells Its soluble fibres and pectin reduce intestinal glucose absorption, also enhanced insulin sensitivity and secretion	(Chattopadhyay, 1993)
<i>Opuntia streptacantha</i> (paddle cactus)	Leaves		Shapiro & Gong, 2002)
<i>Psidium guajava</i> (Guava)	Bark	Lowers blood glucose	(Lim et al., 2009)
<i>Suaeda fruticosa</i> (Alkali seepweed)	Whole plant	Facilitates cellular glucose uptake and utilization	(Benwahhoud, Jouad, Eddouks, & Lyoussi, 2001)
<i>Swertia chirayita</i> (Bitter Stick)	Whole plant	Increases insulin secretion by pancreatic $\beta$ cells	(Saxena, Bajpai, Murthy, & Mukherjee 1993)
<i>Vinca rosea</i> (Periwinkle)	Whole plant	Prevents the breakdown of starch to glucose	(Ghosh & Suryawanshi, 2001)
<i>Withania somnifera</i> (Winter cherry)	Leaves	Regenerates pancreatic $\beta$ -cells thereby preventing diabetes induction through insulin secretion	(Andallu & Radhika, 2000)
<i>Zingiber officinale</i> (Ginger)	Roots	Lowers blood glucose	(Akhani et al., 2004)

**Table 3: Commonly patronized Dietary Supplements among CAM users**

<b>Dietary Supplement</b>	<b>Benefits/Hypothesised mechanism of action</b>	<b>References</b>
Alpha-lipoic acid	Improves diabetic paraesthesia and neuropathic pain	Birdee & Yeh, 2010; Shane-McWhorter, 2007
Chromium	Lowers plasma lipid levels and increases the sensitivity of insulin by inhibiting tyrosine phosphatase activity and enhancing tyrosine kinase activity at the insulin receptor level	Chang et al., 2007; Shane-McWhorter, 2007
Coenzyme Q10	Improves diabetic paraesthesia and neuropathic pain	Birdee & Yeh, 2010; Shane-McWhorter, 2007
Magnesium	Insulin secretagogue, increases insulin sensitivity & prevents diabetic complications	Chang et al., 2007; Birdee & Yeh, 2010
Omega-3-oils	Lowers triglycerides, has anti-inflammatory, anti-platelet, and lowers blood pressure	Birdee & Yeh, 2010; Chang et al., 2007
Vanadium	Insulin mimetic, increases insulin sensitivity	Birdee & Yeh, 2010; Shane-McWhorter, 2007
Zinc	Improves plasma insulin levels, lipid-lowering effects, reduces body weight, metalloenzyme activator	Chang et al., 2007; Smith & Clinard, 2014

### 2.6.2 Mind-Body Medicine

Mind-body medicine has multicultural and contextual origins, but mostly traced to Eastern traditions. It takes its roots from the concept that, the physical body and mind through a constant interaction, influence each other (Birdee & Yeh, 2010). Overtime, some mind-body practices such as hypnosis, bio-feedback, and cognitive behavioural therapy have been integrated into orthodox medicine and no longer regarded as CAM (Birdee & Yeh, 2010). Some popular mind-body therapies that are still practiced as CAM include yoga, tai chi, and meditation (Birdee & Yeh, 2010).

Though currently popular in the west, yoga originated in India. Its practice has a wide scope; spanning lifestyle modifications to techniques of movement, breathing, chanting,

and meditation (Birdee & Yeh, 2010). Tai chi originated from China and its practice is based on martial arts and ancient healing traditions. The technique of tai chi involves a set of well-coordinated movements with mental focus, breathing, and relaxation (Wayne & Kaptchuk, 2008). Meditation techniques seek to produce a certain desirable mental state by influencing the mind. Some of these techniques include: relaxation response, and many forms of meditation such as: mantra-based mindfulness, transcendental, Zen, and Vipassana meditations (Wayne & Kaptchuk, 2008).

The behavioural and psychotherapeutic effects of mind-body therapies help persons with DM cope with the psychological depression and anxiety associated with chronic disease and thus, improve their quality of life (Kosuri & Sridhar 2009; Song, Ahn, Roberts, Lee, & Ahn 2009).

### **2.6.3 Manipulative and body based therapies**

Manipulative and body based therapies are practices that manipulate or use specific body parts or whole body to confer some form of health benefits. Popular examples include chiropractic therapy, osteopathic manipulation, and hydrotherapy. Hydrotherapy, mostly in the form of hot-tub therapy improves perfusion of skeletal muscles, increases glucose utilization, thereby reducing mean plasma glucose, glycosylated haemoglobin, and the risk of obesity (Hooper, 1999).

### **2.6.4 Energy Therapies**

The practice of energy therapies is founded on beliefs in energy fields around and within the body that can be manipulated for management of diseases Barnes et al. (2004). One popular type of energy therapy is acupuncture. It originated from ancient Chinese medicine and it is based on the concept of energy channels (Qi), termed meridians that run

through the body and on which lie 360 acupuncture points (Hussain & Quigley, 2006). Acupuncture has been reported by both experimental and clinical trials as beneficial for the management DM and its attending complications (Chen & Wei 1985; Huang, 1996). It improves glycaemic control by improving insulin synthesis, increasing the number of insulin receptors on target cells, and facilitating the peripheral catabolism of glucose (Chen & Wei, 1985). Acupressure, which uses the same acupuncture points, influences the same meridians, but through the use of manual or finger pressure rather than needles. Massage involves the Manipulation of body tissues to bring about improved perfusion, relaxation, and energy. It has been reported to be beneficial, both for glycaemic control (Field, et al., 1997), and improving anxiety (Wu & Li, 1998).

### **2.7 Costs Associated with CAM Use**

Empirical evidence suggests that significant proportions of populations in the developing world rely on the traditional medicine form of CAM for management and cure of diseases. However, precise data on the use of CAM; including their costs, are unavailable (WHO Traditional Medicine Strategy, 2002). In the advanced world, the expenditure on CAM is significant and a keeps rising rapidly too.

In a cross-sectional study of complementary alternative medicine use among patients with type 2 diabetes mellitus in the primary care setting in Malaysia, respondents' monthly average out-of-pocket expenditure on CAM was about US\$ 16.9 ± 32.5. Whereas nearly 9 of every 10 respondents spent about US\$ 17 or less on CAM treatments, the rest spent more than US\$ 53 (Ching, Zakaria, Paimin, & Jalalian, 2013). In an earlier survey amongst complementary and alternative medicine (CAM) users with type 2 diabetes in Malaysia, Huri et al. (2009) found that more than half (52.3%) of respondents spent about US\$ 7.2 to US\$ 13.9 on CAM on a monthly basis. Nearly 44% of them spent more than

US\$ 13.9 on CAM each month. In Thailand, the average monthly cost of CAM use per person was estimated at US\$ 8.58; exclusive of indirect cost such as transportation or wage loss from working time spent seeking CAM services (Sripa, 2005).

In Malaysia, whereas an estimated annual expenditure of US\$ 300 million is spent on orthodox medicine, that for CAM is US\$ 500. More than a decade ago, annual expenditure on CAM was US\$ 2.7 billion in the USA, US\$ 2.4 billion in Canada, US\$ 2.3 billion in UK, and US\$ 0.8 billion in Australia (WHO Traditional Medicine Strategy, 2002).



## CHAPTER THREE

### METHODS

#### 3.1 Study Design

A descriptive cross-sectional study design was used. The study population constituted persons of all ages living with Diabetes Mellitus (DM), and attending any of the three diabetes clinics within the metropolis. In a face-to-face interview, participants completed a questionnaire comprising questions on socio-demographic, diabetes characteristics, types of CAM and modes of use, and costs of CAM therapies. A Checklist was used to review their medical records. Data extracted from their medical records included: diagnosis, treatment regimen, comorbidities and complications, and cost of treatment. Thus, both primary and secondary data were used to complement and triangulate the findings. A CAM user was defined as one who has used any form of CAM on at least one occasion since being diagnosed of DM.

#### 3.2 Study Area

The study was conducted in the Tamale Metropolitan area; one of 26 districts in the Northern region of Ghana. I selected Tamale metropolis for this study because it has the largest number of health facilities in the northern region that run DM clinics. These serve as referral centers for DM patients from other districts and municipalities in the region. Thus, a good mix of patients from all parts of the region (urban and rural) made for a rich study population.

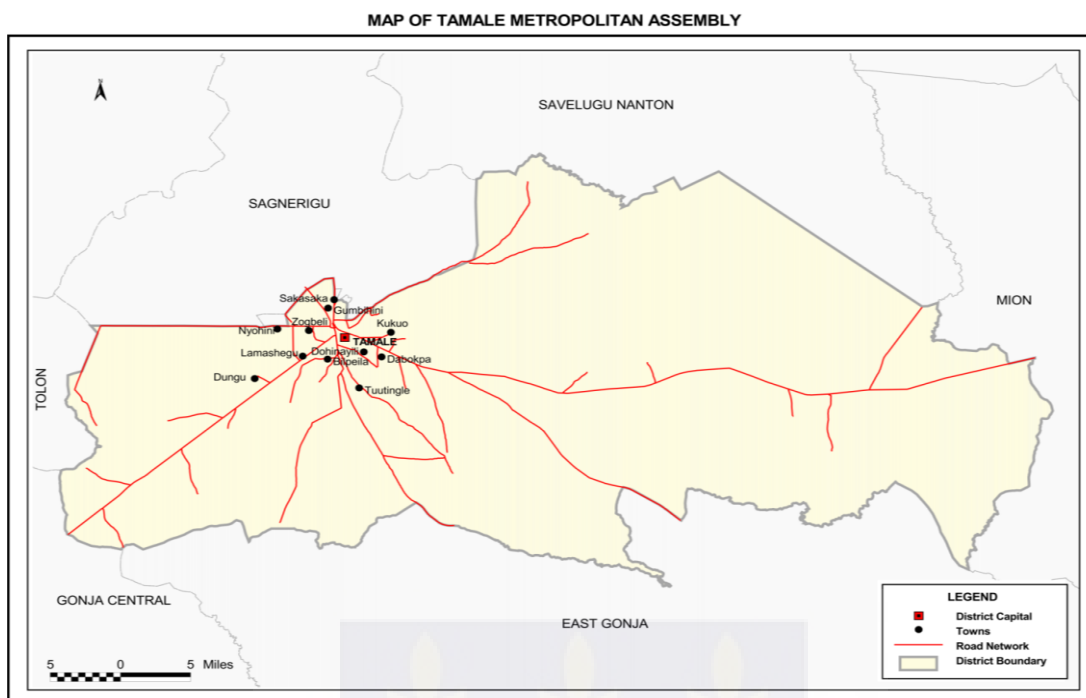
Tamale metropolis is located in the central part of the region and shares boundaries with the Sagnarigu District to the west and north, Mion District to the east, East Gonja to the south and Central Gonja to the south-west. The Metropolis has a total estimated land size of 646.9 sqkm (GSS; 2014). Geographically, the It lies between latitude 9<sup>0</sup> 16 and 9<sup>0</sup> 34

north; and longitudes  $0^{\circ} 36$  and  $0^{\circ} 57$  west. The population is 233, 252. Nearly 81% of this population lives in the urban areas of the metropolis (GSS; 2014).

There are three referral hospitals in the Tamale metropolis. These are: Tamale Teaching Hospital (TTH) the Tamale Central Hospital (TCH), and Tamale West Hospital (TWH). All these hospitals run diabetic clinics owing the high burden of the disease. There are many clinics and medical centers that are owned by missions and private entities.



**Figure 2: Geographical Location of Tamale Metropolitan in Ghana**  
Source: Ghana Statistical service, GIS, 2014.



**Figure 3: Map of Tamale Metropolis**

Source: Ghana Statistical service, GIS, 2014.

### 3.3 Study Variables

- I. The outcome variable was defined as the use of any form of CAM since diagnosis of DM.
- II. The independent variables were:
  - a) Socio-demographic and economic factors such as: age, sex, ethnicity, educational status, marital status, employment status, average monthly income etc.
  - b) History of diabetes confirmed by hospital records, type of DM, treatment for diabetes, lifestyle modifications such as specific diet and regular exercise for control of diabetes.
  - c) Factors related to CAM use such as:

Influence of friends, relatives and neighbours working in CAM, reason for selection of CAM medications, consulting a doctor for CAM, frequency of visits to

CAM practitioner, frequency of CAM use, supply of CAM, side effects from CAM, satisfaction with CAM use, likelihood to recommend CAM to other patients.

### 3.4 Sample Size Determination

The minimal sample size (n) for the study was estimated using the Cochran's sample size formula:

$$n = \frac{Z^2 pq}{d^2}$$

where:

Z = 1.96 for 95% Confidence level

p = the prevalence of the use of complementary and alternative medicine.

Owing to the unknown prevalence of CAM use among Ghanaians living with DM, and the wide variations in the prevalence; 17% to 80% from studies conducted outside Ghana, (Chang et al., 2007); p was assumed to be 50% in order to obtain largest minimum sample size.

p = 0.50

q = 1-p = 1-0.50 = 0.50

d is the tolerable margin of error; assumed as 5% = 0.05

This gave a minimum sample size of 385.

A 10% allowance for response attrition was made to give 424 which was rounded off to 430. Hence, 430 subjects were targeted for participation in this study.

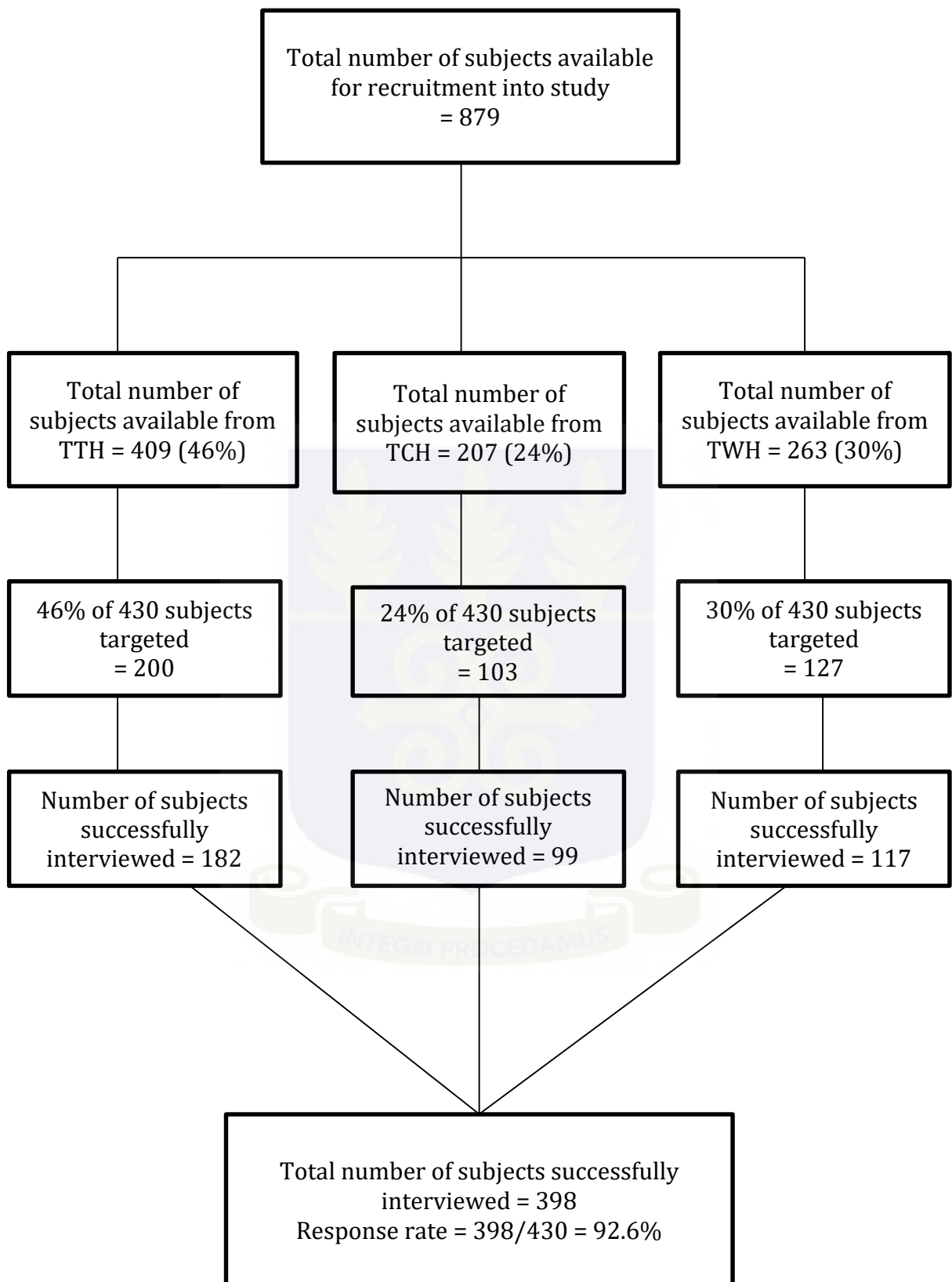
### **3.5 Sampling Method**

There were three hospitals that run diabetic clinics within the Tamale metropolis. All three were included in the study. From their respective databases of diabetic patients for the preceding six months to the commencement of data collection, a total of about 879 attendants were found. Of these, TTH had 409 (46%), TCH had 207 (24%), and TWH had 263 (30%) of attendants. By these proportions, 200 subjects were targeted for interview from TTH, 103 from TCH, and 127 from TWH. Thus, the targeted total of 430 subjects was obtained to participate in the study using systematic random sampling.

At TTH two diabetic clinics were run per week on Tuesday and Friday. An average of 45 patients attended each clinic. Since 200 respondents were expected from 409 patients, a sampling interval of 2 was used. Taking the number 2 at random from patients registered to for consultation on each clinic day as a starting point, 17 patients were interviewed on 12 clinic days over a period of 6 weeks.

At TCH, the diabetic clinic was run on only Thursday each week with an average attendance of 40. A sampling interval of 2 was used to select the targeted 103 respondents from a total of 207. For each clinic, 18 respondents were targeted for interview over a six-week period. Starting randomly from the first registered patient on each day, alternate patients were selected for interview.

At TWH, two (2) clinics were run per month with an average attendance of 48. A sampling interval of 2 was used to select the targeted 127 patients. Over a seven-week period, 25 patients were targeted for interview on each of five (5) clinic days. The first patient on the register for each clinic day was taken as a random starting point, and subsequent patients selected alternately. The sampling procedure is summarized on the flow chart in Figure 4.



**Figure 4 Sample Selection Process**

### **3.6 Quality Control**

Six research assistants; five nurses and one final year medical student who were fluent in the two most popular local languages (dagbanli and hausa) in the study area were recruited and trained. The training focused on understanding the objectives of the study, the information the questionnaire intended to elicit from subjects, and how to administer the questionnaire without leading questions. Ethical issues were discussed and these included, courtesy and respect for the rights of the subjects, and confidentiality of their responses and information obtained from their medical records.

Pretesting of the questionnaires was done on 30 subjects; 10 from each of the three hospitals. Following the pretesting, a second training session was held for the research assistants to refine the study tools. Some items were rephrased to improve clarity, and others were modified to include more options. During the data collection, the review of medical records served to validate some of the responses to the questionnaires, and also to fill in subjects' recall gaps. The responses from the pretesting were not included in analysis.

### **3.7 Data Processing and Analysis**

Hard copies of completed questionnaires were checked for completeness. The data entry and cleaning was done using Microsoft excel software 2013, and then imported into STATA/SE version 13.1. where further data cleaning was done. In particular, missing values, duplicate entries, inconsistent entries, were checked for and corrected. The data were then coded in STATA format for analysis.

Summary descriptive statistics were performed and presented as: frequencies, proportions, means and standard deviations, tables, and graphs. Chi-square test was performed for

categorical data. Multiple logistic regression analyses model was used to assess the correlates of CAM use. Variables were put in the model in a descending order of their strength of association with CAM use as per the results of the Chi-square tests. The effect of each variable on the model was assessed. Variables that contributed to a better fit of the model were maintained, otherwise, they are excluded. A p value of  $<0.05$  was considered statistically significant.

### **3.8 Ethical Considerations**

#### **3.8.1 Ethical Approval for Study**

Approval for the study protocol and tools was obtained from the Ghana Health Service Ethics Review Committee. A formal permission was sought from the head of each of the three (3) hospitals.

#### **3.8.2 Risks and Benefits**

Potential respondents were made to understand that there were no serious risks in participating in the study. However, they understood that taking some time off to answer questions may be inconvenient for them. However, they were assured that well trained research assistants would be quick enough to minimize the inconvenience.

Potential respondents were also made to understand that there were no direct benefits for participation. However, information obtained would be used to provide some recommendations to improve the management of DM in Ghana and beyond.

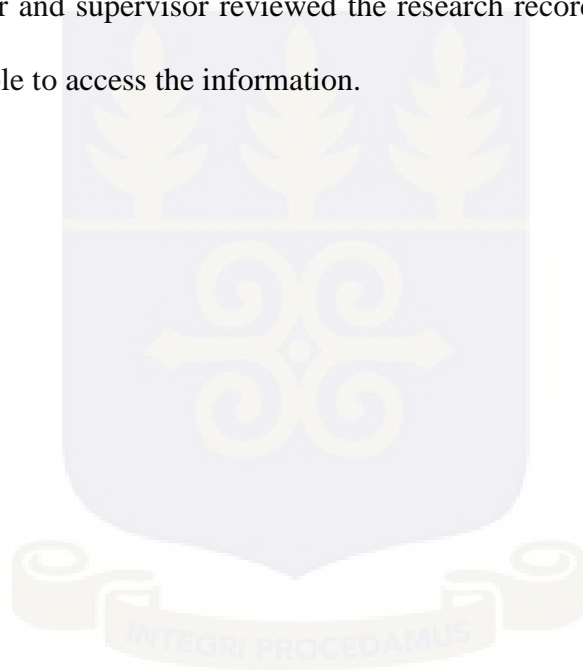
#### **3.8.3 Respondents' Rights**

Potential respondents were made to understand that participation in the study was entirely voluntary. Their decision not to enter the study, failure to answer any question or

termination of the interview at any point was fully respected and considered by the principal investigator. They understood that their treatment will not be affected by their attitude towards the study.

#### **3.8.4 Confidentiality of Respondents' information**

Information provided for this study was handled with strict confidentiality. The information was used exclusively for research purposes and will never be used against the participants. Data analysis was done at the aggregate level to ensure anonymity. The Principal Investigator and supervisor reviewed the research records, and no unauthorized individual(s) were able to access the information.

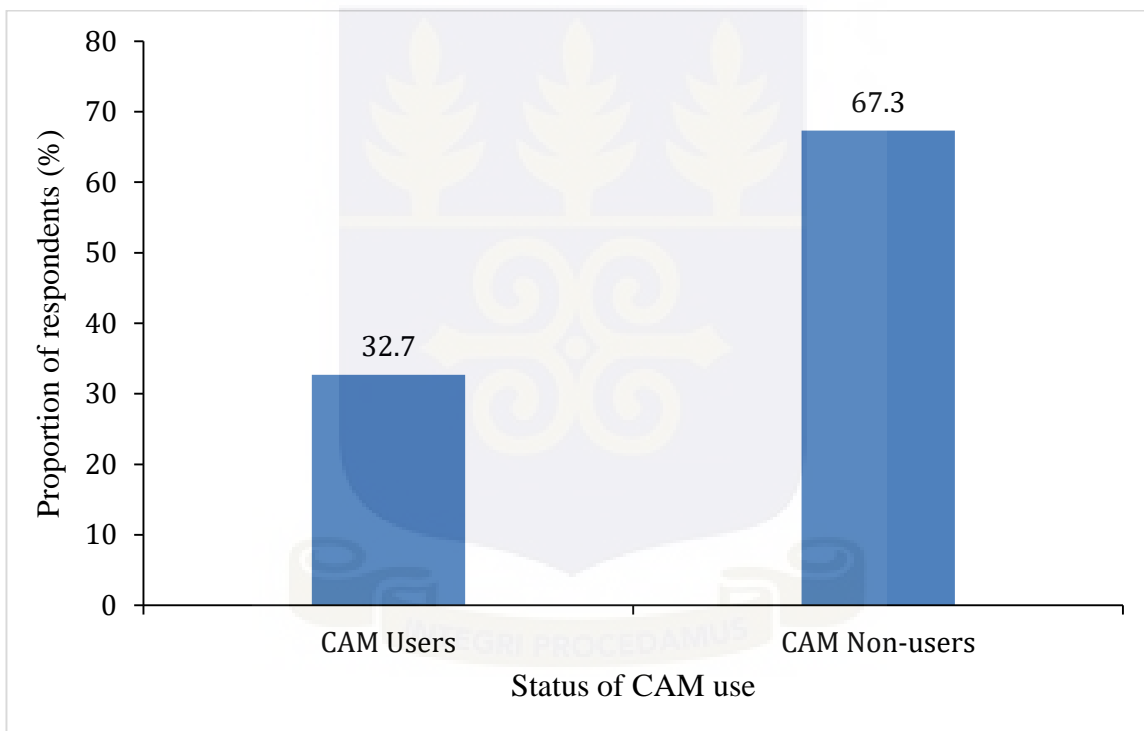


## CHAPTER FOUR

### RESULTS

#### 4.1 Prevalence of Complementary and Alternative Medicine use among DM Patients

Of the 430 patients who were recruited for the study, 398 successfully completed the interview; giving a response rate of 92.6%. Of these 398 patients, 345(86.7%) resided in the Tamale metropolis. Among the respondents, 380 (95.5%) had type 2 DM, 14 (3.5%) had type 1 DM, and 4 (1.0%) had gestational DM. The proportion of CAM use among respondents was 32.7% (130/398). Figure 4 displays their patronage of CAM use.



**Figure 5: Status of CAM use among respondents**

#### 4.2 Socio-demographic characteristics of respondents and CAM use

The ages of respondents ranged from 16 to 89 years; with an average age of  $57.1 \pm 13.0$  years. Majority of respondents were females 289 (72.6%), and married 284 (71.4%). The socio-demographic characteristics of respondents are summarized on Tables 4a and 4b.

**Table 4a: Socio-demographic characteristics of the respondents and their associations with CAM use**

<b>Characteristic</b>	<b>Overall Total (N=398)</b>	<b>CAM users (n=130)</b>	<b>CAM non-users (n=268)</b>	<b>Crude OR (95% CI)</b>	<b><math>\chi^2</math></b>	<b>p- value</b>
<b>Hospital</b>					4.43	0.11
TTH	182(45.7)	68(37.4)	114(62.6)	1		
TCH	99(24.9)	25(25.3)	74(74.7)	1.77(1.02-3.04)		
TCW	117(29.4)	37(31.6)	80(68.4)	1.29(0.79-2.11)		
<b>Age Group</b>					3.77	0.15
< 45	55(13.8)	21(38.2)	34(61.8)	1		
45-60	196(49.3)	55(28.1)	141(71.9)	1.58(0.85-2.96)		
>60	147(36.9)	54(36.7)	93(63.3)	1.06(0.56-2.01)		
<b>Sex</b>					0.66	0.42
Male	109(27.4)	39(35.8)	70(64.2)	1		
Female	289(72.6)	91(31.5)	198(68.5)	1.2(0.76-1.93)		
<b>Marital Status</b>					1.91	0.59
Married	284(71.4)	92(32.4)	192(67.6)	1		
Single	20(5.0)	9(45.0)	11(55.0)	0.60(0.23-1.46)		
widow/widower	81(20.3)	26(32.1)	55(67.9)	1.01(0.60-1.72)		
Divorced/Sepa- rated	13(3.3)	3(23.1)	10(76.9)	1.60(0.43-5.94)		
<b>Residential Location*</b>					4.86	<b>0.03</b>
Outside Tamale						
Metropolis	58(14.6)	26(44.8)	32(55.2)	1		
Within Tamale						
Metropolis	340 (85.4)	104(30.6)	236(69.4)	1.92(1.09-33.33)		
<b>Educational Level*</b>					12.38	<b>0.03</b>
Non-literate	209(52.5)	63(30.1)	146(69.9)	1		
Basic	99(24.9)	34(34.3)	65(65.7)	0.82(0.50-1.37)		
Secondary	35(8.8)	15(42.9)	20(57.1)	0.57(0.28-1.20)		
Post						
Sec/Voc/Tech	6(1.5)	2(33.3)	4(66.7)	0.86(0.15-4.83)		
Bachelor's						
Degree	32(8.0)	15(46.9)	17(53.1)	0.50(0.23-1.04)		
Postgraduate	17(4.3)	1(5.9)	16(94.1)	6.90(0.90-53.19)		

\* Respondent's characteristic with significant association to CAM use

**Table 4b: Socio-demographic characteristics of the respondents and their associations with CAM use**

Characteristic	Overall	CAM		Crude OR (95% CI)	$\chi^2$	p-value
	Total (N=398)	CAM users (n=130)	non-users (n=268)			
<b>Employment Status *</b>					4.19	<b>0.04</b>
Employed	283 (71.1)	101 (35.7)	182 (64.3)	1		
Unemployed	115 (28.9)	29 (25.2)	86 (74.8)	1.64(1.01-2.70)		
<b>Health Insurance Status*</b>					4.45	<b>0.03</b>
Uninsured	9 (2.3)	6 (66.7)	3 (33.3)	1		
Insured	389 (97.7)	124 (31.9)	265 (68.1)	4.27 (1.05-17.37)		
<b>Monthly Income (GH¢)</b>					0.34	0.84
≤ 500	109 (61.9)	33 (30.2)	76 (69.7)	1		
501-2000	55 (31.3)	25 (45.5)	30 (55.5)	1.14 (0.60-2.16)		
> 2000	12 (6.8)	5 (41.7)	6 (58.3)	1.38 (0.40-4.71)		

\* Respondent's characteristic with significant association to CAM use

From tables 4a and 4b, the residential location, educational level, employment status, and health insurance status of respondents were each significantly associated with CAM use ( $p < 0.05$ ). Compared to DM patients who lived outside the Tamale metropolis, those who lived within the metropolis had nearly twice the odds of using CAM (OR: 1.92; CI: 1.09-33.33). The unemployed patients had a 64% higher odds of using CAM compared to those employed (OR: 1.64; CI: 1.01-2.70). Patients who possessed a valid health insurance had over a four-fold odds of using CAM compared with their uninsured counterparts (OR: 4.27; CI: 1.05-17.37). Having no formal education and receiving postgraduate education were positively associated with CAM use.

#### 4.3 History, Diagnosis, and Management DM among respondents

The average age at diagnosis among respondents was  $51.0 \pm 12.8$  years. On the average, respondents had been diagnosed of DM for  $6.0 \pm 5.5$  years preceding this study.

**Table 5: DM related characteristics of respondents and their associations with CAM use**

<b>Characteristic</b>	<b>Overall Total (N=398)</b>	<b>CAM users (n=130)</b>	<b>CAM non-users (n=268)</b>	<b>Crude OR (95% CI)</b>	<b><math>\chi^2</math></b>	<b>p-value</b>
<b>Type of DM</b>					5.5	0.06
Type 1	14(3.5)	2(14.3)	12(85.7)	1		
Type 2	380(95.5)	125(32.9)	255 (67.1)	2.94 (0.65-13.34)		
Gestational	4(1.0)	3(75.0)	1 (25.0)	18.00 (1.19-271.46)		
<b>Duration of DM (years)</b>					1.42	0.84
≤ 1	64 (16.1)	20 (31.3)	44 (68.7)	1		
1 < Duration ≤ 5	168 (42.2)	55 (32.7)	113 (67.3)	1.07 (0.58-1.99)		
5 < Duration ≤ 10	114 (28.6)	41 (36.0)	73 (64.0)	1.24(0.64-2.37)		
10 <Duration ≤ 15	22 (5.5)	6 (27.3)	16 (72.7)	0.83(0.28-2.42)		
> 15	30 (7.5)	8 (26.7)	22 (73.3)	0.80 (0.30-2.10)		
<b>Family History of DM</b>					0.46	0.50
With history	171 (43.0)	59 (45.4)	71 (54.4)	1		
Without history	227 (57.0)	112 (41.8)	156 (58.2)	0.86 (0.57-1.32)		
<b>Orthodox medicine used</b>					5.1	0.08
Insulin	11 (2.8)	1 (9.1)	10 (90.9)	1		
Oral						
Hypoglycaemics	336 (84.4)	108 (32.1)	228 (67.9)	4.74 (0.60-37.48)		
Both of above	51 (12.8)	21 (41.2)	30 (58.8)	0.68 (0.37-1.24)		
<b>Dietary Modifications*</b>					5.71	<b>0.02</b>
Diet modified	113(28.4)	27 (23.9)	86 (76.1)	1		
Diet not modified	285(71.6)	103 (36.1)	182 (63.9)	1.82(1.10-2.94)		
<b>Physical Exercise</b>					0.72	0.40
Exercised	233 (58.5)	80 (34.3)	153 (65.7)	1		
Did not Exercise	165 (41.5)	50 (30.3)	115 (69.7)	0.83 (0.54-1.28)		
<b>Complications Status</b>					3.28	0.07
No complication	54 (13.6)	12 (22.2)	42 (77.8)	1		
Complication	344 (86.4)	118 (34.3)	226 (65.70)	1.07 (0.99-1.15)		
<b>Number of Complications</b>						
None	54 (13.6)	42 (77.8)	12 (22.2)	1	3.43	0.18
1-2 complications	170 (42.7)	110 (64.7)	60 (35.3)	1.91 (0.93-3.90)		
≥3 complications	174 (43.7)	116 (66.7)	58 (33.3)	1.75 (0.85-3.58)		

\* Respondent's characteristic with significant association to CAM use

The practice of dietary modification for the control of DM as shown on table 5 was significantly associated with CAM use ( $\chi^2 = 5.71$ ;  $p = 0.02$ ). Compared with DM patients who did not practice any form of dietary modification, those who modified their diet in order to improve glucose control had about twice the odds of using CAM (OR: 1.82; CI: 1.10-2.94). Type 2 DM patients had a three times odds of patronizing CAM compared with their type 1 counterparts (OR; 2.94; CI: 0.65-13.34). Compared with insulin, the use of oral hypoglycaemic agents for the management of DM had nearly five (5) times the odds of CAM use. Metformin, glibenclamide, glimepiride, and glipizide were the common orthodox oral hypoglycaemic agents prescribed at the diabetic clinics from which patients were recruited. Respondents who had any type of DM complications had a slightly higher odds of CAM use compared with those without any DM complications (OR: 1.07; CI: 0.99-1.15).

#### **4.4 Correlates of CAM use among respondents**

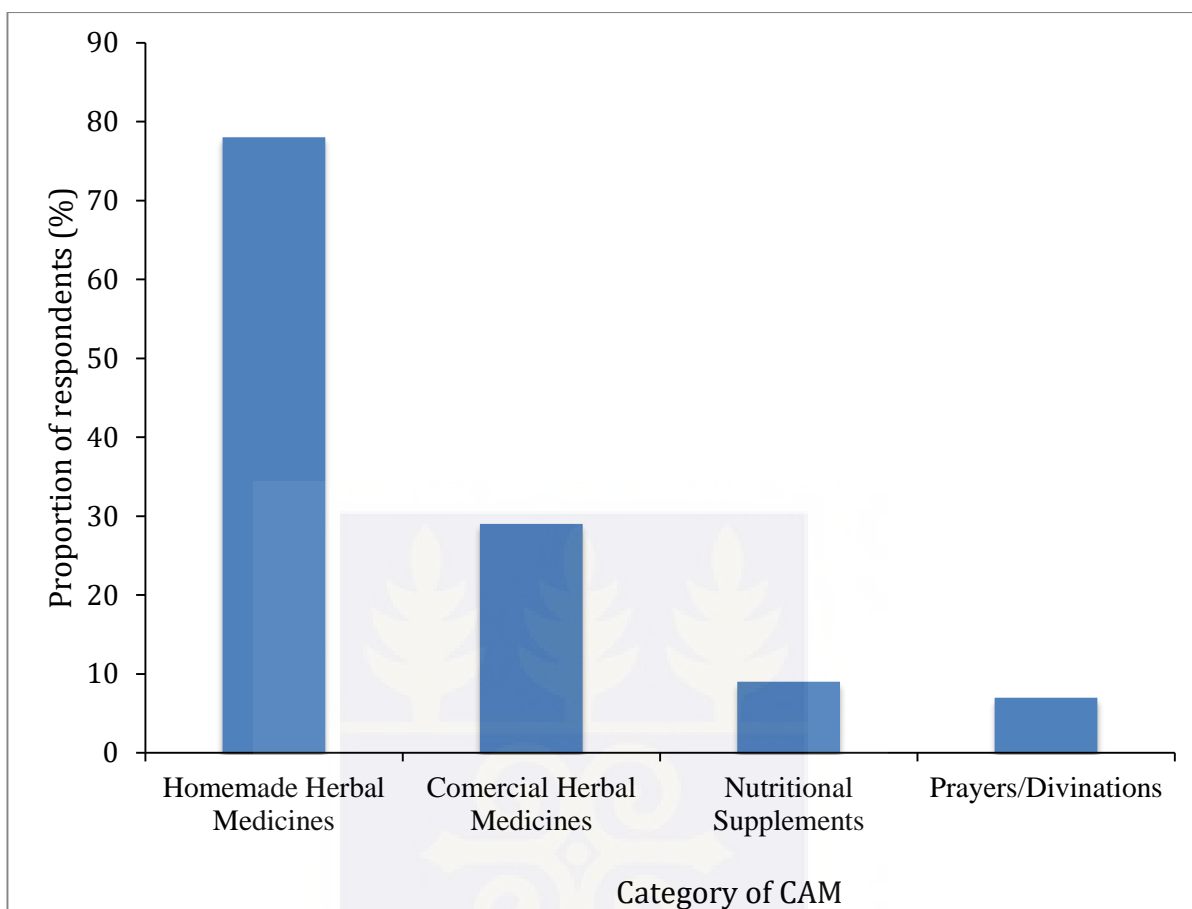
On multiple logistic regression, seven variables contributed to a model that significantly predicted CAM use among respondents (Table 6). Respondents who resided within Tamale metropolis had a significantly higher adjusted odds of CAM use (adjusted OR: 2.04; CI: 1.12-3.70). The remaining six variables that contributed to the overall better fit of the model were: the practice of dietary modification, educational level, health insurance status, employment status, type of DM, and DM complications status.

**Table 6: Correlates of CAM use among respondents on multiple logistic regression**

<b>Characteristic</b>	<b>Crude OR (95% CI)</b>	<b>Adjusted OR (95% CI)</b>
<b>Residence #</b>		
Outside Tamale Metropolis	1	1
Within Tamale Metropolis	1.92(1.09-33.33)	<b>2.04 (1.12-3.70)</b>
<b>Dietary Modification</b>		
Diet modified	1	1
Diet not modified	1.82(1.10-2.94)	1.54 (0.90-2.61)
<b>Educational Level</b>		
Illiterate	1	1
Basic	0.82(0.50-1.37)	0.99 (0.57-1.71)
Secondary	0.57(0.28-1.20)	0.76 (0.34-1.68)
Post Sec/Voc/Tech	0.86(0.15-4.83)	1.03 (0.18-5.91)
Bachelor's Degree	0.50(0.23-1.04)	0.66 (0.30-1.48)
Postgraduate	6.90(0.90-53.19)	7.66 (0.96-61.16)
<b>Health Insurance Status</b>		
Uninsured	1	1
Insured	4.27 (1.05-17.37)	3.79 (0.89-16.16)
<b>Employment Status</b>		
Employed	1	1
Unemployed	1.64(1.01-2.70)	1.54 (0.92-2.63)
<b>Type of DM</b>		
Type 1	1	1
Type 2	2.94(0.65-13.34)	0.47 (0.01-2.28)
Gestational	18 (1.19-271.46)	0.10 (0.01-1.44)
<b>DM Complications Status</b>		
Without complications	1	1
With complications	1.07 (0.99-1.15)	0.95 (0.88-1.03)

# Independent significant predictor of CAM use

#### 4.5 Types and Sources of CAM used by the Respondents



**Figure 6: Categories of CAM used by respondents**

Of the 130 CAM users, 78% (101) used indigenous homemade herbal medicines, and 29% (38) used commercially prepared herbal medicines. The main sources of CAM included herbs obtained from: backyard gardens, farms, the wild bush, herbalists, pharmacy shops, and drug peddlers.

#### 4.6 Biologically based CAM used by respondents

The most common biologically based CAMs used by respondents were poorly identified herbal concoctions, 36.9% (48) (Table 7). Nearly 60% (77) of all CAM users among the respondents had tried one form of bitters or the other. Some respondents used more than one type of CAM. Most respondents used more than one type of biologically based herbal preparation. For easy comparison of their popularity, the total number of CAM users (n=130) is used as the denominator.

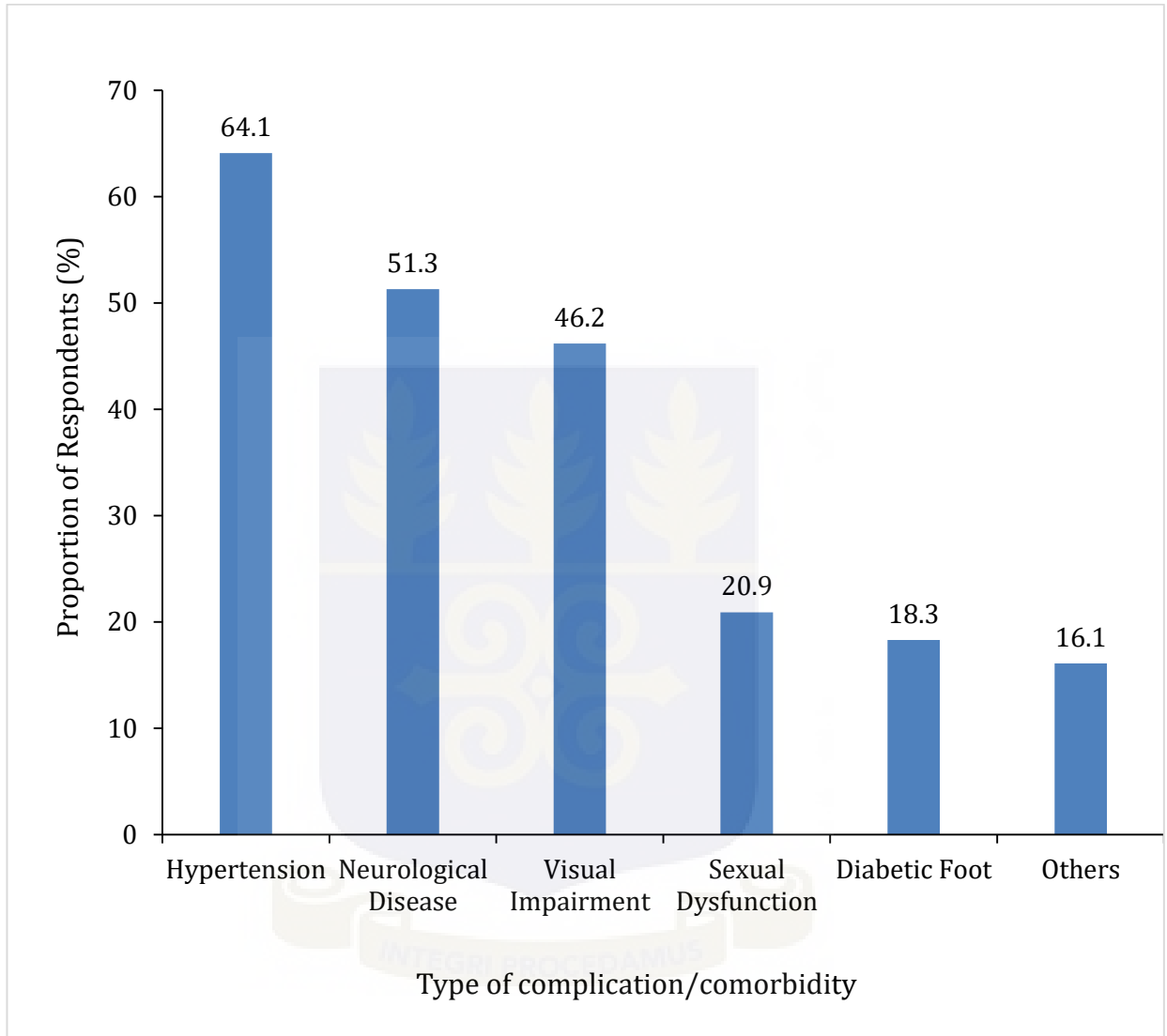
**Table 7: Common biologically based herbal preparations used by respondents.**

Biologically Based Preparation	Number(n=130)	Proportion (%)
Herbal concoctions (un-named)	48	36.9
Bitter cola	39	30.0
Azara Tampilin bitters	32	24.6
Bitters (un-named)	31	23.8
Commercial herbal mixtures	27	20.8
Neem tree leaf extract	24	18.5
Pawpaw leaf extract	22	16.9
Dawadawa spice	19	14.6
Dandelion leaf extract	18	13.8
Mango leaf & bark extract	17	13.1
Afa Ali bitters	14	10.8
Bitter leaf	13	10.0
Aloe Vera gel	11	8.5
Chinese tea	8	6.2

#### 4.7 Diabetes Mellitus related Complications among the Patients

The most common complication or comorbidity among them was hypertension (Figure 7).

The average number of complications per patient was  $2.5 \pm 1.2$ .



**Figure 7: Distribution of DM related complications/comorbidities among respondents**

#### 4.8 Attitudes and Experiences of Patients who used CAM

Table 8 summarizes the attitudes and experiences of the 130 CAM users in my study.

**Table 8: Experiences with CAM among CAM users**

Experiences with CAM use	(n=130)	%
Friends are main source of information on CAM	64	49.2
Mass media (TV and Radio) are main source of information on CAM	54	41.5
Consulted /informed a doctor about CAM use	21	16.2
Visited CAM practitioner Once since diagnosis	34	26.2
Visited CAM practitioner several times since diagnosis	88	67.7
Used CAM Daily	66	50.8
Used CAM Weekly	16	12.3
Used CAM Occasionally	40	30.8
Used CAM only once previously	8	6.2
Ever experienced Adverse effects	9	6.9
Cannot tell if they ever experienced Adverse Effects of CAM	27	20.8
Improvement of DM symptoms /Satisfied with CAM	89	68.5
Will recommend CAM to other DM patients	78	60.0
Will continue to use CAM in the future	78	60.0
Do not consider using CAM in the future	27	20.8
May use CAM in the future	25	19.2

Of the 130 CAM users, only 21 (16.2%) of them had either informed or discussed their decision to use CAM with their doctors and other healthcare workers from whom they

received medical care. The commonest reason for CAM use was for experimentation (43.1%); followed by recommendation by friends (38.5%). Only 4.8% of respondents were referred to use CAM by their orthodox health practitioners. On the average, about 51% (66) of them used CAM on a daily basis. Of all the CAM users, about 68.5% (89) indicated that they were satisfied with the CAM they used because they experienced improvement in their symptoms. Nearly 7% (9) of the CAM users had experienced at least one episode of adverse reaction from biologically based CAM. Their main concerns about biologically based CAM were: fear of the risk of adverse effects 40.9% (53), and lack of trust in CAM 39.2% (51).

#### **4.9 Cost Estimation of Orthodox Medicines and CAM Treatments**

Among the CAM users, 48.5% (63) spent money to buy CAM that were not homemade. Their monthly CAM expenditure ranged from GH¢ 5.00 to GH¢ 206.00; with a mean expenditure of GH¢  $24.77 \pm 30.59$ . This expenditure represents about 3% of their average monthly income (GH¢  $843.89 \pm 1256.89$ ). The corresponding monthly expenditure on orthodox medicine as paid by health insurance, ranged from GH¢ 1.80 to GH¢ 126.00; with a mean of GH¢  $45.01 \pm 29.58$ . A paired t - test for a difference between the mean monthly expenditures on CAM and orthodox medicine revealed that CAM was cheaper than orthodox medicines ( $p = 0.0001$ ).

## CHAPTER FIVE

### DISCUSSION

Complementary and Alternative Medicine use has become an important aspect of the management of chronic diseases such as DM. This study sought to estimate the proportion of CAM use, the modes of use, determine its correlates, and estimate the costs of CAM therapies among DM outpatients of the Tamale metropolis.

#### **5.1 Prevalence of Complementary and Alternative Medicine use among persons**

##### **living with Diabetes Mellitus**

The distribution of the types of diabetes among the patients was typical; about 95.5% (380) were type 2, 3.5% (14) type 1 DM, and 1% (4) gestational DM. The study reveals that 32.7 % of the respondents used CAM to complement orthodox treatment. Similar studies in other countries have reported varying prevalence of CAM use among DM patients. Compared to the findings of this study, higher prevalence of CAM use was reported in studies conducted in Asia viz. South Korea; 65% (Lee et al., 2004), Thailand; 47.8% (Sripa, 2005), India; 67.7% (Hasan, et al., 2009), Taiwan; 61% (Chang et al., 2010), and Sri Lanka; 76% (Medagama et al., 2014). In Mexico and Nigeria also, higher prevalence of 62% (Argáez-López et al., 2003), and 46% (Ogbera et al., 2010) respectively were reported. On the other hand, lower prevalence of CAM use was found in similar studies in Jordan; 16.6 % (Wazaify et al., 2011), and Australia; 23.6% (Clifford et al., 2003), and South Korea (Kim et al., 2011). Comparable findings to the estimated prevalence of 32.7% in this study are from studies in Canada; 31% (Ryan et al., 2001), Saudi Arabia; 33.3% (Al Saeedi et al., 2003), South Africa; 38.5% (Singh et al., 2004), and Lebanon; 38% (Naja et al., 2014).

These wide variations in the prevalence of CAM use could be explained in part by differences in the perceptions of CAM across cultures and geographical locations around the globe. In this study, the 32.7% proportion of CAM use could be an under-estimation because, patients are routinely reprimanded by orthodox healthcare practitioners for using herbal concoctions; yet these form the bulk of the CAM used in this study. Furthermore, the study was hospital based and interviews conducted by healthcare personnel. The high nondisclosure rate of CAM use by these patients is suggestive of this possible under-estimation.

In a study to evaluate ethnic differences in CAM use among persons with DM, Villacaballero et al., (2010) found that the prevalence of all forms of CAM was higher among Caucasians, African Americans, and Hispanics on one hand, compared to Pacific Islanders, Asians, and other ethnic minorities on the other. In this same study, Villacaballero et al. found significant ethnic differences regarding the prevalence of some particular forms of CAM. For example, they found that the use of prickly pear (nopal) was more prevalent among Hispanics living with DM; while multivitamins were more prevalent among their Caucasians counterparts. These findings are consistent with those of Arcury et al., (2006), whose study of CAM use in a multi-ethnic population revealed that the prevalence of CAM use was a function of culture; where its practice was an integral part of the health maintenance strategy of some rural American ethnic groups.

The variation in the prevalence of CAM use is also attributable to differences in study designs, and the heterogeneity of CAM practices. Thus, estimates of CAM use will vary depending on the scope of CAM therapies being considered in any given study. For example, even though Lee et al., (2004) reported a 65% prevalence of CAM use in Korea, Kim et al., (2011) reported a 24% prevalence in the same country when manipulation-

based therapies and mind–body medicine were excluded from their definition of CAM.

Furthermore, some studies surveyed all types of DM among all ages whilst others focused only on type 2 DM among persons aged 18 years and older. For example, even though both the Sri Lankan and Malaysian studies focused on only type 2 DM patients, the former surveyed the use of non-commercial types of biologically based remedies only (Medagama et al., 2014); whilst the later captured the entire spectrum of CAM (Ching et al., 2013).

For any given scope of CAM defined too, studies define a CAM user differently. A CAM user has been variously defined as one who has used CAM in the preceding three months (Ching et al., 2013; Sripa, 2005), or in the preceding year (Singh et al., 2004), or since the diagnosis of DM (Naja et al., 2014). In this study, I defined CAM as the use of all forms of CAM since diagnosis, and in all persons living with any type of diabetes. This definition is made this wide so that it will be very sensitive in capturing CAM use.

## **5.2 Socio-demographic characteristics and CAM use**

In this study, dwellers in the urban part of the metropolis are twice more likely to use CAM compared with their counterparts from the rural settlements around it. Indeed, the difference in place of dwelling of respondents is the most significant independent predictor of CAM use. A similar finding where urban dwellers were more likely to use CAM compared with their rural counterparts was reported among Turkish diabetes patients (Ceylan et al., 2009). Given that biologically based CAM remedies were the most popular among the respondents, this observation may be attributed to the ready availability of supplies in the relatively larger markets of urban areas. Door to door, and office to office drug peddling is common place in the Tamale metropolis. This could also partly

explain the higher odds of CAM use among respondents who reside within Tamale metropolis. They may also tend to have greater networks of friends and relatives who share information on the sources of, and their experiences with CAM. There are many media outlets within the metropolis that constantly run unfettered radio and TV commercials on many of these herbal remedies despite efforts made by regulatory bodies such as the Traditional Medicine Practice Council (TMPC) to stem these practices. This media presence, can also be a contributing factor to CAM uptake among urban dwellers especially.

This study also reveals that CAM use was more common among respondents aged 45 to 60 years; compared to both younger and older age groups. This finding contrasts with reports from similar studies where CAM use was more common among DM patients aged above 60 years in the USA (Bell et al., 2006; Egede et al., 2002), and in South Korea (Lee et al., 2004). It also contrasts with reports from studies among Turkish DM patients (Ceylan et al., 2009) and South Korean DM patients (Kim et al., 2011); where CAM use was more common among DM patients younger than 45 years. Yet, other researchers did not find any correlations between age and CAM use (Singh et al., 2004). Thus, the influence of age on CAM use may still be inconclusive.

Formal education and employment status serve as proxies to the socioeconomic status (SES) of individuals in many societies. In this study, respondents who earn more than GH¢ 500 (US\$ 116) per month are increasingly more likely to use CAM compared to those who earn less (Table 4b). For example, relative to those who earn less than GH¢ 500 (US\$ 116) per month, both those who earn between GH¢ 500 (US\$ 116) and GH¢ 2000 (US\$ 465), and those who earn more than GH¢ 2000 (US\$ 465) per month, have higher odds of CAM use. Even though the literature is not conclusive on SES being a predictor of

CAM use, it suggests that societies with appreciable populations in the middle and upper classes tend to favour CAM use. For example, for most regions of North America and Western Europe, a high SES was found to be a positive predictor of CAM use (Verhoef, Balneaves, Boon, & Vroegindewey, 2005). Conversely, in Turkey and Hawaii a low SES was a positive predictor of CAM use (Verhoef et al., 2005).

The educational status of respondents shows some interesting patterns of CAM use, where all respondents with some formal education from basic through to a bachelor's degree are less likely to use CAM compared to their counterparts without formal education, and those with postgraduate degree. This finding is consistent with those reported from our next-door neighbour - Nigeria (Obgera et al., 2010) and from the USA (Bell et al., 2006; Egede et al., 2002) where highly educated persons; usually of high SES, patronized nutritional supplements more than those of lower SES. The reason for this observation among our respondents could be that the average Ghanaian elite is more health conscious. Furthermore, their access to information, employment in white colour jobs, coupled with their ability to afford western life styles, could be contributory factors. This can be seen in the consistency of this finding between these Ghanaian respondents and those from the USA. Nutritional supplements are widely marketed in urban Ghana and are largely perceived as the preserve of the elite class who are better able to afford them also. The ability to afford some exclusive forms of CAM has been identified as a driver of CAM use (Arcury et al., 2002; Spinks et al., 2013).

Another interesting finding is that, health insured patients among respondents in this study had 5 times significantly higher odds of using CAM ( $p = 0.03$ ); a finding reported by Spinks et al. (2013) in their investigation of the costs and drivers of CAM use in people with type 2 diabetes in Australia. This statistically significant positive correlation between

the health insurance status and CAM use in this study suggests that, insured persons who their orthodox treatments covered may have additional money to explore CAM in their efforts to gaining the best quality of life possible. Yet, Spinks et al. demonstrated that, overall, CAM use is associated with poor quality of life. Contrary to this key finding, a study on the differences in access to health care services between insured and uninsured adults with diabetes in Mexico (Pagan & Puig, 2005), and another study on the prevalence and correlates of CAM use among diabetic patients in Lebanon (Naja et al., 2014), each found a negative correlation between CAM use and the possession of health insurance cover.

Albeit statistically insignificant, this study reveals that females are more likely to use CAM. This finding is consistent with many reports of a positive correlation between the female sex and CAM use (Clifford et al., 2003; George, 2001; Najm et al., 2003; Spinks et al., 2013). Generally, the literature concludes that these findings hold because, women from all cultural backgrounds and socioeconomic classes tend to care more about their health and take initiatives towards improving their disease prognoses.

### **5.3 DM related characteristics and CAM use**

This study also demonstrates that, the duration of disease among respondents is positively associated with CAM use for only up to 10 years from the time of diagnosis. Beyond 10 years, respondents are less likely to use CAM. This finding is consistent with results from similar studies only to some extent because, these previous studies reported continuous positive correlations between longer periods of disease and CAM use (Argáez-López et al., 2003; Bell et al., 2006). The findings from my study suggest that respondents embraced CAM in their initial enthusiasm to keep their DM in check, but possibly did not get the expected benefits after a decade of trying various options. In a related finding, at

least 7% of CAM users from this study recalled some adverse effects of CAM, and 31.5% of respondents who used CAM indicated their expectations were not met. Unmet expectations, coupled with adverse effects from CAM, could be contributory factors to the waning patronage of CAM with durations of disease beyond a decade.

The study results further demonstrate that, type 2 DM respondents are three times more likely to use CAM compared with their type 1 counterparts. One would have thought that because insulin injection is invasive and unpleasant compared with oral hypoglycaemic medicines, type 1 DM patients would indulge CAM more. However, the results point to the contrary. The reason could be that, the type 1 DM patients learned very early in their disease, through severe symptoms and rapid onset of acute complications, that insulin cannot be substituted for by CAM. This would then have reduced their trust in CAM compared with type 2 patients whose glycaemic control takes longer to derail following poor adherence to orthodox regimen.

Also, CAM users from this study who oblige to orthodox recommendations on lifestyles modification such as dietary modification and physical exercise are also more likely than the others to use CAM. The results show that, the practice of dietary modification is a significant predictor of CAM use. The reason could be that, these set of respondents have an attitude of wanting to do more to improve their condition. It can therefore be inferred that, this attitude of self-help may drive them to explore CAM, all in their passion to stay healthier.

#### **5.4 Types and sources of CAM for DM**

Indigenous homemade herbal medicines are the most popular category of CAM; with a patronage of nearly 8 of every 10 respondents. These indigenous homemade herbal

medicines refer to foods and herbal remedies that form part of the longstanding traditional healing systems of Ghanaians. These herbs are harvested from backyard gardens, farms, and the wild bush; and prepared at home for use. Common examples of homemade herbs include boiled liquid extracts from the leaves of: neem (*Azadirachta indica*), pawpaw (*Carica papaya*), and mango (*Mangifera indica*). The liquid extract from neem leaves increases insulin secretion by pancreatic  $\beta$  cells and regenerates the insulin producing  $\beta$  cells (Jelodar et al., 2005). Sangeetha et al., (2010) demonstrated that mango leaf extract contains 3 $\beta$ -taraxerol, which enhances insulin induced glucose uptake through translocation of the glucose transporter, GLUT 4. This finding is very much in keeping with reports of CAM use among respondents from: South Africa (Singh et al., 2004), Lebanon (Naja et al., 2014), and Sri Lanka (Medagama et al., 2014); where their popular CAM were mostly obtained from readily available plant species in their respective countries. Until recently, bitter leaf (*Vernonia amygdalina*) was used as the main component of a vegetable soup. With the rising prevalence of DM and the search for natural remedies, local folks have now recognized its antidiabetic property and it has since become just more than a vegetable. The medicinal reputation of bitter leaf has also been reported by Ogbera et al. (2010) among persons living with DM in Nigeria.

Unlike the afore-stated medicinal plants that are known by the general community, there is yet another sub-group of herbal medicines that are prepared as concoctions by local spiritual herbalist. The hallmark of these spiritual herbalist is the shrouding of their concoctions in mystery. Some assert that, the knowledge and skills used to make these concoctions have been handed down to them by their ancestors and passed on from generation to generation along their family lines (Ogbera et al., 2010). They are particularly reluctant about discussing components of their concoctions (Ogbera et al., 2010).

### **5.5 Reasons for using CAM**

The study results show that most common reason (43.1%) for CAM use is that, users want to experiment with CAM and satisfy themselves of their purported efficacies. The results indicate that only 4.8% of respondents are referred to use CAM by their orthodox health practitioners while 38.5% of CAM users used it based on recommendation by friends. Many (83.8%) did not disclose use of CAM to their healthcare practitioners; even though these patients were sampled from diabetic clinics run by these health practitioners. This is not particularly surprising because the literature is replete with comparable non-disclosure rates from Mexico (Argáez-López et al., 2003), Thailand (Sripa, 2005), Taiwan (Chang et al., 2010), Nigeria (Ogbera et al., 2010), and Lebanon (Naja et al., 2014). In this study, a permutation of three (3) main reasons for nondisclosure of CAM use were given by respondents viz. they did not think it necessary, fear of reprimand by healthcare practitioner, and failure of healthcare practitioner to enquire about their CAM use. These findings suggest that healthcare practitioners are either not fully awakened to the popularity of CAM use among their patients, or they are very complacent about the superiority of the orthodox treatment they offer. For these reasons therefore, they may not bother to ask about patients' attitudes towards CAM during routine consultations. There is therefore enough reason to worry about treatment adherence and possible drug-drug interactions, since all respondents who used CAM combined it with the orthodox treatment regimens. At least 7% of CAM users in this study have recalled adverse effects in the form of dizziness, palpitations, and confusion which could have been as a result of hypoglycaemia from the synergistic effects of orthodox medications and some CAM therapies.

### **5.6 Cost of CAM therapies**

In this study, given that 97.7% of respondents had a valid health insurance cover, it is unlikely that cost of orthodox medicine, can be a contributory factor to CAM use. Even though the study findings indicate that CAM is significantly cheaper than orthodox medicines, these respondents do not make out-of-pocket payments owing to their insurance cover. Contrary to this finding, the high cost of orthodox medicines for the management of DM has been cited severally as contributing to CAM use in the USA (Astin, 1998), Australia (Verhoef et al., 2004), South Korea (Lee et al., 2004), and Turkey (Ceylan et al., 2009).

The average monthly out-of-pocket expenditure of our respondents on CAM was GH¢ 24.77 (US\$ 6.00). This is fairly comparable to their counterparts in Thailand, where the average out of pocket expenditure on CAM was \$8.58 (Sripa, 2005); but nearly one third (US\$ 16.9) reported from a Malaysian study (Ching et al., 2013). Furthermore, with less than the average cost of US\$ 6.00 that the respondents spend on CAM per month, one can secure a national health insurance cover for a whole year in Ghana. This is because the state has subsidized the premiums for securing an insurance cover for all members.

### **5.7 Consequences of CAM use among Diabetes Mellitus Patients**

Given the disproportionate number of CAM users in this study who patronize herbal medicines from various sources, there are legitimate concerns about the poor knowledge of active ingredients of these concoctions. Many of these concoctions are homemade. Hence, there is no guarantee that standard manufacturing procedures are adhered to. The use of some CAM is generally accepted to pose health risks through: their intrinsic toxicity, toxicity of impurities contained therein, their interaction with other drugs, and the risk of reducing adherence to proven orthodox therapy, (Ventola, 2010).

The issue of herbal drug contamination - inadvertent or deliberate, has also been widely reported. Some commonly used Ayurvedic medicines that are marketed online have been reported to contain lethal levels of lead, arsenic, and mercury (Saper et al., 2008). The Centers for Disease Control and Prevention (CDC), USA, has implicated some Ayurvedic medicines in cases of lead poisoning among pregnant women (CDC. 2012). Glibenclamide was also found as a contaminant of some Indian herbal medicines (Padinjakara, Ashawesh, Butt, Nair, & Patel, 2009). In even a worse case, phenformin, a banned substance, was found in some Chinese proprietary medicines marketed under the trade name “wonder pill” (Koh & Woo, 2000).

All the CAM users in this study co-administered herbal medicines and nutritional supplements with orthodox medicines such as metformin, glibenclamide, glimepiride, glipizide. The pharmacokinetic and pharmacodynamics effects of these oral hypoglycaemic medicines can be altered by herbal medicines in ways that result in adverse effects (Rehman, Choi, Choe & Yoo, 2015). In the short term, these adverse effects may threaten the lives of victims in acute events of hypoglycaemia through drug-herb synergistic effects. In the long term, adverse effects could lead to poor disease prognosis through persistent hyperglycaemia caused by reduced drug bioavailability and drug-herb antagonistic effects (Izzo & Ernst, 2009).

Some of the long term complications of DM among our respondents included hypertension, strokes, diabetic foot, visual impairment, chronic kidney disease, and sexual dysfunction. All these reduce economic productivity and take away from their quality of life patients (Spinks et al., 2013). Ultimately, these result in higher costs of healthcare for the state in face of an already stretched national healthcare budget.

Non-biologically based CAM are not free of consequences either. Chiropractic manipulations of the spine have been reported to cause arterial dissection (Ernst, 2001). Non-compliance with, or failure of the aseptic technique has resulted in serious infections such as hepatitis, HIV, and sub-acute bacterial endocarditis (Ernst & White, 1997). Fortunately, these forms of CAM are not found among users of CAM in this study. Instead prayer/divination was practised by at least 7% of respondents in this study. Depending on the way that prayer is practised, it could also have detrimental effects as a form of CAM. In clinical practice in Ghana, it is not uncommon for patients to present with diabetic ketoacidosis (DKA), or hypoglycaemia from prayer camps where these prayers/divinations take place.

Even though CAM is being integrated to the healthcare system in Ghana, the co-administration of unapproved complementary and orthodox medicines poses dangers of drug-herb interactions, and poor adherence to proven therapies. The consequence of this practice is poor glycaemic control with its attending acute and long term complications.

### **5.8 Limitations of the Study**

The study was hospital based and could not capture data on CAM use among persons living with DM in the general population. Hence the external validity of the findings may be applicable to only those DM patients attending other diabetic clinics.

Also, respondents were interviewed at their respective clinics by healthcare practitioners. Well aware of the biases of these professionals towards CAM, it cannot be guaranteed that respondents did not alter their true experiences with CAM use in order to please their interviewers. Thus, the social desirability bias might have affected the sincerity of their responses, and hence the veracity of the study results.

There was also the potential of recall bias, however, the review of medical records alongside the administration of the questionnaires in order to triangulate the findings served to minimize this bias.

Nevertheless, the strength of this study rests in its contribution to evidence on CAM use among persons living with DM in Ghana.



## CHAPTER SIX

### CONCLUSION AND RECOMMENDATIONS

#### 6.1 Conclusion

CAM use is common among Diabetes Mellitus Outpatients of Tamale Metropolis. Homemade and commercial herbal concoctions are the most patronized CAM. Social networks and the electronic mass media are promoters of CAM use. Residing in an urban town, the practice of dietary modification for glycaemic control, having no formal education, receiving a postgraduate education, being unemployed, and living with type 2 DM strongly influence CAM use. CAM were significantly cheaper than orthodox medicines, and constituted a small fraction of the average monthly income of CAM users. Overall, majority of CAM users are satisfied with CAM.

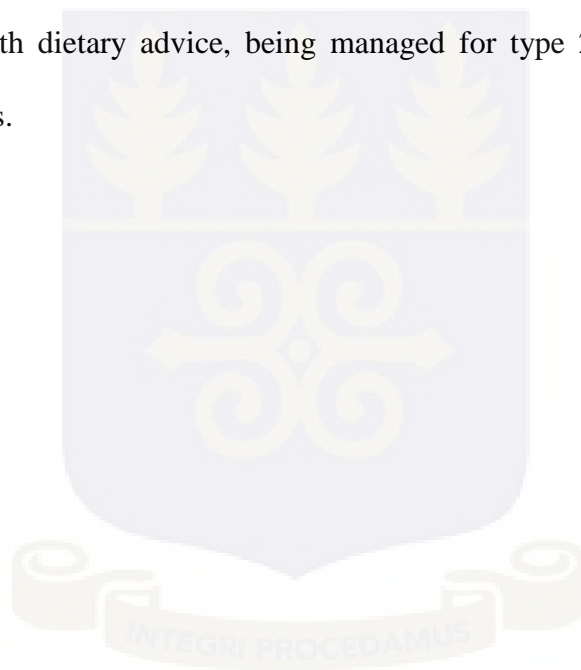
#### 6.2 Recommendations for policy and practice

Following from the findings of this study, the following are recommended:

1. The Ghana Health Service (GHS) should strategize to improve communication between patients and orthodox healthcare practitioners through in-service training in patient-doctor communication. Given the high non-disclosure rates about patients' CAM use, open communication between patients and their healthcare practitioners on the use of CAM should be encouraged in our health facilities by the facility management teams.
2. Health education to the public via mass media should be done by the health promotion unit of GHS. The public in general, and persons living DM in urban areas in particular, should be educated on the potential hazards of unlicensed CAM products and practices. The health promotion units at the regional, municipal, and

district health directorates should incorporate routine interactive health education programmes on radio and television into their annual work plans to raise awareness on CAM use.

3. Prescribers (physicians, physician assistants) and other healthcare workers who care for persons living DM should make an extra effort to enquire and offer some health education on CAM use to all DM patients. However, in this regard, special attention should be paid to those who are: residents of urban areas, without formal education, unemployed, holders valid health insurance, aged 45 years or older, compliant with dietary advice, being managed for type 2 DM, and DM related complications.



## REFERENCES

- Abuaisha, B. B., Costanzi, J. B., & Boulton, A. J. M. (1998). Acupuncture for the treatment of chronic painful peripheral diabetic neuropathy: a long-term study. *Diabetes research and clinical practice*, 39(2), 115-121.
- Agarwal, V. I. P. I. N., Sharma, A. K., Upadhyay, A. N. S. H. U., Singh, G. O. P. E. N. D. R. A., & Gupta, R. A. J. I. V. (2012). Hypoglycemic effects of *Citrullus colocynthis* roots. *Acta Pol Pharm*, 69(1), 75-9.
- Aikins, A. D. G. (2006). Reframing applied disease stigma research: a multilevel analysis of diabetes stigma in Ghana. *Journal of community & applied social psychology*, 16(6), 426-441.
- Ajabnoor, M. A. (1990). Effect of aloes on blood glucose levels in normal and alloxan diabetic mice. *Journal of ethnopharmacology*, 28(2), 215-220.
- Akhani, S. P., Vishwakarma, S. L., & Goyal, R. K. (2004). Anti-diabetic activity of *Zingiber officinale* in streptozotocin-induced type I diabetic rats. *Journal of pharmacy and Pharmacology*, 56(1), 101-105.
- Al Saeedi, M., El Zubier, A. G., Bahnassi, A. A., & Al Dawood, K. M. (2003). Patterns of belief and use of traditional remedies by persons living with DM in Mecca, Saudi Arabia.
- Ali-Shtayeh, M. S., Jamous, R. M., & Jamous, R. M. (2012). Complementary and alternative medicine use amongst Palestinian diabetic patients. *Complementary Therapies in Clinical Practice*, 18(1), 16-21.
- Al-Shamaony, L., Al-Khazraji, S. M., & Twaij, H. A. (1994). Hypoglycaemic effect *Artemisia herba alba*. II. Effect of a valuable extract on some blood parameters in diabetic animals. *Journal of Ethnopharmacology*, 43(3), 167-171.
- American Diabetes Association. (2014). Diagnosis and classification of diabetes mellitus. *Diabetes care*, 37(Supplement 1), S81-S90.
- Amoah, A. G., Owusu, S. K., & Adjei, S. (2002). Diabetes in Ghana: a community based prevalence study in Greater Accra. *Diabetes research and clinical practice*, 56(3), 197-205.
- Anand, P., Murali, K. Y., Tandon, V., Chandra, R., & Murthy, P. S. (2007). Preliminary studies on antihyperglycemic effect of aqueous extract of *Brassica nigra* (L.) Koch in streptozotocin induced diabetic rats.
- Ananthi, J., Prakasam, A., & Pugalendi, K. V. (2003). Antihyperglycemic activity of *Eclipta alba* leaf on alloxan-induced diabetic rats. *The Yale journal of biology and medicine*, 76(3), 97.
- Andallu, B., & Radhika, B. (2000). Hypoglycemic, diuretic and hypocholesterolemic effect of winter cherry (*Withania somnifera*, Dunal) root.

- Antwi-Baffour, S. S., Bello, A. I., Adjei, D. N., Mahmood, S. A., & Ayeh-Kumi, P. F. (2014). The Place of traditional medicine in the African society: The science acceptance and support. *American Journal of Health Research*, 2(2), 49-54.
- Arcury, T. A., Bell, R. A., Snively, B. M., Smith, S. L., Skelly, A. H., Wetmore, L.K., & Quandt, S. A. (2006). Complementary and alternative medicine use as health self-management: rural older adults with diabetes. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, 61(2), S62-S70.
- Arcury, T. A., Quandt, S. A., Bell, R. A., & Vitolins, M. Z. (2002). Complementary and alternative medicine use among rural older adults. *Complementary Health Practice Review*, 7(3), 167-186.
- Argález-López, N., Wachter, N. H., Kumate-Rodríguez, J., Cruz, M., Talavera, J., Rivera-Arce, E., & Lozoya, X. (2003). The use of complementary and alternative medicine therapies in type 2 persons living with DM in Mexico. *Diabetes care*, 26(8), 2470-2471.
- Astin, J. A. (1998). Why patients use alternative medicine: results of a national study. *Jama*, 279(19), 1548-1553.
- Astin, J. A., Pelletier, K. R., Marie, A., & Haskell, W. L. (2000). Aston, J. A., Pelletier, K. R., Marie, A., & Haskell, W. L. (2000). Complementary and alternative medicine use among elderly persons: one-year analysis. *J Gerontol Med Sci*, 55, M4-M9.
- Atlas, I. D. (2015). International Diabetes Federation, Brussels, 2015.
- Barnes, P. M., Powell-Griner, E., McFann, K., & Nahin, R. L. (2004, June). Complementary and alternative medicine use among adults: United States, 2002. In *Seminars in integrative medicine* (Vol. 2, No. 2, pp. 54-71). WB Saunders.
- Barr, E. L., Zimmet, P. Z., Welborn, T. A., Jolley, D., Magliano, D. J., Dunstan, D. W., ... Wong, T. Y. (2007). Risk of cardiovascular and all-cause mortality in individuals with diabetes mellitus, impaired fasting glucose, and impaired glucose tolerance. *Circulation*, 116(2), 151-157.
- Baskaran, K., Ahamath, B. K., Shanmugasundaram, K. R., & Shanmugasundaram, E. R. B. (1990). Antidiabetic effect of a leaf extract from *Gymnema sylvestre* in non-insulin-dependent diabetes mellitus patients. *Journal of ethnopharmacology*, 30(3), 295-305.
- Beagley, J., Guariguata, L., Weil, C., & Motala, A. A. (2014). Global estimates of undiagnosed diabetes in adults. *Diabetes research and clinical practice*, 103(2), 150-160.
- Bell, R. A., Suerken, C. K., Grzywacz, J. G., & Lang, W. (2006). Complementary and alternative medicine use among adults with diabetes in the United States. *Alternative therapies in health and medicine*, 12(5), 16.

- Bent, S., Tiedt, T. N., Odden, M. C., & Shlipak, M. G. (2003). The relative safety of ephedra compared with other herbal products. *Annals of Internal Medicine*, 138(6), 468-471.
- Benwahhoud, M., Jouad, H., Eddouks, M., & Lyoussi, B. (2001). Hypoglycemic effect of *Suaeda fruticosa* in streptozotocin-induced diabetic rats. *Journal of ethnopharmacology*, 76(1), 35-38.
- Birdee, G. S., & Yeh, G. (2010). Complementary and alternative medicine therapies for diabetes: a clinical review. *Clinical Diabetes*, 28(4), 147-155.
- Bisht, S., & Sisodia, S. S. (2011). Assessment of antidiabetic potential of *Cinnamomum tamala* leaves extract in streptozotocin induced diabetic rats. *Indian journal of pharmacology*, 43(5), 582.
- Braun, L., & Cohen, M. (2010). Herbs & Natural Supplements—An Evidence-based Approach.
- Carmona, G. A., Hoffmeyer, P., Herrmann, F. R., Vaucher, J., Tschopp, O., Lacraz, A., & Vischer, U. M. (2005). Major lower limb amputations in the elderly observed over ten years: the role of diabetes and peripheral arterial disease. *Diabetes & metabolism*, 31(5), 449-454.
- Centers for Disease Control and Prevention (CDC). (2012). Lead poisoning in pregnant women who used Ayurvedic medications from India--New York City, 2011-2012. *MMWR. Morbidity and mortality weekly report*, 61(33), 641.
- Ceylan, S., Azal, Ö., Taşlipinar, A., Türker, T., Açikel, C. H., & Gulec, M. (2009). Complementary and alternative medicine use among Turkish diabetes patients. *Complementary therapies in medicine*, 17(2), 78-83.
- Chang, H. Y. A., Wallis, M., & Tiralongo, E. (2010). Use of complementary and alternative medicine among people with type 2 diabetes in Taiwan: a cross-sectional survey. *Evidence-Based Complementary and Alternative Medicine*, 2011.
- Chang, H. Y., Wallis, M., & Tiralongo, E. (2007). Use of complementary and alternative medicine among people living with diabetes: literature review. *Journal of advanced nursing*, 58(4), 307-319.
- Chattopadhyay, R. R. (1993). Hypoglycemic effect of *Ocimum sanctum* leaf extract in normal and streptozotocin diabetic rats. *Indian journal of experimental biology*, 31(11), 891.
- Chen, F., Nakashima, N., Kimura, I., & Kimura, M. (1995). Hypoglycemic activity and mechanisms of extracts from mulberry leaves (*folium mori*) and cortex *mori radidis* in streptozotocin-induced diabetic mice. *Yakugaku zasshi: Journal of the Pharmaceutical Society of Japan*, 115(6), 476-482.
- Chen, J. F., & Wei, J. (1985). Changes of plasma insulin level in diabetics treated with acupuncture. *Journal of traditional Chinese medicine= Chung i tsa chih ying wen*

pan/sponsored by All-China Association of Traditional Chinese Medicine, Academy of Traditional Chinese Medicine, 5(2), 79-84.

- Ching, S. M., Zakaria, Z. A., Paimin, F., & Jalalian, M. (2013). Complementary alternative medicine use among patients with type 2 diabetes mellitus in the primary care setting: a cross-sectional study in Malaysia. *BMC complementary and alternative medicine*, 13(1), 148.
- Clifford, R. M., Batty, K. T., Davis, W., & Davis, T. M. (2003). Prevalence and predictors of complementary medicine usage in diabetes: Fremantle Diabetes Study. *Journal of Pharmacy Practice and Research*, 33(4), 260-264.
- Coulter, I. D., & Willis, E. M. (2004). The rise and rise of complementary and alternative medicine: a sociological perspective. *Medical Journal of Australia*, 180(11), 587-590.
- Dunning, T. (2014). Overview of complementary and alternative medicine and diabetes. *Practical Diabetes*, 31(9), 381-386.
- Eddouks, M., Lemhadri, A., & Michel, J. B. (2004). Caraway and caper: potential anti-hyperglycaemic plants in diabetic rats. *Journal of ethnopharmacology*, 94(1), 143-148.
- Egede, L. E., Ye, X., Zheng, D., & Silverstein, M. D. (2002). The prevalence and pattern of complementary and alternative medicine use in individuals with diabetes. *Diabetes care*, 25(2), 324-329.
- Ernst, E. (2000). Prevalence of use of complementary/alternative medicine: a systematic review. *Bulletin of the world health organization*, 78(2), 258-266.
- Ernst, E. (2001). Life-threatening complications of spinal manipulation. *Stroke*, 32(3), 809-810.
- Ernst, E. (2001). 'Neue Deutsche Heilkunde': complementary/alternative medicine in the Third Reich. *Complementary therapies in medicine*, 9(1), 49-51.
- Ernst, E., & White, A. (1997). Life-threatening adverse reactions after acupuncture? A systematic review. *Pain*, 71(2), 123-126.
- Espinoza, E. O., Mann, M. J., & Bleasdel, B. (1995). Arsenic and mercury in traditional Chinese herbal balls. *New England Journal of Medicine*, 333(12), 803-804.
- Ewins, D. L., Bakker, K., Young, M. J., & Boulton, A. J. M. (1993). Alternative medicine: potential dangers for the diabetic foot. *Diabetic medicine*, 10(10), 980-982.
- Ezike, A. C., Akah, P. A., Okoli, C. C., & Okpala, C. B. (2010). Experimental evidence for the antidiabetic activity of *Cajanus cajan* leaves in rats. *Journal of basic and clinical pharmacy*, 1(2), 81.

- Field, T., Hernandez-Reif, M., LaGreca, A., Shaw, K., Schanberg, S., & Kuhn, C. (1997). Massage therapy lowers blood glucose levels in children with Diabetes Mellitus. *Diabetes Spectrum, 10*, 237-239.
- Finney, L. S., & Gonzalez-Campoy, J. M. (1997). Dietary chromium and diabetes: is there a relationship? *Clinical Diabetes, 15*(1), 6-9.
- Garrow, D., & Egede, L. E. (2006). Association between complementary and alternative medicine use, preventive care practices, and use of orthodox medical services among adults with diabetes. *Diabetes care, 29*(1), 15-19.
- George, L. K. (2001). The social psychology of health. In R. H. Binstock & L. K. George (Eds.), *Handbook of aging and the social sciences* (pp. 217–237). San Diego: Academic Press.
- Gertner, E., Marshall, P. S., Filandrinos, D., Potek, A. S., & Smith, T. M. (1995). Complications resulting from the use of Chinese herbal medications containing undeclared prescription drugs. *Arthritis & Rheumatology, 38*(5), 614-617.
- Ghana Statistical Service (GSS)(2014), Tamale Metropolis. Available at: [www.statsghana.gov.gh/docfiles/2010\\_District.../Tamale%20Metropolitan.pdf](http://www.statsghana.gov.gh/docfiles/2010_District.../Tamale%20Metropolitan.pdf) [July 10, 2017]
- Ghosh, S., & Suryawanshi, S. A. (2001). Effect of Vinca rosea extracts in treatment of alloxan diabetes in male albino rats.
- Gill, G. V., Redmond, S., Garratt, F., & Paisey, R. (1994). Diabetes and alternative medicine: cause for concern. *Diabetic medicine, 11*(2), 210-213.
- Gray, A. M., & Flatt, P. R. (1998). Antihyperglycemic actions of Eucalyptus globulus (Eucalyptus) are associated with pancreatic and extra-pancreatic effects in mice. *The journal of nutrition, 128*(12), 2319-2323.
- Guariguata, L., Whiting, D. R., Hambleton, I., Beagley, J., Linnenkamp, U., & Shaw, J. E. (2014). Global estimates of diabetes prevalence for 2013 and projections for 2035. *Diabetes research and clinical practice, 103*(2), 137-149.
- Gupta, K., Chou, M. Y., Howell, A., Wobbe, C., Grady, R., & Stapleton, A. E. (2007). Cranberry products inhibit adherence of p-fimbriated Escherichia coli to primary cultured bladder and vaginal epithelial cells. *The Journal of urology, 177*(6), 2357-2360.
- Hjelm, K., & Atwine, F. (2011). Health-care seeking behaviour among persons with diabetes in Uganda: an interview study. *BMC International Health and Human Rights, 11*(1), 11.
- Hooper, P. L. (1999). Hot-tub therapy for type 2 diabetes mellitus. *New England Journal of Medicine, 341*(12), 924-925.
- Huang, K. C. (1996). *Acupuncture: the past and the present*. Vantage Press.

- Huang, W. F., Wen, K. C., & Hsiao, M. L. (1997). Adulteration by synthetic therapeutic substances of traditional Chinese medicines in Taiwan. *The Journal of Clinical Pharmacology*, 37(4), 344-350.
- Huri, H. Z., Lian, G. T. P., Hussain, S., Pendek, R., & Widodo, R. T. (2009). A survey amongst complementary alternative medicine (CAM) users with type 2 diabetes. *Int J Diabetes & Metabolism*, 17, 9-15.
- Hussain, Z., & Quigley, E. M. M. (2006). Systematic review: complementary and alternative medicine in the irritable bowel syndrome. *Alimentary pharmacology & therapeutics*, 23(4), 465-471.
- IDF, D. A. G. (2015). Update of mortality attributable to diabetes for the IDF Diabetes Atlas: Estimates for the year 2013. *Diabetes research and clinical practice*, 109(3), 461.
- Iwu, M. M., Igboko, O. A., Okunji, C. O., & Tempesta, M. S. (1990). Antidiabetic and aldose reductase activities of biflavanones of *Garcinia kola*. *Journal of Pharmacy and Pharmacology*, 42(4), 290-292.
- Izzo, A. A., & Ernst, E. (2009). Interactions between herbal medicines and prescribed drugs. *Drugs*, 69(13), 1777.
- Jagtap, A. G., & Patil, P. B. (2010). Antihyperglycemic activity and inhibition of advanced glycation end product formation by *Cuminum cyminum* in streptozotocin induced diabetic rats. *Food and Chemical Toxicology*, 48(8), 2030-2036.
- Javanbakht, M., Baradaran, H. R., Mashayekhi, A., Haghdoost, A. A., Khamseh, M. E., Kharazmi, E., & Sadeghi, A. (2011). Cost-of-illness analysis of type 2 diabetes mellitus in Iran. *PloS one*, 6(10), e26864.
- Jelodar, G., Maleki, M., Motadayen, M., & Sirus, S. (2005). Effect of fenugreek, onion and garlic on blood glucose and histopathology of pancreas of alloxan-induced diabetic rats. *Indian journal of medical sciences*, 59(2), 64.
- Jeppesen, P., & Bek, T. (2004). The occurrence and causes of registered blindness in diabetes patients in Århus County, Denmark. *Acta Ophthalmologica Scandinavica*, 82(5), 526-530.
- Jepson, R. G., Williams, G., & Craig, J. C. (2012). Cranberries for preventing urinary tract infections. *Cochrane Database Syst Rev*, 10(10).
- Kamble, S. M., Kamlakar, P. L., Vaidya, S., & Bambole, V. D. (1998). Influence of *Coccinia indica* on certain enzymes in glycolytic and lipolytic pathway in human diabetes. *Indian journal of medical sciences*, 52(4), 143-146.
- Kanodia, A. K., Legedza, A. T., Davis, R. B., Eisenberg, D. M., & Phillips, R. S. (2010). Perceived benefit of Complementary and Alternative Medicine (CAM) for back

- pain: a national survey. *The Journal of the American Board of Family Medicine*, 23(3), 354-362.
- Kazmi, I., Rahman, M., Afzal, M., Gupta, G., Saleem, S., Afzal, O. Anwar, F. (2012). Anti-diabetic potential of ursolic acid stearyl glucoside: a new triterpenic glycosidic ester from *Lantana camara*. *Fitoterapia*, 83(1), 142-146.
- Kesavadev, J., Saboo, B., Sadikot, S., Das, A. K., Joshi, S., Chawla, R., ... & Kalra, S. (2017). Unproven Therapies for Diabetes and Their Implications. *Advances in therapy*, 34(1), 60.
- Khan, B. A., Abraham, A., & Leelamma, S. (1995). Hypoglycemic action of *Murraya koenigii* (curry leaf) and *Brassica juncea* (mustard): mechanism of action. *Indian journal of biochemistry & biophysics*, 32(2), 106.
- Kim, H. J., Chun, K. H., Kim, D. J., Han, S. J., Kim, Y. S., Woo, J. T., ... & Lee, K. W. (2011). Utilization patterns and cost of complementary and alternative medicine compared to conventional medicine in patients with type 2 diabetes mellitus. *Diabetes research and clinical practice*, 93(1), 115-122.
- Kirigia, J. M., Sambo, H. B., Sambo, L. G., & Barry, S. P. (2009). Economic burden of diabetes mellitus in the WHO African region. *BMC international health and human rights*, 9(1), 6.
- Koh, H. L., & Woo, S. O. (2000). Chinese proprietary medicine in Singapore: regulatory control of toxic heavy metals and undeclared drugs. *Drug safety*, 23(5), 351-362.
- Kosuri, M., & Sridhar, G. R. (2009). Yoga practice in diabetes improves physical and psychological outcomes. *Metabolic syndrome and related disorders*, 7(6), 515-518.
- Kudolo, G. B. (2001). The Effect of 3-Month Ingestion of Ginkgo biloba Extract (EGb 761) on Pancreatic  $\beta$ -Cell Function in Response to Glucose Loading in Individuals with Non-Insulin-Dependent Diabetes Mellitus. *The Journal of Clinical Pharmacology*, 41(6), 600-611.
- Kumar, D., Bajaj, S., & Mehrotra, R. (2006). Knowledge, attitude and practice of complementary and alternative medicines for diabetes. *Public Health*, 120(8), 705-711.
- Kumar, R. V., & Augusti, K. T. (1989). Antidiabetic effect of a leucocyanidin derivative isolated from the bark of *Ficus bengalensis* Linn. *Indian journal of biochemistry & biophysics*, 26(6), 400-404.
- Lee M.S., Lim H.J., & Moon S.R. (2004) Survey of the use of complementary and alternative medicine among Korean diabetes mellitus patients. *Pharmacoepidemiology and Drug Safety* 13(3), 167–171.

- Lemay, J.F., Amin, A., & Pacaud, D. (2011). Complementary and alternative medicine use in children and adolescents with type 1 diabetes. *Paediatr Child Health* 16, 468–72.
- Lim, S., Yoon, J. W., Choi, S. H., Cho, B. J., Kim, J. T., Chang, H. S.,.....Jang, H. C. (2009). Effect of ginsam, a vinegar extract from *Panax ginseng*, on body weight and glucose homeostasis in an obese insulin-resistant rat model. *Metabolism*, 58(1), 8-15.
- Longmore, M., Wilkinson, I., Baldwin, A., & Wallin, E. (2014). *Oxford handbook of clinical medicine*. Oxford University Press.
- Mabey, D., Gill, G. G., Parry, E., Weber, M. W., Whitty, C. J., Louis, J., & Louis, J. (2014). Principles of medicine in Africa.
- Matheka, D. M., & Alkizim, F. O. (2012). Complementary and alternative medicine for type 2 diabetes mellitus: Role of medicinal herbs. *Journal of Diabetes and Endocrinology*, 3(4), 44-56.
- Matheka, D. M., & Demaio, A. R. (2013). Complementary and alternative medicine use among diabetic patients in Africa: a Kenyan perspective. *Pan African Medical Journal*, 15(1).
- McMahan, S., & Lutz, R. (2004). Alternative therapy use among the young-old (Ages 65 to 74): an evaluation of the MIDUS database. *Journal of Applied Gerontology*, 23(2), 91-103.
- Medagama, A. B., Bandara, R., Abeysekera, R. A., Imbulpitiya, B., & Pushpakumari, T. (2014). Use of Complementary and Alternative Medicines (CAMs) among type 2 diabetes patients in Sri Lanka: a cross sectional survey. *BMC Complementary and alternative medicine*, 14(1), 374.
- Mendis, S., Fukino, K., Cameron, A., Laing, R., Filipe Jr, A., Khatib, O., ... & Ewen, M. (2007). The availability and affordability of selected essential medicines for chronic diseases in six low-and middle-income countries. *Bulletin of the world health organization*, 85(4), 279-288.
- Mitchinson, A. R., Kim, H. M., Rosenberg, J. M., Geisser, M., Kirsh, M., Cikrit, D., & Hinshaw, D. B. (2007). Acute postoperative pain management using massage as an adjuvant therapy: a randomized trial. *Archives of surgery*, 142(12), 1158-1167.
- Naja, F., Mousa, D., Alameddine, M., Shoaib, H., Itani, L., & Mourad, Y. (2014). Prevalence and correlates of complementary and alternative medicine use among diabetic patients in Beirut, Lebanon: a cross-sectional study. *BMC complementary and alternative medicine*, 14(1), 185.
- Naik, S. R., Barbosa Filho, J. M., Dhuley, J. N., & Deshmukh, V. (1991). Probable mechanism of hypoglycemic activity of bassic acid, a natural product isolated from *Bumelia sartorum*. *Journal of ethnopharmacology*, 33(1-2), 37-44.

- Najm, W., Reinsch, S., Hoehler, F., & Tobis, J. (2003). Use of complementary and alternative medicine among the ethnic elderly. *Alternative therapies in health and medicine*, 9(3), 50.
- Nampoothiri, S. V., Prathapan, A., Cherian, O. L., Raghu, K. G., Venugopalan, V. V., & Sundaresan, A. (2011). In vitro antioxidant and inhibitory potential of Terminalia bellerica and Emblica officinalis fruits against LDL oxidation and key enzymes linked to type 2 diabetes. *Food and Chemical Toxicology*, 49(1), 125-131.
- Nouwen, A., Nefs, G., Caramlau, I., Connock, M., Winkley, K., Lloyd, C. E., ... & European Depression in Diabetes (EDID) Research Consortium. (2011). Prevalence of depression in individuals with impaired glucose metabolism or undiagnosed diabetes. *Diabetes Care*, 34(3), 752-762.
- Ogbera, A. O., Dada, O., Adeleye, F., & Jewo, P. I. (2010). Complementary and alternative medicine use in diabetes mellitus. *West African journal of medicine*, 29(3).
- Ojewole, J. A. O., & Adewunmi, C. O. (2003). Hypoglycemic effect of methanolic extract of Musa paradisiaca (Musaceae) green fruits in normal and diabetic mice. *Methods and findings in experimental and clinical pharmacology*, 25(6), 453-456.
- Padinjakara, R. K., Ashawesh, K., Butt, S., Nair, R., & Patel, V. (2009). Herbal remedy for diabetes: two case reports. *Experimental and Clinical Endocrinology & Diabetes*, 117(01), 3-5.
- Pagán, J. A., & Puig, A. (2005). Differences in access to health care services between insured and uninsured adults with diabetes in Mexico. *Diabetes Care*, 28(2), 425-426.
- Patel, D. N., Low, W. L., Tan, L. L., Tan, M. M. B., Zhang, Q., Low, M. Y., ... & Koh, H. L. (2012). Adverse events associated with the use of complementary medicine and health supplements: an analysis of reports in the Singapore Pharmacovigilance database from 1998 to 2009. *Clinical Toxicology*, 50(6), 481-489.
- Perez, C., Dominguez, E., Canal, J. R., Campillo, J. E., & Torres, M. D. (2000). Hypoglycaemic activity of an aqueous extract from Ficus carica (fig tree) leaves in streptozotocin diabetic rats. *Pharmaceutical biology*, 38(3), 181-186.
- Porter, R. S., & Kaplan, J. L. (2011). The Merck Manual of Diagnosis and Therapy Nineteenth Edition. Merck sharp & Dohme corp., A subsidiary of Merck & Co. Inc., *Whithouse station*, 2868.
- Prakasam, A., Sethupathy, S., & Pugalendi, K. V. (2002). Antihyperglycaemic effect of Casearia esculenta root extracts in streptozotocin-induced diabetic rats. *Die Pharmazie*, 57(11), 758-760.
- Ravi, K., Ramachandran, B., & Subramanian, S. (2004). Protective effect of Eugenia jambolana seed kernel on tissue antioxidants in streptozotocin-induced diabetic rats. *Biological and Pharmaceutical Bulletin*, 27(8), 1212-1217.

- Rehman, S. U., Choi, M. S., Choe, K., & Yoo, H. H. (2015). Interactions between herbs and antidiabetics: an overview of the mechanisms, evidence, importance, and management. *Arch Pharm Res*, 38(7), 1281-98.
- Ryan, E. A., Pick, M. E., & Marceau, C. (2001). Use of alternative medicines in diabetes mellitus. *Diabetic Medicine*, 18(3), 242-245.
- Sachdewa, A., Nigam, R., & Khemani, L. D. (2001). Hypoglycemic effect of Hibiscus rosa sinensis L. leaf extract in glucose and streptozotocin induced hyperglycemic rats.
- Sangeetha, K. N., Sujatha, S., Muthusamy, V. S., Anand, S., Nithya, N., Velmurugan, D.,...Lakshmi, B. S. (2010).  $\beta$ -taraxerol of *Mangifera indica*, a PI3K dependent dual activator of glucose transport and glycogen synthesis in 3T3-L1 adipocytes. *Biochimica et Biophysica Acta (BBA)-General Subjects*, 1800(3), 359-366.
- Saper, R. B., Phillips, R. S., Sehgal, A., Khouri, N., Davis, R. B., Paquin, J., ... & Kales, S. N. (2008). Lead, mercury, and arsenic in US-and Indian-manufactured Ayurvedic medicines sold via the Internet. *Jama*, 300(8), 915-923.
- Satheesh, M. A., & Pari, L. (2004). Antioxidant effect of *Boerhavia diffusa* L. in tissues of alloxan induced diabetic rats.
- Saxena, A. M., Bajpai, M. B., Murthy, P. S., & Mukherjee, S. K. (1993). Mechanism of blood sugar lowering by a swerchirin-containing hexane fraction (SWI) of *Swertia chirayita*. *Indian journal of experimental biology*, 31(2), 178-181.
- Shane-McWhorter, L. (2007). *Complementary and alternative medicine (CAM) supplement use in people with diabetes: a clinician's guide*. American Diabetes Association.
- Shapiro, K., & Gong, W. C. (2002). Natural products used for diabetes. *Journal of the American Pharmaceutical Association (1996)*, 42(2), 217-226.
- Sharma, R. D., Sarkar, A., Hazara, D. K., Mishra, B., Singh, J. B., Sharma, S. K., ..... Maheshwari, P. K. (1996). Use of fenuqreek seed powder in the management of non-insulin dependent diabetes mellitus. *Nutrition Research*, 16(8), 1331-1339.
- Shaw, J. E., Sicree, R. A., & Zimmet, P. Z. (2010). Global estimates of the prevalence of diabetes for 2010 and 2030. *Diabetes research and clinical practice*, 87(1), 4-14.
- Sheela, C. G., & Augusti, K. T. (1992). Antidiabetic effects of S-allyl cysteine sulphoxide isolated from garlic *Allium sativum* Linn. *Indian journal of experimental biology*, 30(6), 523-526.
- Singh, S. N., Vats, P., Suri, S., Shyam, R., Kumria, M. M. L., Ranganathan, S., & Sridharan, K. (2001). Effect of an antidiabetic extract of *Catharanthus roseus* on enzymic activities in streptozotocin induced diabetic rats. *Journal of Ethnopharmacology*, 76(3), 269-277.

- Singh, V., Raidoo, D. M., & Harries, C. S. (2004). The prevalence, patterns of usage and people's attitude towards complementary and alternative medicine (CAM) among the Indian community in Chatsworth, South Africa. *BMC Complementary and Alternative Medicine*, 4(1), 3.
- Smith, J. D., & Clinard, V. B. (2014). Natural products for the management of type 2 diabetes mellitus and comorbid conditions. *Journal of the American Pharmacists Association*, 54(5), e304-e321.
- Song, R., Ahn, S., Roberts, B. L., Lee, E. O., & Ahn, Y. H. (2009). Adhering to a t'ai chi program to improve glucose control and quality of life for individuals with type 2 diabetes. *The Journal of Alternative and Complementary Medicine*, 15(6), 627-632.
- Spinks, J., Hollingsworth, B., Manderson, L., Lin, V., & Canaway, R. (2013). Costs and drivers of complementary and alternative medicine (CAM) use in people with type 2 diabetes or cardiovascular disease. *European Journal of Integrative Medicine*, 5(1), 44-53.
- Sripa, S. (2005). Usage of and cost of complementary/alternative medicine in persons living with DM. *J Med Assoc Thai*, 88(11), 1630-7.
- Szegedi, A., Kohlen, R., Dienel, A., & Kieser, M. (2005). Acute treatment of randomised controlled double blind non-inferiority trial versus paroxetine. *Bmj*, 330(7490), 503.
- Thorve, V. S., Kshirsagar, A. D., Vyawahare, N. S., Joshi, V. S., Ingale, K. G., & Mohite, R. J. (2011). Diabetes-induced erectile dysfunction: epidemiology, pathophysiology and management. *Journal of diabetes and its complications*, 25(2), 129-136.
- Tu, H. T., & Hargraves, J. L. (2004). High cost of medical care prompts consumers to seek alternatives. *Data bulletin (Center for Studying Health System Change)*, (28), 1.
- Ulbricht, C. (2012). What Every Clinician Should Know About Herb–Supplement–Drug Interactions. *Alternative and Complementary Therapies*, 18(2), 67-70.
- Unwin, N., Gan, D., & Whiting, D. (2010). The IDF Diabetes Atlas: providing evidence, raising awareness and promoting action. *Diabetes research and clinical practice*, 87(1), 2-3.
- van Houtum, W. H., Lavery, L. A., & Harkless, L. B. (1996). The impact of diabetes-related lower-extremity amputations in The Netherlands. *Journal of Diabetes and its Complications*, 10(6), 325-330.
- Ventola, C. L. (2010). Current issues regarding complementary and alternative medicine (CAM) in the United States: part 2: regulatory and safety concerns and proposed governmental policy changes with respect to dietary supplements. *Pharmacy and Therapeutics*, 35(9), 514.

- Verhoef, M. J., Balneaves, L. G., Boon, H. S., & Vroegindewey, A. (2005). Reasons for and characteristics associated with complementary and alternative medicine use among adult cancer patients: a systematic review. *Integrative cancer therapies*, 4(4), 274-286.
- Villa-Caballero, L., Morello, C. M., Chynoweth, M. E., Prieto-Rosinol, A., Polonsky, W. H., Palinkas, L. A., & Edelman, S. V. (2010). Ethnic differences in complementary and alternative medicine use among patients with diabetes. *Complementary therapies in medicine*, 18(6), 241-248.
- Vuksan, V., Stavro, M.P., Sievenpiper, J.L., Beljan-Zdravkovic, U., Leiter, L.A., Josse, R.G., & Xu, Z. (2000). Similar postprandial glycaemic reductions with escalation of dose and administration time of American ginseng in type 2 diabetes. *Diabetes Care* 2000, 23, 1221–6.
- Warren, N., Canaway, R., Unantenne, N., & Manderson, L. (2013). Taking control: Complementary and alternative medicine in diabetes and cardiovascular disease management. *Health: 17*(4), 323-339.
- Wayne, P. M., & Kaptchuk, T. J. (2008). Challenges inherent to t'ai chi research: part I—t'ai chi as a complex multicomponent intervention. *The Journal of Alternative and Complementary Medicine*, 14(1), 95-102.
- Wazaify, M., Afifi, F. U., El-Khateeb, M., & Ajlouni, K. (2011). Complementary and alternative medicine use among Jordanian patients with diabetes. *Complementary therapies in clinical practice*, 17(2), 71-75.
- World Health Organisation - Diabetes: WHO Fact Sheet NO. 312. Available at: [www.who.int/mediacentre/factsheets/fs312/en/](http://www.who.int/mediacentre/factsheets/fs312/en/) [Accessed: June 16, 2017].
- World Health Organization. (2016). *Global Report on Diabetes*. Geneva: World Health Organization; 2016.
- World Health Organization. (2002). *WHO traditional medicine strategy 2002-2005*.
- Wu, W., & Li, C. (1998). Diabetes mellitus treated by massage. *Journal of traditional Chinese medicine= Chung i tsa chih ying wen pan/sponsored by All-China Association of Traditional Chinese Medicine, Academy of Traditional Chinese Medicine*, 18(1), 64.
- Yoshikawa, M., Murakami, T., Kadoya, M., Matsuda, H., Muraoka, O., Yamahara, J., & Murakami, N. (1996). Medicinal Foodstuffs. III. Sugar Beet. (1): Hypoglycemic Oleanolic Acid Oligoglycosides, Betavulgarosides I, II, III, and IV, from the Root of Beta vulgaris L.(Chenopodiaceae). *Chemical and pharmaceutical bulletin*, 44(6), 1212-1217.
- Yuan, C. S., Wu, J. A., Lowell, T., & Gu, M. (1998). Gut and brain effects of American ginseng root on brainstem neuronal activities in rats. *The American journal of Chinese medicine*, 26(01), 47-55.

Zhuo, X., Zhang, P., & Hoerger, T. J. (2013). Lifetime direct medical costs of treating type 2 diabetes and diabetic complications. *American journal of preventive medicine*, 45(3), 253-261.



**APPENDICES**

**Appendix 1: Questionnaire**

**Correlates of Complementary and Alternative Medicine Use among Diabetes Mellitus Outpatients in Tamale Metropolis, Ghana-2017**

Patient Folder number.....

Date of data collection...../...../.....

Information provider                      0. Patient                      1. Care giver

**Section A: Socio-demographic data**

1. Sex     Male (0)             Female (1)

2. Age .....(completed years)

3. Current address:

Region.....Town.....Tel.....

4. Marital status

- Married (0)
- Single (1)
- Widowed (2)
- Divorced/separated (3)
- Other (specify) (4)

5. Formal Education

- None (0)
- Primary/JHS/Middle School (1)
- Secondary (2)
- Vocational/Technical degree (3)
- Bachelor's degree (4)
- Postgraduate degree (5)

6. Are you employed?             Yes             No

7. Occupation

- Unemployed (0)
- Retired (1)
- Housewife (2)
- Business owner (3)
- Manual/ unskilled Employee (4)
- Farming (5)
- Professional (6)
- Other (specify) (7).....

8. Average monthly income in (Ghana cedis) .....

9. Smoking status

- Never (0)
- Former smoker (2) Duration since you stopped smoking ....
- Current smoker (3) Cigarettes, packs/day .....

10. Alcohol consumption

- Never (0)
- Former consumer (1) Duration since you stopped...
- Current consumer (2) glasses/can/bottles per day/week....

11. Are you health insured?

- No (0)
- Yes, but registration expired (1)
- Yes, registration valid (2)

**Question 11 to 24: Disease History and Management**

12. How long ago were you diagnosed of DM? ..... Years ..... Months

13. How old were you at diagnosis? .....

14. What type of DM do you have?

- Type 1 (0)
- Type 2 (1)
- Gestational (2)

15. Do you have a family history of DM?  Yes (0)  No (1): if yes, who?

16. When did you last visit your doctor/physician assistant?

- Within 1 month (0)
- Within 1-6 months (1)
- Within 6months – 1 year (2)
- More than 1 year (3)
- Don't remember (4)

17. Where did you seek treatment on your last visit?

- Government Facility (0)
- Private Facility (1)
- Pharmacy (2)
- Herbal Center (3)
- Other (4)

18. Why did you use the option above? (Tick as many as apply)

- Easy accessibility (0)
- Better medication (1)
- Better attention/customer service (2)
- Better facilities (3)
- Low cost (4)
- Others (5)

19. Which system of management do you usually use for your DM?

1. Orthodox
2. CAM
3. A combination of both

20. If you are using Orthodox medicine, what type are you on?

- Oral hypoglycaemic tablets (0)
- Injection (1)
- Both tablets and Injection (2)
- Others (specify)..... (3)

21. Presence of DM complications  Yes  No  Don't know

22. Which of the following conditions (complications/comorbidities) do you have?

Sr. No.	Disease	Disease present	Disease absent	Treatment Yes / No	CAM treatment Yes / No
1	Heart Disease				
2	Hypertension				
3	Elevated Cholesterol				
4	Kidney disease				
5	Neurological disease				
6	Diabetic foot				
7	Visual Impairment				
8	Sexual Dysfunction				
9	Liver disease				
10	Others (specify)				

23. Do you follow any dietary modifications for the control of DM?

- Yes (0)  No (1)

24. Do you do any physical exercise for the control of DM?

- Yes (0)  No (1)

25. If yes, how many times in a week do you exercise for up to 30 minutes? .....

**Questions 25 to 32: Types and sources of CAM**

26. Which of the following do you use? Tick as many that apply.

- Local herbal medicines (0)
- Chinese herbal medicines (1)
- Indian herbal medicines (2)
- Nutritional supplements (3)
- Prayers / Divinations (4)
- Others (5)

27. Do you have any of your relatives, friends, or neighbours working in CAM?

- Yes (0)  No (1)

28. What is/are you source(s) of information about CAM?  
 Friends (0)  
 Relatives (1)  
 Mass Media (2)  
 Social Media (3)  
 Medical doctor/ paramedic (4)  
 Cultural believes/recommendation (5)
29. From where do you get your CAM services/supply?  
 Friends (0)  
 Relatives (1)  
 CAM practitioners (2)  
 Market (3)  
 Hospital herbal pharmacy  
 Others (specify)..... (3)
30. What is the reason for selection of CAM for the management of DM? (multiple)  
 Orthodox medicine is not working (0)  
 CAM is easily available (1)  
 CAM is cheaper (2)  
 Orthodox medicines are toxic or too invasive (3)  
 CAM is user friendly (4)  
 CAM is free from side effects (5)  
 I want to take my fate into my own hands (6)  
 Experimenting (7)  
 Recommendation from other DM patient(s) (8)  
 Others (9)
31. Did you consult your doctor before getting CAM?  
 Yes (0)     No (1) If yes, why? If no, why not? .....
32. How often have you visited your CAM practitioner since diagnosis?  
 Once (0)     Several times (1)
33. How often do you use CAM for management of DM?  
 Daily (0)  
 Weekly (1)  
 Occasionally (2)  
 Only once previously (3)

**Questions 33 to 37: Experiences with CAM use**

34. Have you experienced adverse effects from CAM?  
 Yes (specify)..... (0)     No (1)     Cannot tell (2)
35. Are you satisfied with CAM use/are there improvements of DM symptoms?  
 Yes (0)  
 No (1)  
 Undecided (2)

36. Would you recommend CAM to DM patients?

- Yes (0)  
 No (1)  
 Undecided (2)

37. If No or undecided from Q34, why not?

- Do not believe in it (0)  
 The medical doctor did not prescribe it (1)  
 Afraid of the side effects (2)  
 Unnecessary additional cost (3)  
 Mainstream medicine is best (4)  
 Not evidence based (5)

38. Would you consider using CAM in the future?

- Yes (0)  
 No (1)  
 Maybe (2)

**Questions 38 to 40: Cost estimations**

39. What are the costs of orthodox medicines in the last month?

Sr. No.	Name of Medicine	Dose	Frequency	Rate	Total
1					
2					
3					
4					
5					

40. What are the costs of CAM in the last one month?

Sr. No	System of CAM	Name of Medicine	Dose	Rate	Total
1					
2					
3					
4					
5					

**Appendix 2: Informed Consent Request**

**Correlates of complementary and alternative medicine use among diabetes outpatients in Tamale Metropolis, Ghana, 2017**

Good morning/ good afternoon/good evening. I am Basil Kaburi, a student of MPhil Applied Epidemiology and Disease Control at the School of Public Health, University of Ghana. As a part of the course requirement, I am conducting a study to find out the “Correlates of complementary and alternative medicine use among diabetes outpatients in Tamale metropolis”. For this, I would like to conduct an interview for about 30 minutes.

I am assuring that all the information that you will be sharing with me will be kept highly confidential and only used for research and academic purpose only. You may not be getting any direct benefits by participating in this study, but the information you share will be useful for making health policy in future. Your participation in this study is purely voluntary. You may choose not to answer any question and you have the right to withdraw your participation at any time during the interview without any explanation, without fear of harm or penalty. Your co-operation will add greatly to scientific knowledge and benefit to the society.

For any clarification regarding the study, you can contact me directly (0206276929 or kbenduri@yahoo.com). In case you wish to seek any further clarification regarding this study, you can contact the Epidemiology Department of the School of Public Health, University of Ghana via email: epidemiologydc@gmail.com

Study ID Number:

Place:

Date:

Name and Signature of the interviewer: .....

**Appendix 3: Respondent’s Consent Form**

I have read the details in the information sheet. The purpose of the study and my involvement in the study has been explained to me. By signing on this consent form, I indicate that, I am willing to participate in the study and I understand what will be expected from me. I know that I can withdraw my participation at any time during the interview without any explanation. I have also been informed who should be contacted for further clarifications.

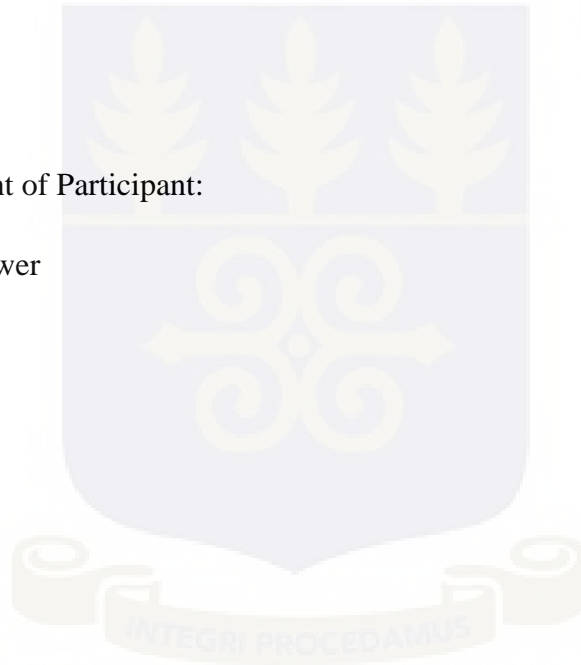
I, ----- agree to participate in the study.

Place:

Date:

Signature/Thumbprint of Participant:

Signature of interviewer



**Appendix 4: Common Herbal Medicines Used by Respondents**



**Afa Ali Bitters (liquid concoction)**

**(Unknown constitution)**



**Azara Tampilin Bitters (granular form)**

**(Unknown constitution)**



**Azara Tampilin Bitters (liquid concoction)**

**(Unknown constitution)**



**Bitter cola (*Garcinia kola*)**

**Inhibits glucose-6-phosphatase required for gluconeogenesis**

**(Iwu, Igboko, Okunji, & Tempesta, 1990)**