Predictors of Herbal Medicine Use amongst Adults with Type 2 Diabetes in an Urban Setting in Cameroon

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Abstract

Background: Type 2 diabetes mellitus (T2DM) is currently a major global public health burden associated with elevated blood glucose. The use of herbal medicine in the management of type 2 diabetes is currently on the rise both in developed and developing countries. This study sets out to determine the prevalence of herbal medicine use and to identify the factors associated with herbal medicine use amongst type 2 diabetes patients. **Methods:** A community based cross-sectional study involves 123 adults living with type 2 diabetes (90 males and 30 females), mean age 58.7 ± 9.5 years in the Bamenda III health district of the North West Region of Cameroon. Data on the different types of herbs used, frequency and mode of herbal medicine use as well as reasons for using herbal medicines in the management of T2DM were assessed using a structured questionnaire. Anthropometric and diabetes related measurements were carried out following standard procedures. Logistic regression analysis was used to identify the independent predictors of herbal medicine use. **Results:** The prevalence of herbal medicine use was 24.4% (n = 30) amongst which 37.4 % used both herbs and orthodox medicine. A higher proportion of diabetic males used herbal medicines compared to females and this difference was significant (X^2 = 5.243, p < 0.027). Also, a higher proportion of patients who had attained secondary/tertiary education used herbal medicine compared to those who had attained only primary education and this difference was significant (X^2 = 10.75, p = 0.005). The most commonly used herbs were *Vernonia amygdalina* leaves (19.10%), Aloe vera (13.48%), *Mangifera indica* leaves (11.24%) including its bark and *Carica papaya* leaves (8.99%). Bivariate analysis indicated that being male (OR 2.8, 95% CI, 1.14 -6.79) and having attained secondary/tertiary education (OR 13.2, 95% CI, 1.6

- 29.9) were significantly (p < 0.05) associated with herbal medicine use. While, diabetes duration of 3 - 10 years (OR 1.9, 95% CI, 0.79 - 4.75), being ≥50 years (OR 2.3, 95% CI, 0.48 - 10.72), being single (OR 0.92, 95% CI, 0.39 - 2.10), and being a farmer/retired (OR 1.2, 95% CI, 0.47 - 2.78) were not significantly (p > 0.05) associated with herbal medicine use. Multivariate analysis revealed that having attained secondary /tertiary education (OR 10.5, 95% CI, 1.30 - 35.23) was an independent predictor of herbal medicine use in the study population. **Conclusion:** This study has demonstrated that amongst T2DM patients in Cameroon having attained secondary/tertiary education positively influences the use of herbal medicine in the management of T2DM.

Keywords

Predictors, Type 2 Diabetes, Adults, Herbal Medicine, Management, Cameroon

1. Introduction

Type 2 diabetes mellitus (T2DM) is currently a major global public health burden to the individual, the family and the society and its rates worldwide have reached alarming proportions [1]. According to the International Diabetes Federation (IDF) [2], in 2021, diabetes was considered the fastest growing global emergencies of the 21st century with an estimated 537 million people living with diabetes. T2DM accounts for 90% - 95% of all the causes of diabetes globally. In addition, more than 80% of people with diabetes are living in low- and middle-income countries [2] [3] and it is associated with high rates of morbidity and mortality [3] [4] [5] [6].

According to the American Diabetes Association [7], the management of diabetes involves continuous medical care and patient self-management education to prevent acute and long-term complications. Effective management of diabetes involves frequent measurement of blood glucose, diet and exercise alongside a complex balancing of insulin dosing which is often very challenging even to the most motivated patient. However, the management of diabetes has remained a major challenge to the patient, the healthcare provider as well as family members of the patients [8] [9] [10]. Early and intensive intervention in patients with diabetes helps in reducing the risk of microvascular and macrovascular complications and disease progression [6].

Herbal medicine use is another form of healthcare especially in sub-Saharan Africa and other developing countries. According to the World Health Organization [11], herbal medicine is defined as herbs, plant extracts, herbal materials and herbal products that contain plant parts as active ingredients [11] [12]. In addition, WHO [13] classifies herbal medicine use under complementary and alternative medicine (CAM). Alternative medicines are widely used globally by patients with chronic diseases including patients with T2DM. The use of herbal medicine in the management of diabetes is currently on the rise [14] [15] [16] [17] [18]. A report by WHO [13] in 2019 estimated that about 80% of people in

developing countries including sub-Saharan Africa and Asia were using traditional and alternative medicines mostly plant based. This can be attributed to the fact that the use of herbs for the treatment of diseases is an important part of the African culture that is accepted by most Africans despite the availability of conventional drugs. Moreover, the familiarity of these herbs increases their uptake for the treatment of chronic diseases.

In the last two decades, the demand for herbal medicines in the developed nations has risen [19]. For instance a study carried out in Europe and America, estimated that the proportion of people who have used herbal medicines at least once in the population was 42% and 75% respectively [20]. Similar findings have been reported in Saudi Arabia [21] [22] [23] and Egypt [24] [25]. In addition, studies in Kuwait [26] and Thailand [27], found that 30.6% and 37.5% of type 2 diabetics respectively used herbal medicine. In Africa, there exists a wide variation in the prevalence of herbal medicine use in the management of type 2 diabetes. The prevalence ranges from 27% in South Africa [28], 58% in Sudan [15], 62% in Ethiopia [17], 67.5% in Nigeria [18] and 80.2% in Egypt [24].

Given the chronic nature of T2DM and long-term complications, patients are often prompted into using alternative medicine in the management of their condition [29]. This might be explained by the fact that they believe some herbal extracts are natural [30], safe [31] [32], provide symptomatic relief and help in the prevention of complications in patients [33]. Evidence also suggests that some herbal extracts help in the regeneration of pancreatic beta cells thereby improving glycaemic control in the patients [34]. However, evidence on the safety and effectiveness of herbal medicines compared to conventional medicines is inconclusive. Some studies have found a significant reduction in glycosylated haemoglobin (HbA1c), cholesterol and fasting blood glucose with little or no side effects with the use of some herbal extracts [31] [32] [35]. However, it is currently unclear if there are any side effects to the herbs used by type 2 diabetics in our setting given most of the herbs used are commonly consumed as vegetables as a source of vitamins and fibre.

In Cameroon, there is limited data on the prevalence of herbal medicine use amongst people living with type 2 diabetes and the factors associated with herbal medicine use amongst these patients. Understanding the predictors of herbal medicine use in this population will provide valuation information to guide targeted intervention and thus better outcome for the patients.

This study therefore set out to determine the prevalence of herbal medicines use and to identify the factors associated with herbal medicine use amongst type 2 diabetes patients in the Bamenda III health district of the North West Region of Cameroon.

2. Materials and Methods

2.1. Study Design and Study Participants

This was a community-based cross-sectional study carried out between January 2022 and May 2022 involving 123 type 2 diabetes patients (93 males and 30 fe-

males) aged 22 years and above diagnosed with T2DM and living in the Bamenda III health district in the North West Region of Cameroon using a convenient random sampling technique. Participants were selected provided they were clinically diagnosed and classified in a hospital for type 2 diabetes according to the 1999 WHO criteria [36]. However, we excluded all type 2 diabetics with cognitive problems. Patients were enrolled with the help of a community health worker (CHW) who identified households with type 2 diabetic patients. Prior to data collection the researcher (assisted by a trained nurse and a CHW) visited all the eligible study participants in the health area, explained the purpose of the study and those who consented to be part of the study were distributed consent forms after which a meeting for data collection was scheduled. During the scheduled visit, the research staff accompanied by a nurse and the CHW met with the study participants between 7am and 9am to ensure they were still in a state of fasting. After the collection of all anthropometric parameters, participants who were literate were requested to compete a structured questionnaire in the presence of the researcher. However, those who were non-literate were assisted in the completion of the questionnaire by the researcher.

2.2. Ethical Considerations

Approval to carry out this study was obtained from the Institutional Review Board (IRB) of The University of Bamenda (Ref No 2022/0429/UBa/IRB). Administrative clearance was gotten from the Regional Delegation of Public Health for the North West Region (Ref No 203/ATT/NWR/RDPH/BRIGAD). Written informed consent was obtained from all the quarter heads and patients respectively before any data collection procedure started.

3. Data Collection

3.1. Anthropometry and Blood Glycaemia (Fasting Blood Sugar)

Data collection was carried out at home between 7am and 9am in order for participants to be in a state of fasting. Height and weight were measured by nurses recruited to assist in the data collection process, ensuring all standard procedures were respected. Height was measured to the nearest 0.1cm without shoes using a portable stadiometer (Seca 213, Germany). The body weight of each patient was measured with using a digital scale (Omron BF511, Japan) to the nearest 0.1 kg. The body mass index (BMI) was then calculated as weight (kg) divided by height (cm) squared [37]. Fasting blood sugar was measured using an Accu-Chek Active Blood Glucose monitoring system (Germany).

Data on the different types of herbs used by the study population, frequency and mode of herbal medicine as well as reasons for using herbal medicines in the management of T2DM was assessed using a structured questionnaire (Additional file). The questionnaire was made up of 17 questions and had the following sections: 1) Sociodemographic characteristics that included; age, gender, marital status, level of education, religion and occupation. 2) Diabetes related characte-

ristics which included; family history of type 2 diabetes (Yes/No), diabetes duration and diabetes complications (Yes/No). 3) Herbal medicine use included; frequency of herbal medicine use (once a day, twice a week, weekly), mode of herbal medicine use (boiling, mixing with oil and chewing).

This questionnaire was adapted from previous studies carried out in Nigeria [18] and Saudi Arabia [25], which had been previously developed and validated on the Complementary and Alternative Medicine Use [38]. A written consent that explained the purpose of the study was distributed to the study participants. In addition, the nurses explained the purpose of the study before any data collection and those who consented to the study were asked to sign the consent form. The questionnaire was piloted amongst 15 randomly selected adults living with type 2 diabetes in the Bamenda I health district two weeks prior to data collection to test the effectiveness of the questionnaire.

3.2. Statistical Analysis

Statistical analysis was carried out using SPSS for Windows version 23.0. Continuous variables were checked for normality using the Kolmogorov-Smirnov (K-S) test. Patients' sociodemographic characteristics and diabetes specific variables were summarized using frequency distribution tables and charts. Association between categorical variables was assessed using Chi square test. Means of continuous variables was assessed using an independent student t-test and ANOVA as appropriate. Binary logistic regression analysis was done to identify the predictors of herbal medicine used followed by multiple logistic regression to identify independent predictors for herbal medicine use. All measures of association were presented as odds ratios with their 95% confidence interval. Statistical significance was set at $p < 0.05$.

4. Results

4.1. Descriptive and Diabetes Related Characteristics of the Study Population

This study included 123 adults with type 2 diabetes. Table 1 shows the descriptive and diabetes related characteristics of the study participants according to herbal medicine use. This study found that a higher proportion of diabetic males (40.0%) used herbal medicines compared to females (19.4%) and this difference was significant ($X^2 = 5.243$, $p = 0.027$). It was also observed that a higher proportion of patients who had attained secondary/tertiary education used herbal medicine in the management of type 2 diabetes compared to those who had attained only primary education (35.4% vs 24.0% respectively). This difference was statistically significant ($X^2 = 10.75$, $p = 0.005$). In addition, a higher proportion of the BMI overweight study participants (25.5%) were using herbal medicine compared to their BMI-normal weight (23.5%) and BMI-obese counterparts (23.7%). However, these differences were not significant ($X^2 = 0.054$, $p = 0.973$). Furthermore, a higher proportion of patients with normal FBS used herbs compared

to those who had a higher FBS (33.3% vs 19.3%). However, this difference was not significant (X^2 = 2.079, p = 0.122).

Table 1. Descriptive and diabetes related characteristics of the study participants according to herbal medicine use (N = 123).

Variable	Overall N	Overall (%)	Herbal medicine use User [n (%)]	Herbal medicine use Non-user [n (%)]	X^2	*p*-value
Age categories (years)					1.269	0.260
<50	15	12.2	2 (13.3)	13 (86.7)		
≥50	108	87.8	28 (25.9)	80 (74.1)		
Gender					5.243	**0.027**
Male	93	75.6	12 (40.0)	18 (60.0)		
Female	30	24.4	18 (19.4)	75 (80.6)		
Marital status					1.449	0.485
Single	9	7.3	1 (11.1)	8 (88.9)		
Married	76	61.8	18 (23.7)	58 (76.3)		
Divorced	38	30.9	11 (28.9)	27 (71.1)		
Educational level					10.758	**0.005**
No formal education	25	20.3	1 (4.0)	24 (96.0)		
Primary	50	40.7	12 (24.0)	38 (76.0)		
Secondary/Tertiary	48	39.0	17 (35.4)	31 (64.6)		
Occupation					5.583	**0.031**
Trader	36	29.3	4 (11.1)	32 (88.9)		
Civil servant/Private	26	21.2	7 (26.9)	19 (73.1)		
Retired/farmer	61	49.6	19 (31.1)	42 (68.9)		
Diabetes duration					3.102	0.212
<3 years	32	26	8 (25)	24 (75)		
3 - 10 years	61	49.6	18 (29.5)	43 (70.5)		
>10 years	30	24.4	4 (13.3)	26 (86.7)		
Family History of DM					0.608	0.569
Yes	65	52.8	14 (21.5)	51 (78.5)		
No	58	47.2	16 (27.6)	42 (72.4)		
Fasting Blood Sugar (mg/dl)					2.079	0.122
Normoglycaemia	42	34.1	14 (33.3)	28 (66.7)		
Hyperglycaemia	81	65.9	16 (19.8)	65 (80.2)		
Diabetes Complications					1.001	0.456
Yes	29	24.2	5 (17.2)	24 (82.8)		
No	91	75.8	24 (26.4)	67 (73.6)		
BMI categories (kg/m^2)					0.054	0.973
Normal weight	17	13.8	4 (23.5)	13 (76.5)		
Overweight	47	38.2	12 (25.5)	35 (74.5)		
Obese	59	48	14 (23.7)	45 (76.3)		

DM: Diabetes mellitus.

4.2. Prevalence of Herbal Medicine Use among the Study Participants

In this present study, the prevalence of herbal medicine use was 24.4%, amongst which 37.4% used both herbs and orthodox medicine. The mean age of the study participants was 58.7 ± 9.5 years. There was no significant difference (X^2 = 1.269, p = 0.260) in the mean age between herbal medicine users (59.2 years) and non-herbal medicine users (58.6 years).

4.3. Mean Clinical and Biochemical Parameters of the Study Participants according to Herbal Medicine Use

Table 2 shows the mean clinical and biochemical parameters of the study participants according to herbal medicine use. There was no significant difference (p > 0.05) in the weight, height, BMI and fasting blood sugar between the users and non-users of herbs in the management of type 2 diabetes. However, non-herbal medicine users had a higher mean fasting blood sugar (154.0 mg/dl) compared to herbal medicine users (137.6 mg/dl). In addition, non-herbal medicine users were on average taller (159 cm) compared to herbal medicine users (81.4 cm).

Amongst the participants who used herbs in the management of T2DM, there was no significant difference (p = 0.349) in the mean FBS according to frequency of use with a mean FBS of 151.5 mmHg, 175.6 mg/dl and 157.9 mg/dl for participants who used herbs once a day, twice a day and weekly respectively.

4.4. Types of Herbal Plants Used in the Management of T2DM in the Study Population

Figure 1 shows the different types of herbs used by our study participants in the management of type 2 diabetes. The most commonly used herbs by the study population in the management of T2DM were bitter leaves (*Vernonia amygdalina*) (19.10%), Aloe vera (13.48%), mango leaves (*Mangifera indica*) (11.24%) including its bark and pawpaw leaves (*Carica papaya*) (8.99%). While, coffee (*Coffea arabica*) leaves (1.12%), cape gooseberry (*Physalis peruviana*) leaves (1.12%), okro (*Abelmischus esculrntus*) 1.12%) and onion (*Allium cepa*) (1.12%) were the herbs least utilize by the study population in the management of type 2 diabetes. Regarding the frequency of herbal medicine use, the participants reported that they used these herbs weekly (35.6%), twice a week (37.8%) and once a day (26.7%). Our study found that a majority (80.0%) of the herbal medicine users were recommended that family and friends, while 4.4%, 6.7% and 8.9% were self-recommended, recommended by a medical doctor and social media respectively. In addition, the participants reported using herbal medicines for other ailments like malaria (53.6%, typhoid fever (39.3%), cancer (3.6%) and body pain (3.6%) respectively. With respect to the mode of use of the herbal medicines, the most common modes of utilization reported by the study participants were boiling in water (78.7%) and chewing (14.9%).

Some of the reasons reported by the study participants for herbal medicine used included advice from friends and relatives (82.2%), accessibility and availability of

traditional medicines (57.8%) and high cost of conventional medicines (44.4%) respectively. **Figure 2** shows the different responses of the study participants on reasons for using herbal medicines in the management of type 2 diabetes.
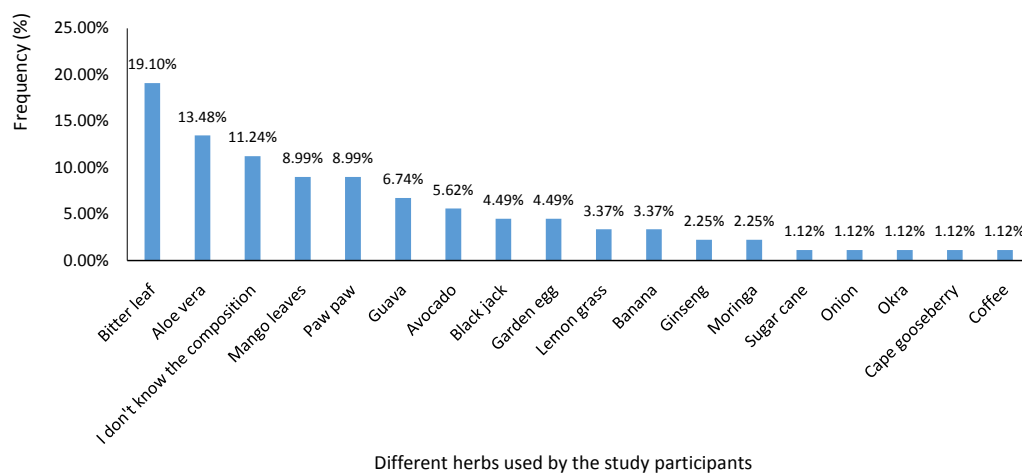

Figure 1. The different herbs used by the study population in the management of T2DM.

Table 2. Clinical and biochemical parameters of the study participants according to herbal medicine use [N = 123, Mean (95% CI)].

Variable	Whole sample	Herbal medicine use		*p*-value
		User (n = 30)	Non-user (n = 93)	
Weight (kg)	79.3 (76.1 - 84.5)	59 (55.9 - 62.1)	58.6 (56.4 - 60.7)	0.452
Height (cm)	159.7 (157.9 - 161.4)	81.4 (75.1 - 87.7)	159.0 (156.9 - 161.1)	0.192
BMI (kg/m²)	31.3 (29.9 - 32.7)	31.2 (28.8 - 33.6)	31.3 (29.7 - 32.9)	0.938
FBS (mg/dl)	150.04 140.5 - 159.5)	137.6 (120.2 - 154.9)	154.0 (142.7 - 165.3)	0.142

CI: Confidence interval; FBS: Fasting blood sugar; BMI: Body mass index.
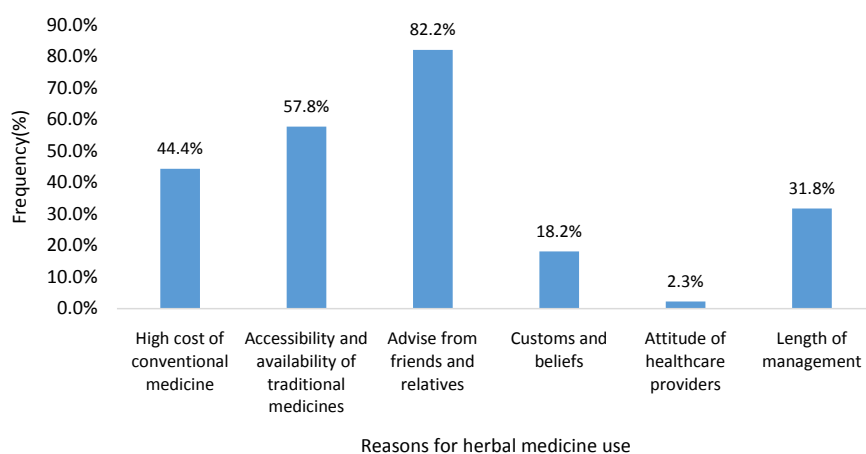
Figure 2. Responses of study participants on reasons for herbal medicine use in the management of T2DM.

4.5. Predictors of Herbal Medicine Use amongst Patients with Type 2 Diabetes

Bivariate analysis (unadjusted associations between herbal medicine use and some selected factors) in Table 3 indicated that being male (OR 2.8, 95% CI, 1.14 - 6.79) and having attained secondary/tertiary education (OR 13.2, 95% CI, 1.6 - 29.9) was significantly *(*p < 0.05) associated with herbal medicine use. While, being 50 years and older, (OR 2.3, 95% CI, 0.48 - 10.72), being single (OR 0.92, 95% CI, 0.39 - 2.10), living with diabetes for 3 - 10 years (OR 1.9, 95% CI, 0.79 - 4.75) and being a farmer/retired (OR 1.2, 95% CI, 0.47 - 2.78) were not significantly (p > 0.05) associated with herbal medicine use. Also, having a positive family history of diabetes (OR 0.9, 95% CI, 0.47 - 2.03) and presence of diabetes complications (OR 0.7, 95% CI, 0.29 - 1.56) did not show any significant associations (p > 0.05) with herbal medicine use.

Table 3. Predictors of herbal medicine use in the study population (univariate analysis) N = 123.

Variable	Herbal medicine use		OR	95% CI	*p*-value
	User [n (%)]	Non-user [n (%)]			
Age categories (years)					
<50	2 (13.3)	13 (86.7)	2.3	0.48 - 10.72	0.299
≥50	28 (25.9)	80 (74.1)	Ref		
Gender					
Male	12 (40.0)	18 (60.0)	2.8	1.14 - 6.79	**0.025**
Female	18 (19.4)	75 (80.6)	Ref.		
Marital status					
Single/Divorced	12 (25.5)	35 (74.5)	0.91	0.39 - 2.10	0.817
Married	18 (23.7)	58 (76.3)	Ref		
Diabetes duration					
<3 years	8 (25)	24 (75)	1.1	0.41 - 3.06	0.150
3 - 10 years	18 (29.5)	43 (70.5)	1.9	0.79 - 4.75	0.818
>10 years	4 (13.3)	26 (86.7)	Ref		
Educational level					
Secondary/Tertiary	17 (35.4)	31 (64.6)	13.2	1.63 - 29.98	**0.015**
Primary	12 (24.0)	38 (76.0)	1.7	0.72 - 4.19	0.218
No formal education	1 (4.0)	24 (96.0)	Ref		
Occupation					
Retired/Farmer	19 (31.1)	42 (68.9)	1.2	0.47 - 2.78	0.764
Trader	4 (11.1)	32 (88.9)	0.5	0.17 - 1.14	0.094
Civil servant/Private	7 (26.9)	19 (73.1)	Ref		
Family History of DM					
Yes	14 (21.5)	51 (78.5)	0.9	0.47 - 2.03	0.952
Diabetes Complications					
Yes	5 (17.2)	24 (82.8)	0.7	0.29 - 1.56	0.350

DM: Diabetes mellitus; CI: Confidence interval; OR: Odds ratio.

Multivariate analysis (Table 4), revealed that having attained secondary/tertiary education (OR 10.5, 95% CI, 1.30 - 35.23) was significantly associated with herbal medicine use amongst the study participants.

5. Discussion

The use of herbal medicine in the management of chronic diseases including T2DM is increasingly on the rise in both developing and developed nations [14] [15] [16] [17] [18]. This might be attributed to the fact that herbal extracts are believed to be safe [31] [32] [35], natural and effective in the relief of symptoms in patients [30]. However, very little attention has been focused on the use of herbal medicine in the management of diabetes in our setting. Our study set out to determine the proportion of type 2 diabetics using herbal medicines and to identify the factors associated with herbal medicine use amongst type 2 diabetes patients in the Bamenda III health district of the North West Region of Cameroon.

This study has shown that having attained secondary/tertiary education was an independent predictor of herbal medicine use in our setting. This can be attributed to the fact that herbal medicine use in the management of diseases is an important part of the African culture that is recognized and accepted by most Africans, in spite of the availability of conventional medicine.

This study found that the prevalence of herbal medicine use amongst type 2 diabetics was 24.4% with 37.4 % using both herbs and conventional drugs. The rise in the use of herbs in the management of diseases in our setting might be attributed to the availability of these herbs. In addition, the aggressive nature in which these herbs are advertised and campaigned for in our setting may also be contributing to their high uptake [39] without advice from medical practitioners [40] [41]. However, the use of herbs and conventional drugs increase the risk of drug-herb interactions and reduce the benefits from conventional drugs [42]. These findings are consistent with those obtained in Kuwait [26] and Thailand [27] but lower than those obtained in Nigeria [18], Saudi Arabia [22] and Egypt [24]. This might also be attributed to the high cost of conventional drugs, which

Table 4. Multivariate analysis to identify independent predictors of herbal medicine use in the study population.

Variable	OR	95% CI	*p*-value
Gender			
Male	2.2	0.81 - 7.73	0.125
Female	Ref		
Educational level			
Secondary/Tertiary	10.5	1.30 - 35.23	**0.029**
Primary	1.4	0.53 - 3.49	0.530
No formal education	Ref		

OR: odds ratio, CI: Confidence interval.

usually have side effects [43] [44]. In addition, the fact that herbal medicine treatment methods are culturally in line with the patient's values and beliefs may also explain the upturn in the use of herbs in the management of diabetes [45] [46]. The differences in prevalence might be attributed to differences in the geographical location and levels at which the populations depend on herbs for the management of T2DM. In spite of the differences in the prevalence of herbal medicine use in our study amongst type 2 diabetics, herbal medicine globally is becoming increasingly important in the management of diabetes.

This study also found that a significantly higher proportion of diabetic males and those who have attained secondary/tertiary education used herbal medicines compared to females, a finding in contrast to that obtained in Nigeria [18] [24] and Kuwait [26] but contrary to those obtained in Thailand [27] and Saudi Arabia [22]. In addition, this study found that a higher proportion of T2DM patients who were married used herbal medicines compared to those who were single or divorced but it was not significant. These are similar to those obtained in Kuwait [26], and Thailand [27] but in contrast to those obtained in Nigeria [18]. Again, we found that a higher proportion of BMI-normal weight type 2 diabetics used herbal medicines compared to their BMI-obese counterparts. These findings are contrary to those obtained by Prasopthum *et al.* [27].

In this study, we also observed that T2DM patients who having been living with diabetes for 3 to 10 years used herbal medicines compared to those who have been living with diabetes for more than 10 years. These findings are in contrast to those observed by El Bayoumy *et al.* [26] in 2022 and Huri *et al.* [47] in 2009.

Herbal medicine users had a lower mean FBS compared to non-herbal users. This might be attributed to the fact that some of these herbal extracts has been proven to help in the regeneration of pancreatic beta cells thereby improving blood glucose levels in the patients [34]. Again, we observed that 25.9% of patients 50 years and older used herbal medicine compared to 13.3% of those less than 50 years. In addition, more than 35% of patients who had attained secondary/tertiary education were herbal medicine users compared to 4.0% of those with no formal education. This may reflect better knowledge and awareness of herbal medicine due to higher literacy rates among those with formal education.

The most commonly used herbs were *Vernonia amygdalina* (19.10%) leaves, *Aloe vera* (13.48%), *Mangifera indica* (11.24%) leaves including its bark and *Carica papaya* (8.99%) leaves. This is because these herbs are widely available and thrive well in the country. This finding is in line with that obtained in Nigeria [18] where the *Vernonia amygdalina* leaves (bitter leaf) was the most common herb used by patients in the management of type 2 diabetes. These herbs had different modes of utilization with boiling (78.7%) being the most common mode of utilization. Our study participants also used herbs in the treatment of other diseases with malaria (53.6%) and typhoid fever (39.3%) being the common ailments treated with herbs. More than 50% of our study participants reported advice from friends, relatives, accessibility and availability of traditional medicines

as reasons for using herbal medicines.

Bivariate analysis (unadjusted associations between herbal medicine use and some selected factors) indicated that being male (OR 2.8, 95% CI, 1.14 - 6.79) and having attained secondary/tertiary education (OR = 13.2, 95% CI, 1.6 - 29.9) were significantly $(p < 0.05)$ associated with herbal medicine use. This is because older adults and educated individuals are more likely to seek alternative treatments for their health problems [18]. Similarly, Alrowais [48] in a hospital-based cross-sectional study in Riyadh involving four major hospitals reported that the most frequent herbal medicine users in the management of T2DM were patients aged 60 and 75 years. While, being 50 years and older, (OR 2.3, 95% CI, 0.48 - 10.72), being single (OR 0.92, 95%CI, 0.39 - 2.10), living with diabetes for 3 -10 years (OR 1.9, 95% CI, 0.79 - 4.75) and being a farmer/retired (OR = 1.2, 95% CI, 0.47 - 2.78) were not significantly (p > 0.05) associated with herbal medicine use. Also, having a positive family history of diabetes (OR 0.9, 95% CI, 0.47 - 2.03) and presence of diabetes complications (OR 0.7, 95% CI, 0.29 - 1.56) were not significantly associated with herbal medicine use.

Educational level has been found to positively influence the use of herbal medicine. The multivariate analysis in our study showed that secondary/tertiary education was an independent predictor of herbal medicine use. This finding is in contrast to findings in Morrocco [49].

The limitations of this study included the fact that, the small sample size of the study might have brought about the lack of association between age, marital status and diabetes duration for users of herbs and non-users in the management of T2DM. Finally, the study was carried out only in one region of the country and the cross-sectional nature of this study cannot show elements of causality as such findings might not be a true reflection of herbal medicine use amongst people living with type 2 diabetes in the country. In spite of the limitations of this study, it has provided for the first time data on the factors associated with herbal medicine use amongst type 2 diabetes patients in the management of T2DM in the North West Region of Cameroon.

6. Conclusion

This study amongst T2DM patients in Cameroon has demonstrated that having attained secondary/tertiary education was an independent predictor of herbal medicine use in the management of T2DM in our setting. It is currently unclear if having formal education positively influences herbal medicine use or the fact that a patient has attained secondary/tertiary education is an indicator of herbal medicine use in the management of T2DM in our setting. Therefore, having attained secondary/tertiary education may not be the "causal factor" for herbal medicine use but just an indicator for its use.

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Availability of Data

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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Authors' Contributions

LLN was responsible for the conception and design of the study, directed data collection and organization, statistical analysis and drafting of the manuscript. AYD contributed to the conception and design of the study, participated in data collection as well as interpretation and drafting of the manuscript. LKN contributed to the conception and design of the study, participated in data collection, analysis of data and interpretation of data as well as drafting of the manuscript. SM contributed to the conception and design of the study, participated in data collection, analysis of data as well as interpretation and drafting of the manuscript. All authors read and approved the final version of the manuscript for submission.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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Abbreviations and Acronyms

T2DM	Type 2 diabetes mellitus
CI	Confidence interval
OR	Odds ratio
TM	Traditional medicine
BMI	Body mass index
DM	Diabetes mellitus
WHO	World Health Organization
ADA	American Diabetes Association
ANOVA	Analysis of Variance