

Effect of Medicinal Plants on Lowering Blood Glucose Levels, (Descriptive, Cross-Sectional Study)

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ABSTRACT

A descriptive cross-sectional study was conducted using structured predesigned questionnaires, which were distributed among type II diabetic outpatients registered in (endocrinology clinics) at BMC government hospital and Sede hussien medical center in Benghazi. The data was collected during January to March 2020. A total of 109 questionnaires were distributed among diabetic patients; 100 completed the questionnaires, (response rate= 96%). The results show that (42%) of the diabetic participants used herbal medicines to manage their condition. Statistical analysis was conducted using chi-square test. The results showed that three-quarters of herbal users were women (32%) compared to males. The relationship between education and herbal use was measured, the results displayed that 45% of herbal users were highly educated while about 55% of the consumers had not completed their education. Moreover, we noticed that the majority of herbal medicine users were aged from 51 to 60 years (21%), followed by the group over 60 years and the group from 41 to 50 years (8%), while the age group under 40 years showed the lowest percentage of consumption of medicinal herbs (3%). This can be attributed to the fact that herbal medicine use in the management of diseases is an important part of the Libyan people, which is recognized and accepted by the most of different cultures. These herbs listed in the study questionnaire are widely available in Benghazi and are well known to help in managing type II diabetes.

Keywords: Diabetes Mellitus (DM), medicinal plants, blood sugar, Lamiaceae family, *Ocimum basilicum*, thyme

INTRODUCTION

As a major threat to global health, the diabetes mellitus epidemic is linked to a number of unfavourable outcomes as well as a higher risk of early mortality and disability. Diabetes places a significant financial burden on people with the disease, their families, healthcare institutions, and society as a whole. It results in early mortality, disability, job losses, and disruptions to schooling, all of which have a detrimental impact on a nation's economy. Around one-third of all expenditures, or an estimated US\$ 1.31 trillion, are attributable to these indirect costs [1].

Diabetes Mellitus (DM) is a metabolic disease that presents many difficulties and can affect a patient's entire body's health state, as well as their way of life. Due to the accompanying hyperglycemia, hyperlipidemia, hyperaminoacidemia, and hypoinsulinemia, diabetes mellitus is known to have an impact on numerous physiological bodily functions[2]. Individuals with chronic hyperglycemia face a significant risk of developing long-term macro- and microvascular consequences, including neuropathy, retinopathy, nephropathy, and cardiovascular illnesses [3]. It is now acknowledged that one of the main causes of late-stage diabetic problems is free radicals' capacity to harm biomolecules. According to [4], antioxidant therapy is one of the key therapeutic approaches for managing diabetes in this situation.

Diabetes mellitus (DM) is a rapidly spreading epidemic that impacted 424.9 million people in 2017; by 2045, the number of diabetics is expected to have increased by 48% [5].

Diabetes mellitus is a chronic metabolic disorder marked by elevated blood sugar levels brought on by inefficiencies in the body's ability to produce or use insulin, the hormone that controls blood glucose levels. The International Diabetes Federation estimates that 463 million persons worldwide have diabetes in 2019, and by 2045, that number is predicted to rise to 700 million [6].

Diabetes mellitus (DM) is a dangerous long-term metabolic illness that is linked to hyperglycemia and a number of side effects, such as chronic kidney disease and cardiovascular disease. High blood sugar levels are linked to disruptions in insulin metabolism and homeostasis, which is the cause of diabetes mellitus. Diabetes mellitus (DM) can eventually lead to potentially fatal conditions such heart disease, stroke, kidney damage, and blindness. Despite advancements in treatment over the last few decades, diabetes mellitus still has a high rate of morbidity and mortality. Therefore, in order to reduce the burden of this illness, new therapeutic approaches are required[7].

Diabetes is a long-term illness that has impacted millions of individuals globally. The drawbacks of the present diabetic therapies, such as their high prices and side effects, include insulin therapy and oral medication. As a result, novel and efficient diabetic treatments are required [8]. Diabetes mellitus is a significant local and worldwide issue.[9] state that certain diabetes patients may turn to herbal therapy as an additional method of blood glucose control.

A glucose's physiological significance is crucial. Glycogenolysis, gluconeogenesis, and intestinal absorption during the fed state are the three processes that produce circulating glucose. Glucagon, a hormone generated in the pancreatic α -cells, partially regulates glycogenolysis and gluconeogenesis[10]. Human blood

glucose levels range from 80 to 100 mg/dl. Insulin is secreted in reaction to rising blood glucose levels, and the pancreas is the principal organ engaged in monitoring the organism's nutritional and energetic conditions through blood glucose concentration [11].

An increased blood glucose level causes more glucose to enter the islet of Langerhans' β -cells. additional ATP is generated as a result of the metabolism of additional glucose [12]. The ATP-sensitive K^+ channels (KATP) close in response to an increase in intracellular ATP concentration, which also reduces outward K^+ transport. Extracellular Ca^{2+} enters the cell as a result of the voltage-gated Ca^{2+} channels opening. Increased insulin and lower blood glucose levels result from the exocytosis of insulin-containing vesicles, which is mediated by protein motors and kinases activated by high intracellular Ca^{2+} concentration [13].

As a major danger to world health, the diabetes mellitus epidemic is linked to a number of unfavourable outcomes as well as a higher risk of early mortality and disability. Diabetes places a significant financial burden on people with the disease, their families, healthcare institutions, and society as a whole. It results in early mortality, disability, job losses, and disruptions to schooling, all of which have a detrimental impact on a nation's economy. Around one-third of all expenditures, or an estimated US\$ 1.31 trillion, are attributable to these indirect costs [1].

Numerous plants and marine animals found in Africa are blessed with the ability to treat a wide range of illnesses, including diabetes. Several databases and publications have recorded and proven the traditional usage of these herbs to treat diabetes using a variety of diabetic models. Nevertheless, the majority of studies on African medicinal plants as potential diabetes treatments stop at the proof-of-concept phase. Furthermore, the efficacy in humans was validated by a small number of clinical trials, and the limited number of clinical studies that are now available have not undergone a critical evaluation[14].

According to [15], people use herbal medicine for a range of medical requirements, including the prevention of disease and the treatment of chronic conditions like cancer, diabetes, dyslipidemia, hypertension, and inflammatory bowel disorders. The curative and long-term source for many diseases continues to be the use of medicinal plants for the prevention and treatment of various conditions, most notably diabetes [16].

An endocrine system metabolic condition is diabetes mellitus. This terrible illness is present everywhere in the world and is rapidly endangering human health. Many pharmaceuticals are available to manage and treat diabetic patients, but in recent years, research has looked into the potential benefits of a number of medicinal plants for the disease. These plants' actions have the potential to cure metabolic imbalances and postpone the onset of diabetes consequences. Many phytoconstituents derived from hypoglycemic plants have been found to have antidiuretic properties[17].

Around the world, people use herbal remedies differently depending on where they live, but lately, their use has become more common. Comparable rates have been discovered in the Arab countries. In Arab countries, almost 80% of the populace uses herbal remedies to prevent and cure illnesses [18].

For example, according to [19], 37% of Egyptians reported taking herbal medications, whereas [2] found that a greater percentage of Saudi Arabians (73%) reported using herbal medicines. Due to historical, cultural, and sociological aspects, herbal medicine has remained popular in Jordan [20]. Traditional herbal medicine is most often used for the following reasons: it is less expensive, more in line with the patient's beliefs, eliminates worries about the negative effects of chemical (synthetic) medicines, meets the need for more individualised care, and makes health information more accessible to the general public [21].

Globally, individuals with chronic illnesses are increasingly turning to herbal

therapy as a form of treatment. Without first contacting their medical providers, many diabetics with herbal medicine use[22]. Globally, the practice of using herbal medicine (HM) as a self-management tool to treat a variety of illnesses has grown in popularity. Without being aware of potential herb-drug interactions (HDIs), consumers co-administer herbal products with conventional treatment [23].

There are over 350 species in the genus *Thymus* (Lamiaceae), the majority of which have a significant essential oil concentration [24,25]. According to **Meresa *et al.* (2017)**, the plant's whole components, leaves, or blossoms are traditionally crushed and drank as a tea to treat a variety of ailments, such as diabetes, high blood pressure, general pain syndrome, abdominal pain, intestinal parasites, and renal disease[26].

Thyme is a perennial herbaceous plant belonging to the Lamiaceae family that is used all over the world for culinary, medicinal, and cosmetic purposes. According to **Li *et al.* (2019)**, this herb possesses unique antispasmodic, antiseptic, expectorant, antioxidant, and antibacterial properties [27]. *Thymus vulgaris* also contains triterpenes, polyphenols, tannins, and flavonoids. Lutein, apigenin, naringenin, eriodictyol, cirsilineol, salvigenin, cirsimaritin, thymoine, and thymusine are examples of flavonoids. Ursolic and oleanolic acids are examples of triterpenes [28].

According to reports, extracts of *Ocimum basilicum* (Lamiaceae), usually referred to as "Holy basil," have a variety of pharmacological actions, such as the ability to reduce blood sugar and have hepatoprotective qualities [29,30]. Over the past several decades, there has been an increase in the frequency of diabetes and associated consequences. It is anticipated that the prevalence of diabetes will double in the upcoming year. Diabetes problems are significantly influenced by chronic hyperglycemia, which is defined as increased advanced glycation end products. *Ocimum basilicum*, a plant native to Southeast Asia and India, is utilised

extensively in empirical research to lower blood sugar levels in individuals with diabetes [31]. It is now acknowledged that one of the main causes of late-stage diabetic problems is free radicals' capacity to harm biomolecules [32].

MATERIALS AND METHODS

A descriptive, cross-sectional study design using structured predesigned questionnaires which were distributed

Table (1): Gender of the patients		
Gender	Uses herbal medicine	Doesn't use herbal medicine
Male	10	20
Female	32	38

among type II diabetic outpatients registered at BMC government hospital and Sede hussien medical center which have endocrinology clinics were involved in Benghazi was conducted for the period from January to March 2020.

• Sampling and recruitment strategies

Sample size and recruiting patients, all ≥ 18 years old patients diagnosed with type II diabetes, not pregnant and who were able to take part were included and interviewed during their visits for follow-up care at endocrinology clinics/medical centres or for refill medications, all of them were verbally asked to participate after the study purpose was explained and they were provided with informed consent forms to sign before participation.

Due to time limitations in the sample hospitals, only 109 patients took part in this project. Owing to the fact that it was difficult to obtain the number of registered patients in Internal Medicine departments and endocrinology clinics in Benghazi during COVID19 time.

• Study instrument

A literature review was undertaken to develop both questionnaires to assess the prevalence of herbal usage and evaluate the knowledge, attitudes and beliefs of diabetic patients regarding herbal medicine. After drafting the initial version of each

questionnaire, the advisory group (i.e. pharmacy academic staff) were given these questionnaires to comment on the wording and the content, as per the requirements of the quality assessment. Comments and feedback were obtained and the final questionnaire was developed subsequently. The questionnaire was then piloted to five randomly chosen diabetic patients in one of the endocrinology clinics for feedback on wording, understanding, and ease of use. This helped to assess the feasibility of the questionnaire and acted as a method of face validity. Data collected from the pilot study were not included in the final analysis. The questionnaires were constructed in several parts and covered knowledge, attitudes and beliefs regarding herbal usage.

The questionnaire was divided into two sections, the first focusing on patient-related information such as age, gender, living area, education level and presence of comorbidities, and the second investigated the prevalence of herbal product usage, knowledge of correct usage and disclosure of usage to their doctors. The questionnaire was conducted in Arabic for the patients' convenience.

To ensure this, steps were taken to follow the protocol for data collection. Questionnaires were distributed by the researchers, who were trained to interview participants at the diabetic clinics, to ensure they were received by the target populations. Moreover, data collection was performed on one single occasion and the collected data from all involved hospitals were subsequently analysed. To reduce the inadvertent bias in interpreting responses from open-ended questions, closed questions were chosen.

• Data processing and analysis

The completed survey was processed and analyzed using a quantitative procedure conducted using the statistical methods available in the Statistical Package for the Social Sciences (SPSS 26 software). The descriptive statistics were generated and possible relationships between different variables were assessed using a chi-square test.

RESULTS AND DISCUSSION

A) Gender of the patients

Results in **Table (1) and Figs. (1-3)** explained the percentage of use and non-use of medicinal herbs by males and females. Generally, the results showed that females excelled in the percentage of using medicinal herbs that lowered blood sugar (32%) compared to males, where the lowest percentage of this medicinal herbs was recorded (10%).

Patients with diabetes are more likely to take herbal medication if they are older and/or female. These influences are emphasised in studies from Turkey, Indonesia, Saudi Arabia, and Cameroon. In Cameroon, men used herbal medicine more frequently than women did, and usage was positively impacted by education level as well [33].

In Saudi Arabia, however, patients with diabetes did not exhibit statistically significant correlations between age or gender and the usage of herbal medicine [34]. However, there was a notable difference in the usage of herbal products in Turkey according to gender and education, with women and those with higher levels of education exhibiting a predilection for them [35]. Furthermore, the bulk of Indonesians using herbal medication were women between the ages of 40 and 65, suggesting that patients with diabetes have a predilection for herbal therapies based on their gender and age [34].

Numerous studies conducted globally have yielded comparable findings; yet, among Swedish adults (16–84 years of age), the usage is connected to age, gender, and a number of sociodemographic and health-related behavioural characteristics [36]. Women appear to take dietary supplements more frequently than men do, and both sexes use them more frequently in older people [26]. Furthermore, research indicates that women are more likely than men to take HMPs, and that men's use of HMPs may rise as they age [37]. It was discovered that one-third of the elderly took dietary supplements or HMPs. When it came to the likelihood of being users, women outnumbered men. Moreover, use declined with advancing years. Women are aware of medicinal plants, and many of

them between 60% and 75%, depending on the ailment-think that these remedies are superior to or on par with medications. Plants are still used by women, and many of them are grown in gardens. Lastly, the ladies who were interviewed said that the custom of using plants is still being passed down. This implies that there is a vibrant history of using medicinal plants in this urban setting. Age and sex have already been demonstrated to be the most significant variables in the use of HMPs [26]. The usage of HMPs exclusively did not differ significantly between men and women, according to our research. Nevertheless, according to various regional studies conducted in Swedish, older women take HMPs at a higher rate than males do [36,38]. As previously demonstrated by others, nearly one-third of the women and one-fifth of the men in this study took HMPs and/or food supplements [38].

According to surveys done in various health centres, women make up the majority of participants. This could be because women in Spain visit pharmacies, doctors, and nurses more frequently, and they are also more satisfied with complementary and alternative therapies [39]. The majority of people who practice alternative medicine do so with the justification that they are either treating or preventing an existing condition. The fact that women tend to be more aware of their health status than males could be one reason for the gender gap. According to a number of research, women are more likely than males to take care of their perceived health [40]. Previous research has observed a positive relationship between the use of medicinal plants and age [41]. The conclusion that younger women appear to know as much as older women, however, is inconsistent with research conducted in other parts of the world [42]. Nonetheless, some research indicates that there is no correlation between age and knowledge of medicinal plants [43]. Another source has proposed a hypothesis that could reconcile these two observations [44].

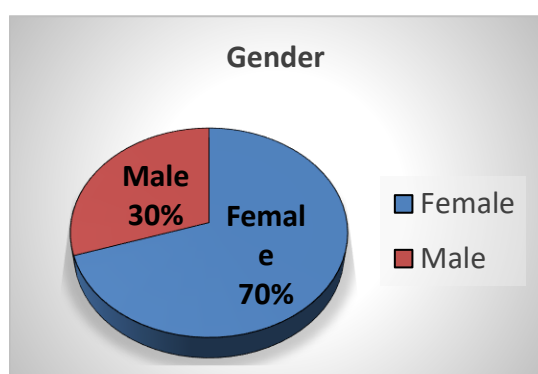


Fig (1) : Gender of patients

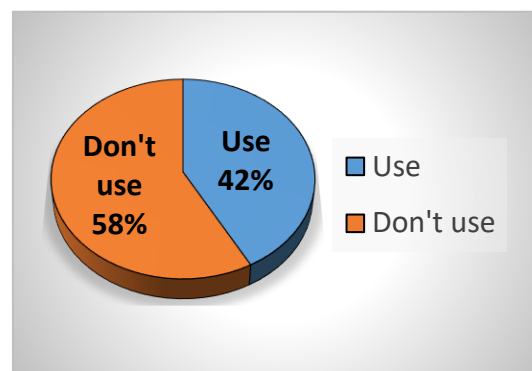


Fig (2) : Use of herbal medicine

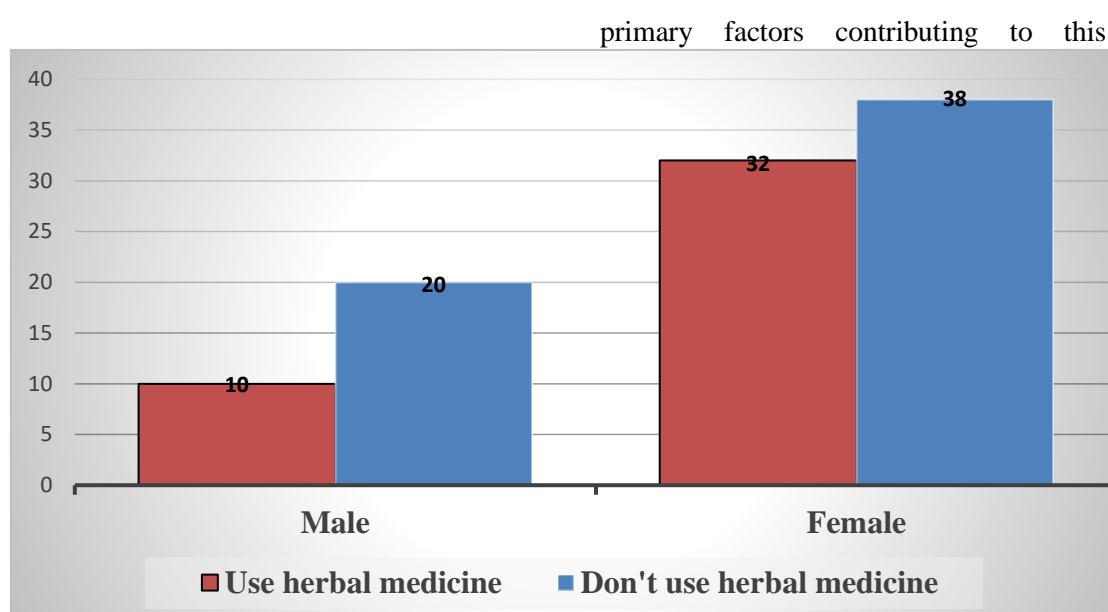


Fig (3) : The relation between gender and the use of herbal medicine

B) Ages of the patients used the medicinal herbs

Results in **Table (2)** and **Figs. (4 and 5)** showed that, the age group ranges from 51 to 60 years most commonly used medicinal herbs (21%), followed by age group over 60 years and age group from 41 to 50 years (8 %), while age group less than 40 years it was less used medicinal herbs (3%).

Demographic statistics (e.g., active population percentage, 43.6%; age range, 55.3% for 18–44, 27.3% for 45–64, and 17.3% for ≥ 65 years) are demonstrated to be representative (**INEbase 2017**). The

discovery are the ease of use and the consumers' perceptions of safety and efficacy. According to this survey, young women with higher levels of education who are between the ages of 18 and 44 most frequently consume medicinal plants. There are statistically significant variations in the frequency of consumption based on respondents' gender, with women reporting higher consumption rates. Prior research has also validated the high frequency of female predilection for medicinal herbs [45].

Additionally, a statistically significant result for age ranges was discovered: respondents between the ages of 18 and 44 drank medicinal herbs more frequently than those between the ages of 45 and 64 ($P = 0,010$) and even more

frequently than those above 65 ($P < 0,001$). This pattern is in contrast to research conducted in other regions of Europe, where older individuals consume more frequently than younger individuals [46]. Furthermore, research from the United States revealed that middle-aged individuals consume medicinal herbs more frequently [47].

Because they are more inclined to look for alternative forms of treatment, older persons (those between the ages of 46 and 60) typically use more herbs than younger people. Similarly, patients between the ages of 60 and 75 were found to be the most regular consumers of herbs for the management of their diabetes in Alrowais' cross-sectional survey, which was carried out in four major hospitals in Riyadh [48]. This study supports the findings of studies on gender differences conducted by Ching, Amaeze, and Mekuria, which indicated that women were more likely than males to use herbal treatments [49,50,51]. Taiwanese study found that individuals between the ages of 20 and 69 used traditional Chinese medicine far more frequently in a similar vein, **Alrowais (2002)** found that patients between the ages of 60 and 75 used herbal medicines the most frequently for the treatment of type 2 diabetes in a hospital-based cross-sectional study conducted in Riyadh encompassing four major hospitals [48]. While having diabetes for three to ten years (OR 1.9, 95% CI, 0.79-4.75), being 50 years of age or older (OR 2.3, 95% CI, 0.48 - 10.72), being single (OR 0.92, 95% CI, 0.39 - 2.10), and being a farmer or retired (OR = 1.2, 95% CI, 0.47 - 2.78) were not significantly ($p > 0.05$) associated with using herbal medicine. Additionally, there was no significant correlation found between the use of herbal medicines and having a positive family history of diabetes (OR 0.9, 95% CI, 0.47-2.03) or the existence of diabetic complications (OR 0.7, 95% CI, 0.29 - 1.56). This result is also in line with the **Ministry of Health of the Republic of Indonesia (2018)** in the DKI Jakarta Regional Health Research which found that people over the age of 35 had a habit of consuming herbal medicine from

traditional medicinal plant so that they were used to consume medicinal plants as a self-medication effort [52].

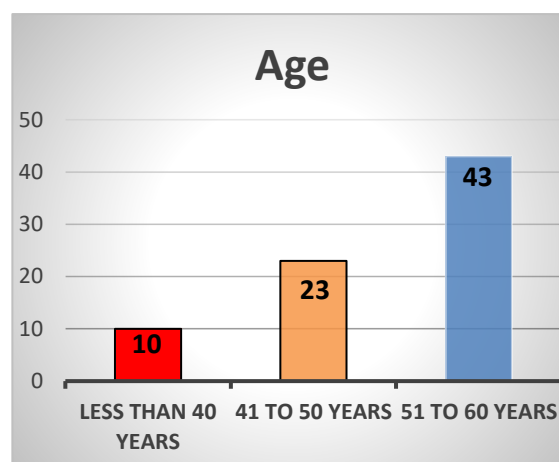


Fig. (4): Ages of the patients

Table (2): Ages of the patients used the medicinal herbs

Age group	Uses herbal medicine	Doesn't use herbal medicine
Less than 40 years	3	7
41 to 50 years	8	15
51 to 60 years	21	22
Over 60	10	14

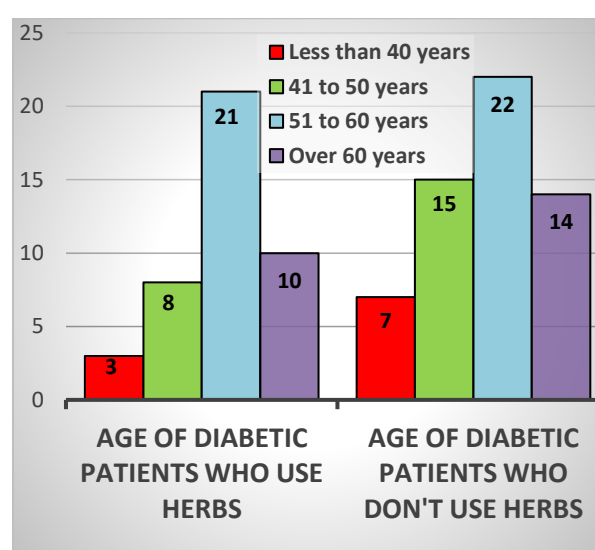


Fig. (5) : The relation between age and the use of medicinal herbs

C) Education of the patients used the medicinal herbs

Results presented in **Table (3) and Figs. (6 and 7)** explained that, the more advanced the educational stage, the greater the awareness of the use of medicinal herbs to lower blood sugar levels. In general, the results showed that university stage students are more commonly used medicinal herbs (19%), followed by primary school students (13%) and secondary stage (10%).

According to this study, using herbal medicines in our setting was independently predicted by having completed secondary or postsecondary education. This is explained by the fact that, despite the accessibility of conventional medicine, the use of herbal medicine in the treatment of illness is an integral aspect of African culture that the majority of Africans recognise and accept.

Compared to those who did not utilise herbal medicine, those who did had a lower mean FBS. This may be explained by the fact that certain herbal extracts have been shown to aid in the regeneration of pancreatic beta cells, which in turn helps patients' blood glucose levels [53]. Once more, we found that whilst 13.3% of patients under 50 years old used herbal therapy, 25.9% of individuals 50 years and above utilised it. Furthermore, compared to 4.0% of patients with no formal education, over 35% of patients who had completed secondary or tertiary education used herbal medicines. Given that more people with formal education have higher literacy rates, this may indicate more knowledge and awareness of herbal therapy.

This is a result of the increased likelihood that educated and older folks may look for alternative treatments for their health issues [49]. The usage of herbal medicine has been proven to be positively influenced by educational attainment. Our study's multivariate analysis revealed that the usage of herbal medicines was independently predicted by secondary or postsecondary education. This result differs from that of Morocco [54].

The use of herbal products is not positively correlated with age, gender, or occupation. Nonetheless, when it comes to the decision to use herbal products, consumers' educational attainment and the amount of product processing have a strong positive correlation [55].

This is because, in these countries, women control the majority of decisions about family healthcare, are more receptive to new ideas, and are more likely than males to favour complementary and alternative medicine (**Shih et al., 2012**). Here, it was discovered that 26.6% of herbal users had only completed primary school, and 31% had not finished their schooling. 58% of the Turkish herbal medicine users in Ilhan's study had only completed their primary education, according to the findings[56]. But according to research done in the United Arab Emirates by [57], patients with higher levels of education secondary and tertiary were the ones who used herbs the most frequently. According to **Baseline Health Research (2018)**, as education levels have increased, the proportion of people using traditional health services (pelayanan kesehatan tradisional, or yankestrad) has increased, while the proportion of people consuming herbal medicine as a medicinal plant in self-medication efforts has decreased [52].

Additionally, using natural products to support a healthy lifestyle and mentality is becoming more and more popular, especially among younger people with higher educational levels[58,46].

Both in developing and developed countries, the use of herbal medicine is growing in the management of chronic illnesses, such as type 2 diabetes (T2DM) [50,59,60]. This could be explained by the belief that herbal extracts are natural, safe, and efficient at relieving patients' symptoms [61,62]. On the other hand, the application of herbal medicine in our context for the treatment of diabetes has received very little attention. In addition, this study discovered that a significantly higher percentage of males with diabetes and those with secondary or tertiary education used herbal medicines than did

females. These findings are in contrast to those made in Kuwait [22] and Nigeria

[49,63], but also to those made in Thailand [64] and Saudi Arabia [65].

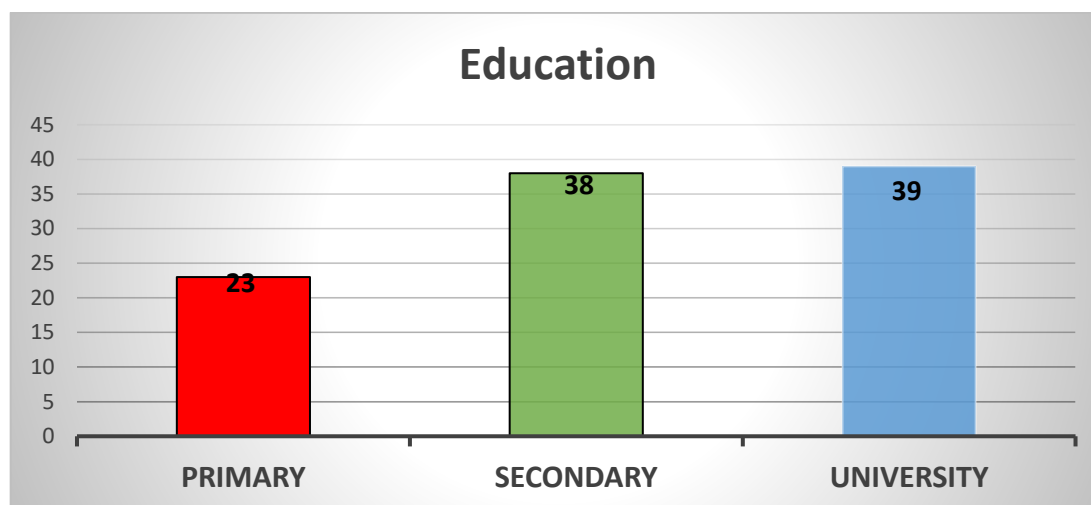


Fig (6) : Education of patients

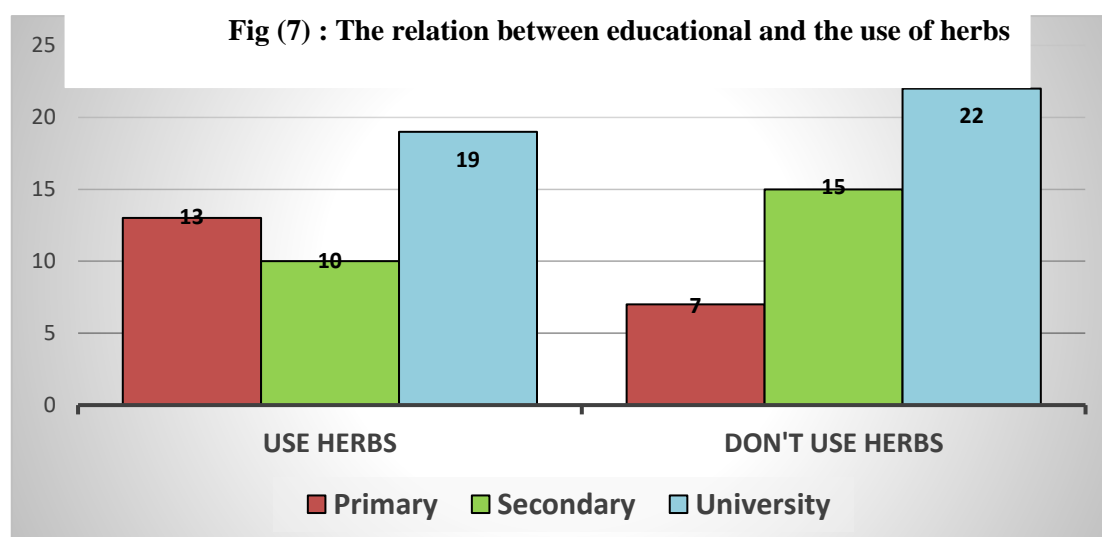


Fig (7) : The relation between educational and the use of herbs

Table (3): correlation between educational and the use of herbs

Education	Uses herbal medicine	Doesn't use herbal medicine
Primary	13	10
Secondary	10	28
University	19	20

Conclusion

This research revealed that managing blood glucose levels with herbal medicine is common practice among diabetic patients and many patients did not disclose this to their doctors, indicating a gap or miscommunication in their

relationship which has an impact on patient health. Thus, doctors need to ask patients about herbal usage, encourage them to talk about it, and be aware of the most recent updates in this rapidly changing field in order to be able to give sound advice on the proper use of herbs for diabetes management. In addition, perception about herb effectiveness and safety is high, suggesting that the general public needs to be educated about the possible harms caused by self-medicating with herbs. The Ministry of Health as well as individual healthcare providers need to consider how current media channels may be used for this type of educational purpose. More government-based research and educational programmes about herbs for diabetes are needed in Benghazi to maximize the benefits and minimize the side effects.

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