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SHORT COMMUNICATION

The Effect of Traditional Home Remedies on Glycemic Control among People with Type 2 Diabetes Mellitus (T2DM)

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Abstract

Traditional home remedy consumption is a typical ancient practice in India. These traditional home remedies are found to have beneficial effects on many chronic conditions. This study was designed to explore the effect of traditional home remedies on glycemic control in people with type 2 Diabetes Mellitus (DM). In this study, 148 type-2 DM patients aged between 35 and 70 of both genders, participated. Among 148 type-2 DM patients, 102 T2DM patients use traditional home remedies along with oral anti-diabetic drugs, while the remaining 46 are non-users. The details of age, duration of type-2 DM, glycated Hb (HbA1c) values, and use of traditional home remedies were obtained from a cross-sectional survey. The HbA1c value of 7-8% was considered an optimal target glycemic control, and ≤ 7% was considered poor control. A mean and SD were used to represent descriptive statistics. An independent sample test was used to compare the mean HBA1c between the fenugreek users and non-users by considering $p<0.05$ as statistically significant. The majority of type-2 DM in our study group used *Trigonella foenum-graecum* (Fenugreek) (76.47%). A small proportion of our study group is using *Azadirachta indica* (Indian lilac or neem) (7.84%), *Momordica charantia* (bitter guard) (3.93%), and *Aegle marmelos L.* (Bengal quince or bael) (2.94%). The HbA1c levels in the majority of the traditional home remedy users were within the recommended target levels. The mean HbA1c levels of fenugreek non-users were significantly higher ($p<0.001$) than fenugreek users. In conclusion, our study shows that type-2 DM traditional home remedy users have better glycemic control than non-users. Home remedies are potent natural food sources that can be used with anti-diabetic drugs. However, such a use should be done with the knowledge of treating doctors, which may help to achieve better glycemic control and prevent type-2 DM-related complications.

Keywords: Bittergourd, Fenugreek, Neem, Traditional Home Remedy, Type 2 Diabetes Mellitus

1. Introduction

Diabetes mellitus is a metabolic disorder characterized by chronic hyperglycemia due to defects in insulin secretion, insulin action, or both[1]. According to the International Diabetic Federation 2019, approximately 463 million adults aged 20 - 79 years old have DM. This disease is expected to spike to 700 million in the year

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2045[2]. Experts project that the incidence of diabetes is set to increase by 64% between 2010 and 2025[3]. If narrowed to Asians, the prevalence of diabetes and Impaired Glucose Tolerance (IGT) are high in most Asian countries and are projected to rise further over the next two decades. The latest trend reveals that Asia will be contributing to more than 60% of the world's diabetic population[4]. The diabetes problem is nowhere more severe than in India, as estimates from the World Health Organization (WHO) indicate that the diabetic population is increasing alarmingly and is predicted to reach 69.9 million by the year 2025 and 80 million by the year 2030[5]. Studies show that in urban Indian adults, the prevalence of diabetes is about 12.1%. The onset is a decade earlier compared to the western population. The researchers opine that the prevalence of Type 2 diabetes is 4-6 times higher in urban areas than in rural areas[6].

Diabetes mellitus is classified into type-1 and type-2, and type-1 diabetes mellitus is due to the complete absence of insulin production due to the complete destruction of the beta cells of the pancreas. Type-2 DM is due to impaired insulin production or insulin resistance in the targeted organs. Type-2 DM has multiple risk factors like obesity, binge-eating, lack of physical activity, stress, and ageing[1]. The treatment choices available for diabetic patients are mainly oral anti-diabetic medicines or insulin[7]. In addition to anti-diabetic drugs, dietary intervention and increased physical activity such as walking and exercise (running, cycling, etc.) are key components of type-2 DM management in both disease and prevention control[8]. Other than anti-diabetic medicines, people worldwide use alternative medical modalities such as Ayurveda, Homeopathy, Unani, Chinese medicine, acupuncture and Sidda. Also, there is a practice of using locally available herbs as an ancient practice. The effects of many of these herbs and alternative medicines are not scientifically proven. Still, people use them with the belief that they help control DM by lowering blood glucose levels.

Traditional Home Remedies (THR) consumption is an ancient practice in India. This concept appeared and developed between 2500-500BC in India. These herbs have been documented in the ancient medical system, and are even mentioned in ancient Vedas and scriptures. Some herbal remedies are still used to treat many diseases that lack modern treatments[9]. Traditional home remedies such as *Coccinia indica* (Ivy gourd), *Ocimum tenuiflorum* (holy basil), *Trigonella foenum-graecum* (Fenugreek), *Gymnema Sylvestre* (Gurmar), *Cinnamomum tamala* (Malabar leaves), *Eugenia jambolana* (Java Plum) and *Momordica charantia* (bitter guard) are commonly used in India. Previous studies have shown that some of these herbs have been beneficial in reducing blood glucose levels[10].

In most instances, traditional home remedy consumption is done without the knowledge of treating doctors. Since both traditional home remedies and anti-diabetic drugs lower the blood glucose level, the treating doctors need to know whether their patients are taking any traditional home remedies to maintain a synergic dose so as to prevent hypoglycemia. Similarly, type-2 DM patients should also see the effects of these traditional home remedies before using them to prevent the combined adverse effects such as hypoglycemia. This could be best achieved by understanding the pattern of traditional herb consumption in the community and its impact on disease management. So, we have designed this study to explore the practice of home remedy consumption in type-2 DM patients in south India and compare the glycemic control between traditional home remedy users and non-users.

2. Materials and Methods

2.1 Study Design

This study is a cross-sectional survey conducted on T2DM patients from predominantly rural and suburban communities of Udupi Taluk, Karnataka, South India.

2.2 Study Participants

The participants included in the research study were people with type-2 DM on oral anti-diabetic drugs. 148 type-2 DM patients of both genders from 467 participants matching our inclusion criteria were included in the study. The participants' mean age and duration of type-2 DM were 55 years and seven years, respectively.

2.3 Inclusion and Exclusion Criteria

Among 148 people with type-2 DM, 102 participants took traditional home remedies orally in the raw form and/or oral anti-diabetic drugs. The remaining 46 people with type-2 DM are on oral anti-diabetic medicines but are not taking any traditional home remedies. Both

groups have male and female participants aged between (35-70), and they are on regular follow-up. All these patients are following a diabetic diet with a practice of mixed diet and exercise regularly.

We have excluded all Type-1 DM patients from our study. The type-2 DM patients on insulin and who reported complications are also excluded from this study. Type-2 diabetes mellitus patients on alternative medicines and not on a regular diet regime are also excluded.

2.4 Ethical Consideration

Before the data collection, the study protocol was approved by the Manipal Academy of Higher Education research committee, and Ethical clearance (IEC 453/2016) was obtained from the Ethics Committee of Manipal Academy of Higher Education. This study protocol is registered with the Clinical Trials Registry of India (bearing the registration number: CTRI/2017/02/007945).

2.5 Data Collection Method

The data was collected using a proforma that included demographic details, diabetes-related information, and specific details on traditional home remedies used for the management type - 2 DM. The HbA1c is the most suitable method to monitor glycemic control because it reflects the mean plasma glucose level for the past 2-3 months[11]. HbA1c was measured using Tina-quant® HbA1c third Generation immunoassay using Cobas c501 from Roche. According to the American Diabetic Association (ADA), the glycaemic status is categorised as "good glycaemic control" when the HbA1c level is between 7-8% and "poor glycaemic control" if the HbA1c level is ≥7%[12].

2.6 Details of Traditional Home Remedies used

The traditional home remedy consumption details were used using a questionnaire and reported in a local Indian language. We have translated that to English and included the scientific name. The detailed traditional home remedies used in the study group are listed in Table 1. *Trigonella foenum-graecum* (Fenugreek), *Azadirachta indica* (Indian lilac), *Aegle marmelos L.* (Bengal quince), *Momordica charantia* (Bitter gourd), *Plectranthus amboinicus* (Mexican mint), *Averrhoa bilimbi* (Cucumber tree), *Elettaria cardamomum* (Cardamom), *Ribes uva-crispa* (Gooseberry), *Withania somnifera* (Indian ginseng), *Costus igneus* (Insulin leaves), *Mangifera indica* (Mango leaves) and *Calotropis gigantea* (Crown flower). The participants were consuming these herbs along with their food

Table 1.

Home Remedy-Type	Age	Duration	HbA1c (%)
Non users (n=46)	55.7±7.71	7.2±4.8	8.3±1.9
Trigonella foenum-graecum (Fenugreek) (n=78)	55.2±8.9	6.8±5.1	7.8±1.7
Azadirachta indica (Indian lilac) (n=8)	55.0±5.9	5.9±4.6	7.7±1.9
Aegle marmelos L. (Bengal quince) (n=4)	53.0±9.1	1.6±1.5	10.9±3.0
Momordica charantia (Bitter gourd) (n=3)	59.0±9.5	9.0±6.6	7.1±0.3
Calotropis gigantea (crown flower) (n=2)	58.5±9.2	10.0±7.1	8.5±1.2
Plectranthus amboinicus (Mexican mint) (n=1)	64.0	14.0	5.7
Averrhoa bilimbi (Cucumber tree) (n=1)	57.0	19.0	7.3
Elettaria cardamomum (Cardomom) (n=1)	63.0	5.0	6.4
Ribes uva-crispa (Gooseberry) (n=1)	56.0	11.0	9.9
Withania somnifera (Indian ginseng) (n=1)	62.0	5.0	5.5
Costus igneus (Insulin leaves) (n=1)	62.0	9.0	10.6
Mangifera indica (Dry mango leaves) (n=1)	63.0	4.0	6.5

in addition to anti-diabetic medicine as a traditional practice.

2.7 Statistical Analysis

All the data were analyzed using Statistical Package 23 for Social Sciences (SPSS). All quantitative variables were estimated using measures of central location (mean) and dispersion (standard deviation). Fenugreek was found to be commonly consumed by these type-2 DM patients. So we have used an independent sample test (t-test) to compare the mean HBA1c between the groups consuming the fenugreek and age, duration of type-2DM and sex-matched non-users.

3. Results

According to our study (Figure 1), *Trigonella foenum-graecum* has the highest traditional home remedy consumption (76.47%) among the people with type-2 DM in Coastal Karnataka. *Azadirachta indica* recorded the second-highest home remedy consumption (7.84%), followed by *Aegle marmelos L.* (3.93%) then *Momordica charantia* (2.94%) and *Calotropis gigantean* (1.96%). The other home remedies found an equal percentage of consumption (0.98%) among these participants in the respective study area.

As depicted in Table 2 below, most participants who consume traditional home remedies have an HbA1c level within the recommended optimal target levels. Type-2 DM patients consuming Fenugreek, Indian lilac, and bitter gourd have a mean HbA1c level of 7.8%, 7.7%, and 7.1%. Despite having a low consumption rate among participants, Mexican mint, cucumber tree, cardomom, Indian ginseng, and dry mango leaves also showed a mean HbA1c level (5.7%, 7.3%, 6.4%, 5.5%, and 6.5%) within the recommended target. However, mean HbA1c levels in Bengal quince, Crown flower, Gooseberry, and insulin leaf users were higher than recommended HbA1c levels.

Table 2.

	TYPE-2 DM PATIENTS	
	Home remedy (fenugreek) non-users (n=46)	**Home remedy users (fenugreek) (n=46)**
Age (mean ± SD)	55.7± 7.7	56.2±7.4
Duration (mean ± SD)	7.1±4.8	6.9±4.5
HbA1c (mean ± SD)	8.3±1.9	7.2±1.1**

**=p<0.001(2-tailed) when compared to non-users of fenugreek

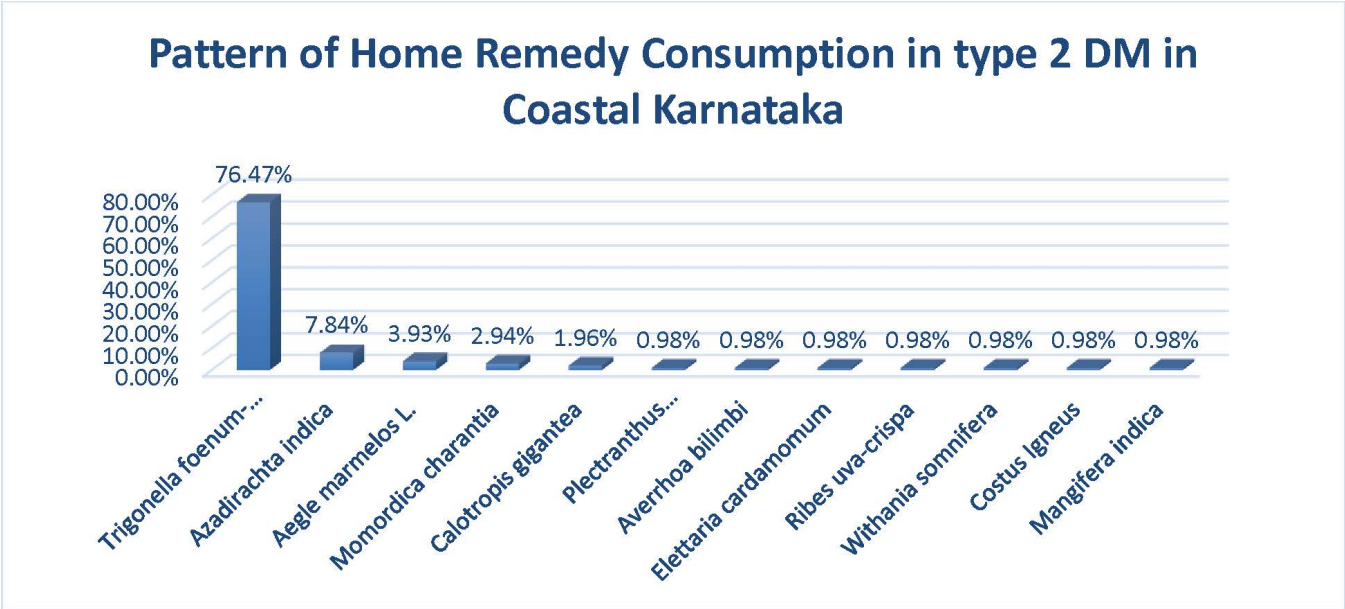

Figure 1.

Table 2 shows an independent t-test to compare the mean HbA1c between age, sex and duration-matched traditional home remedy users and non-users. A significant decrease in the HbA1c ($p<0.001$) levels was observed in traditional home remedy users compared to non-users.

4. Discussion

Home remedies are related to an ancient practice in coastal Karnataka because they are freely available and locally grown. Based on our study, the most commonly used traditional medicine in coastal Karnataka is *Trigonella foenum-graecum*. India is the largest producer, so it is freely available and cost-effective. Fenugreek is used in most food preparation, both in dried and fresh forms[13,14]. It is also stated that most people in Karnataka are aware of the protective effects of fenugreek, bitter gourd, neem leaves and bael leaves as traditional herbs in diabetes mellitus[15]. *Azadirachta indica is* the second-highest used in our study group, followed by *Aegle marmelos* L and *Momordica charantia*. The other traditional home remedy consumption was very minimal in our study group.

The HbA1c levels in fenugreek, bitter gourd, and neem users are within the recommended target. The neem tree is commonly seen in most households in this region. Neem has been proven to reduce serum glucose levels by increasing the insulin receptor proteins, including the tyrosine phosphorylation (Tyr632) of Insulin Receptor Substrate-1 protein (IRS-1), an essential step for insulin signaling. It also reduces serine phosphorylation (Ser636) in IRS-1[16]. Effective glycemic control in neem users of our study group can be related to the hypoglycemic actions of neem, as reported in the literature. Like neem, bitter gourd is also commonly used in the diet. Previous studies have reported that bitter gourd lowers blood glucose levels due to insulin-like molecules within it[17]. In addition to glycolysis and gluconeogenic enzymes, pancreatic beta cells and lipid regulation also act on insulin signaling pathways to lower blood glucose[18]. We relate the better glycemic control of the bitter gourd users in the study group to hypoglycemic actions reported by earlier studies.

The third highest users in our group were Bengal quince. Previous studies have reported that it controls blood glucose levels by inhibiting hepatic glucose output. It also increases insulin sensitivity in the muscles and liver without causing weight gain[19]. The mean HbA1c levels in the four Bengal quince users were higher than the recommended target. It is interesting to see that the mean duration of type-2 DM in these patients is 1.6 years. The inadequate quantity of Bengal quince and non-compliance may be possible reasons for poor glycemic control; however, details are unavailable. *Plectranthus amboinicus, Elettaria cardamomum, Withania somnifera* and *Mangifera indica* users had excellent control of HbA1c. In contrast, the rest of the home remedies have HbA1c levels higher than the recommended target. Overall, the remaining traditional home remedy user's sample sizes were tiny, other than fenugreek. These values do not carry a great significance to relate the poor or better glycemic control due to their use.

Our study compared HbA1c levels between age-sex and duration-matched fenugreek users and non-users and found them to be highly significant, indicating better glycemic control. This is in line with previous studies which reported that fenugreek is helpful in glycemic control in people with type-2 DM[14,20–22]. Fenugreek is a well-known herb from the family *Fabaceae,* and several studies have shown its usefulness in DM and obesity[23]. As per earlier studies, fenugreek contains 4-hydroxy isoleucine (4-OH-Ile), which exhibits insulinotropic and hypoglycemic properties. In humans, fenugreek induces glucose-dependent insulin secretion from pancreatic beta cells.

Furthermore, fenugreek also helps translocate the GLUT-4 transporters, increasing adipose tissue and muscle glucose uptake to reduce blood glucose[24]. Overall, we report that fenugreek consumers have better glycemic control and that using them along with anti-diabetic medication might be beneficial. We relate better glycemic control in fenugreek users to its insulinotropic and hypoglycemic actions. The type of oral anti-diabetic drugs, the dosage of fenugreek and details of synergy between anti-diabetic drugs and fenugreek were not available in our study. So, we recommend further studies in larger populations by exploring the dose of fenugreek, the type of anti-diabetic drug and the synergy between them.

5. Limitations

A few limitations of our study are the limited sample size, lack of patient compliance details, and lack of

dosage details of traditional remedy usage by each subject.

6. Conclusion

Our study shows that type-2 DM traditional home remedy users have better glycemic control than non-users. Home remedies are potent natural food sources and have proven beneficial in lowering blood glucose. The ancient practice of home remedy use can be continued by type 2-DM patients considering its benefits for glycemic control. However, such use should be done with the knowledge of treating doctors. Also, information on the actions of different traditional home remedies on glycemic control is made available to both treating doctors and type-2 DM patients. Overall, we believe the information will help patients and treating doctors control type 2-DM and efficiently prevent related complications.

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