Original Article

A CROSS-SECTIONAL OBSERVATIONAL STUDY ON MISCONCEPTIONS ABOUT DIABETES AND RISK OF HYPOGLYCEMIA WITH CONCURRENT USE OF NATURAL HERBS/HERBAL PRODUCTS

A. SRINIVASAN, JITTA MARY JOSE, MEGHA K. BAIJU, SMRITI SURESH GEORGE

JKK Munirajah Medical Research Foundation College of Pharmacy Ethirmedu, B. komarapalayam 638183, Namakkal Dt, Tamil Nadu, The Tamilnadu Dr. M. G. R. Medical University, Chennai
Email: meghakbaiju9@gmail.com, a.srinivasanmpharm@gmail.com

ABSTRACT

Objective: To determine the various misconceptions in diabetes mellitus and the factors leading to such misconceptions. To find out the association of various misconceptions with the socio-demographic factors.

Methods: A cross-sectional observational study was conducted among 350 diabetic patients for a period of 6 mo. The study was done in diabetic clinics in the districts of Salem and Erode.

Results: The study included a total of 350 patients, among which 206 (58.86%) were females and 144 (41.14%) were males. The majority of the study population was between the age group 61-70 (30.86%). The total misconception scores were low (0-34) in 144 (41.14%), moderate (35-69) in 180 (51.43%) and high (70-104) in 26 (7.43%). Out of 25 patients identified with hypoglycemia 2 patients (8%) had only drug-drug interaction. 10 patients (40%) with both DI and HDI were identified. Herb-drug interactions alone were identified in 13 diabetic patients with hypoglycemia (52%) indicating the risk of hypoglycemia with concurrent use of herbs along with diabetic medications.

Conclusion: In this study carried out in a study population of 350 patients, the majority of the population, which contributes to about 94% had high to moderate knowledge about their condition of diabetes mellitus. The misconceptions about diabetes mellitus were high in 6.57% of the study population.

Keywords: Diabetes, Determinants, Knowledge, Misconceptions, Treatment

INTRODUCTION

According to WHO "Diabetes is a chronic, metabolic disease characterized by elevated levels of blood glucose (or blood sugar), which leads over time to serious damage to the heart, blood vessels, eyes, kidneys, and nerves [1]." India is known as "the diabetes capital of the world" as it harbors the largest number of diabetes patients [2]. In India, its incidence is estimated at 7% of the adult population (approximately 65 million affected people), largely due to genetic susceptibility combined with changing lifestyle of a low-activity high-calorie diet in the growing Indian middle class. But the prevalence of DM is expected to rise in developing countries of Asia due to urbanization and associated obesity [3].

Misconceptions can be defined as an idea that is wrong because it has been based on a failure to understand a situation [4]. Misconceptions are based on popular beliefs or stories that have become associated with a person, community, or occurrence, especially when considered to illustrate a cultural ideal. Diabetes mellitus is a major health problem globally and so are misconceptions [5]. Misconceptions and wrong belief regarding diabetes mellitus and its management can result in poor control, more complications and increased incidence of morbidity and mortality [6]. The commonest misconceptions were "diabetes can be cured by herbal treatment," and "bitter foods can reduce the elevated blood sugar levels" and the misconception "the treatment should be stopped if the diabetes is controlled for a few months". The majority of these misconceptions were diet and drug related [2].

There is a long history of traditional plants used for the control of diabetes in India and China. Currently, the medicinal plants and herbs are being used in extract forms for their anti-diabetic activity. Various clinical studies confirmed that medicinal plant extract shows anti-diabetic activity and restoring the action of pancreatic β-cells [7]. Some of the most common herbs used are: fenugreek, bitter gourd, ginger, garlic, and aloe vera.

Herb-Drug Interactions (HDI) may affect clinical safety and efficacy via additive or synergistic or antagonistic interactions among the herbal components and drug molecules. Negative or harmful interactions tend to receive more attention due to safety considerations. The effects induced by HDIs may result in an enhancement of the desired pharmacological effect [8]. Some of the most common HDIs are fenugreek+glibenclamide, bitter gourd+glimepiride, and fenugreek+soluble human insulin.

MATERIALS AND METHODS

A cross-sectional observational study was conducted among 350 diabetic patients for a period of 6 mo, using a validated self-designed questionnaire. The study was done in diabetic clinics in the districts of Salem and Erode after obtaining approval of the institutional Ethics Committee (REF NO.: EC/PHARM D/2019-07). The questionnaire was designed in English and then translated into Tamil by a language expert. The data collection form consisted of two questionnaires-questionnaire for misconception and a questionnaire for herb use. The scoring of misconceptions was-'0' for the right answer, '2' for wrong answers (misconception), and '1' for 'I don't know'. The total misconception score was calculated and categorized into low (0-34), moderate (35-69), and high (70-104) scores. The misconception questionnaire was categorized into three parts-etiology and general concepts, diet, and treatment. Each of these categories was given sub-scoring. The misconceptions about etiology and general concepts had 19 questions and the score was categorized into low (0-12), moderate (13-25), and high (26-39). Similarly, misconceptions about diet had 16 questions and were categorized as low (0-10), moderate (11-21), and high (22-33). The category of misconceptions about treatment had 17 questions and was given the scoring, low (0-11), moderate (12-23), and high (24-35). The association of misconception scores with various potential determinants was calculated using the Chi-square test. The software Graphpad Prism 8 was used for statistical analysis. The questionnaire for herb use had a total of 12 questions. The

association of herb use with various socio-demographic variables and the risk of hypoglycemia in diabetic patients taking prescription drugs was assessed. Lexicomp, an online clinical database; and a textbook of 'Stockley's Herbal-Drug Interactions' were used for analyzing various interactions.

RESULTS

The study included a total of 350 patients, among which 206 (58.86%) were females and 144 (41.14%) were males. The majority of the study population was between the age group 61-70 (30.86%). Those with the university level of education were 27 (7.7%), higher secondary 17 (4.86%), high school 83 (23.71%), primary school 112 (32.0%), and illiterate 111 (31.71%). There was a family history of diabetes in 121 (34.57%) patients and no history in 229 (65.43%). The time since diagnosis was 0.5-4 y in 122 (34.86%), 5-10 y in 113 (32.29%), 11-15 y in 60 (17.14%) and<15 y in 55 (15.71%).

The misconception score about etiology and general conceptions were low (0-12) in 169 (48.29%), moderate (13-25) in 155 (44.29%) and high (26-39) in 26 (7.43%). The misconception scores about diet were low (0-10) in 110 (31.43%), moderate (11-21) in 212 (60.57%) and high (22-33) in 28 (8.0%). The misconception score about treatment of diabetes was low (0-11) in 179(51.14%), moderate (12-23) in 150 (42.86%) and high (24-35) in 21 (6.0%). The total misconception scores were low (0-34) in 144 (41.14%), moderate (35-69) in 180 (51.43%) and high (70-104) in 26(7.43%).

Table 1 demonstrates the frequency distribution of respondents according to misconceptions about etiology and general concepts. The most common misconceptions identified on etiology and general concepts were that 'Diabetic patients should keep their feet warm' (88%), 'High blood glucose level is worse than the high sugar level in urine' (87.71%) and 'Emotion is the main reason for diabetes' (81.14%).

Table 1: Frequency of respondents with misconceptions about etiology and general concepts of DM

S. No.	Misconceptions about etiology and general concepts (N=350)	Wrong answers	I don't know	Total (%)
1	Eating too much sugar causes diabetes	151	43	55.43
2	Only older people get diabetes	45	7	14.86
3	Diabetes is not a serious disease	136	1	39.14
4	Diabetes is only a hereditary disease	125	11	38.86
5	Diabetes is an infectious disease	8	2	2.86
6	Emotion is the main reason for diabetes	272	12	81.14
7	Diabetes mellitus predominantly affect men	63	42	30.00
8	Being overweight causes diabetes	170	19	54.00
9	There is only one type of diabetes	159	54	60.86
10	Diabetes when diagnosed means you need insulin	42	7	14.00
11	Diabetic patients are more likely to get infections and other illness	78	17	27.14
12	Diabetics cannot lead a normal social life	116	1	33.43
13	Exercise has no role in the control of diabetes	97	3	28.57
14	Diabetic patients cannot do any stressful physical activities	192	3	55.71
15	Women with diabetes should not get pregnant	4	38	12.00
16	Diabetic patients should always keep their feet warm	242	66	88.00
17	Doctor alone can cure diabetes	64	12	21.71
18	Diabetic patients must avoid any cuts or wounds	44	1	12.86
19	High blood glucose level is worse than high sugar level in urine	200	107	87.71

Table 2 illustrates the distribution of respondents according to misconceptions about diet. Similarly, the popular wrong beliefs regarding diet were that 'honey is good for diabetes' (92.86%), 'Underground vegetables such as carrots and radishes will increase blood glucose level' (82%) and 'Sugar substitutes are carcinogenic in humans' (78.29%)

Table 2: Frequency of respondents with misconceptions about diet in patients with DM

S. No.	Misconceptions about diet (N=350)	Wrong answers	I don't know	Total (%)
1	A diabetic patient needs special diabetic diet	248	9	73.43
2	Diabetes can be treated by control of di*et al.* one	36	8	12.57
3	Sweets and chocolates must be avoided by diabetic patients	233	0	66.57
4	Concentrated sweets should be used in limits	33	0	9.43
5	Honey is good for diabetes	299	26	92.86
6	Rice is prohibited for diabetic patients	29	0	8.29
7	Diabetic patients should include more juices and fruits in their diet	103	0	29.43
8	Diabetic patients should eat only a small amount of starchy foods such as bread and potatoes	100	23	35.14
9	All bitter fruits and vegetables will reduce blood glucose level	260	19	79.71
10	Water intake should be reduced in cases of excessive urination	92	9	28.86
11	High protein diet is not suitable for diabetic patients	91	36	36.29
12	Three meals and one or two snacks each day is ideal for diabetic patients	53	2	15.71
13	Eat slowly and stop when full	29	3	9.14
14	Underground vegetables such as carrots and radish will increase the blood glucose level	257	30	82.00
15	Sugar-free products are more expensive	75	108	52.29
16	Sugar substitutes are carcinogenic in humans	90	184	78.29

Table 3 indicates the frequency distribution of respondents according to misconceptions about treatment. The most common misconceptions identified on treatment were 'Anti-diabetic drugs are addictive' (93.14%), 'Herbal therapy is more efficacious and safer than insulin or oral hypoglycemic drugs' (87.14%) and 'Starting of insulin therapy indicates the final stages of diabetes' (80.86%).

Table 3: Frequency of respondents with misconceptions about the treatment of DM

S. No.	Misconceptions about treatment (N=350)	Wrong answers	I don't know	Total (%)
1	There is no need to take medicine when the blood sugar is normal	44	0	12.57
2	You can eat anything you want while taking medications	53	0	15.14
3	Medications of DM should be stopped during other illnesses	41	7	13.71
4	Effectiveness of oral hypoglycemic drugs depends on its cost	133	124	73.43
5	Prolonged use of oral hypoglycemic agents or insulin can lead to serious side effects	100	83	52.29
6	Taking insulin alone can cure diabetes	58	40	28.00
7	Anti-diabetic drugs are addictive	313	13	93.14
8	Starting of insulin therapy indicates the final stages of diabetes	260	23	80.86
9	Using insulin is difficult	56	122	50.86
10	Insulin is more effective than oral hypoglycemic drugs	185	53	68.00
11	An increase in dosage decreases the effect of uncontrolled food intake	72	41	32.29
12	Treatment of diabetes does not prevent complications	49	123	49.14
13	Treatment of diabetes causes impotence	14	159	49.43
14	Diabetic patients should avoid any surgical interventions	40	7	13.43
15	Treatment of DM should be stopped on the day of blood glucose testing	33	3	10.29
16	Treatment should be stopped if DM is well controlled for months	66	5	20.29
17	Herbal therapy is more efficacious and safer than insulin or oral hypoglycemic drugs	239	66	87.14

Table 4 shows the association of the selected socio-demographic variables on the total misconception score. It shows that patients with little or no education and duration of DM below 10 y were significantly (*p<0.05) associated with moderate or high misconception scores. However, age, gender, and family history of DM were not significantly associated with total misconception scores in diabetic patients.

Table 4: Association between total misconception score with socio-demographic variables (N=350)

Socio-demographic variables	Total misconception (number (%))			Total no. of patients	χ2	P-value
	Low 144	Moderate 180	High 26			
Age (in years)						
18-30	0 (0)	0 (0)	0 (0)	0	15.85	0.2
31-40	8 (5.56)	12 (6.67)	4 (15.38)	24	(df=12)	
41-50	26 (18.06)	32 (17.78)	3 (11.54)	61		
51-60	38 (26.39)	51 (28.33)	4 (15.38)	93		
61-70	43 (29.86)	60 (33.33)	5 (19.23)	108		
71-80	26 (18.06)	22 (12.22)	8 (30.77)	56		
>80	3 (2.08)	3 (1.67)	2 (7.69)	8		
Gender						
Male	58 (40.28)	74 (41.11)	12 (46.15)	144	0.29 (df=2)	0.87
Female	86 (59.72)	106 (58.89)	14 (53.85)	206		
Level of education						
Illiterate	35 (24.31)	64 (35.56)	12 (46.15)	111	18.70	0.016*
Primary School	45 (31.25)	57 (31.67)	10 (38.46)	112	(df=8)	
High School	35 (24.31)	45 (25.00)	3 (11.54)	83		
Higher Secondary	14 (9.72)	3 (1.67)	0 (0.00)	17		
University	15 (10.42)	11 (6.11)	1 (3.85)	27		
Family history						
Present	49 (34.03)	68 (37.78)	4 (15.38)	121	5.06 (df=2)	0.08
Absent	95 (65.97)	112 (62.22)	22 (84.62)	229		
Duration of DM (in years)						
0.5-4	50 (34.72)	69 (38.33)	3 (11.54)	122	25.28	0.0003*
5-10	46 (31.94)	62 (34.44)	5 (19.23)	113	(df=6)	
11-15	29 (20.14)	25 (13.89)	6 (23.08)	60		
>15	19 (13.19)	24 (13.33)	12 (46.15)	55		

*Significant with p<0.05, df= Degree of freedom

There was an association of high misconception with abnormal blood glucose levels in 26 patients. Among those, 5 patients had a higher blood glucose level, whereas a total of 21 patients suffered from low blood glucose levels.

Table 5: Association of high misconception with abnormal blood glucose in diabetic patients (n=26)

High misconception	No. of patients
High blood glucose	
RBS	5
Low blood glucose	
FBS	2
RBS	7
PPBS	1
FBS+RBS	1
FBS+PPBS	10
Total	26

Out of the total 350 patients, 255(72.86%) were using herbs along with diabetic medications. The most common herbs were fenugreek used by 165 (64.71%), senna by 78 (30.59%), and bitter gourd by 72

(28.24%) where some patients used more than one herb. The frequency of patients using herbs responded to have benefits while using herbs were 242(95%).
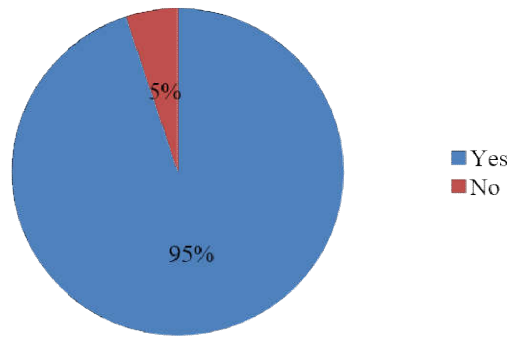

Fig. 1: Benefits after using herbs (n=255)

The occurrence of hypoglycemic symptoms while using herbs were identified in 192 (80%) patients. The most common symptoms of hypoglycemia observed while using herbs were dizziness (72.68%),

palpitations (33.66%), excess sweating (32.20%), and tremor (24.88%) where more than one symptom was observed in a single patient.
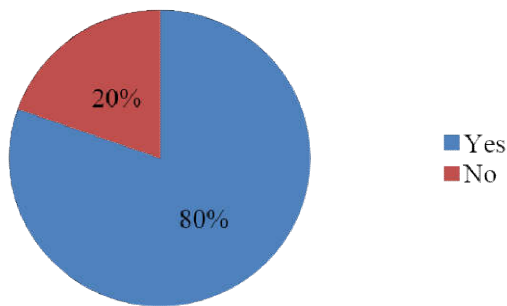

Fig. 2: Occurrence of hypoglycemic symptoms while using herbs (n=242)

Among the patients with hypoglycemic symptoms, it occurred mostly 'once in a month' in 91(47.40%) and 'once' in 77(40.10%). Only 24(12.50%) patients had these hypoglycemic symptoms for more than once in a month. About 185(96.35%) patients had used remedies to relieve the hypoglycemic symptoms that occurred while

using herbs. Among 185 patients who took remedies to relieve hypoglycemic symptoms, the frequency of patients who preferred candy was 96 (51.89%), ORS 84 (45.41%), fruit juices 16 (8.65%) and glucose 2 (1.08%), 13 patients had taken more than one remedy.
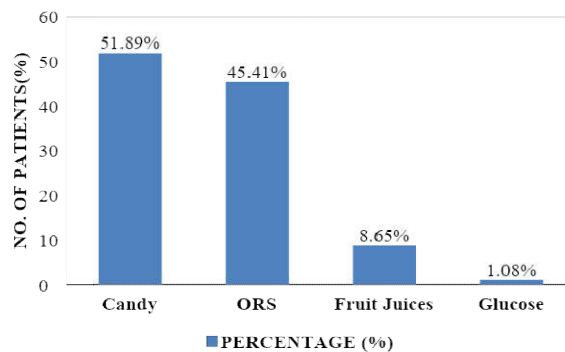

Fig. 3: Types of remedies (n=185)

Herbal use in DM patients was more common in patients above 50 y of age (78.42%) and females (59.22%). DM patients with little or no education (60.39%) and duration of DM below 10 y

(68.24%) were found to use more herbs for diabetic management. A family history of DM was present in only 92(36.08%) patients.

Table 6: Association of herb use with various socio-demographic variables (n=255)

Socio-demographic variables	No. of patients	Percentage (%)
Age group (in years)		
18-30	0	0.00
31-40	16	6.27
41-50	39	15.29
51-60	70	27.45
61-70	81	31.76
71-80	43	16.86
>80	6	2.35
Gender		
Male	104	40.78
Female	151	59.22
Level of education		
Illiterate	75	29.41
Primary School	79	30.98
High School	70	27.45
Higher Secondary	13	5.10
University	18	7.06
Family history		
Present	92	36.08
Absent	163	63.92
Duration of DM (Years)		
0.5-4	82	32.16
5-10	92	36.08
11-15	38	14.90
>15	43	16.86

Table 7. Indicates that out of 25 patients identified with hypoglycemia 2 patients (8%) had only drug-drug interaction. 10 patients (40%) with both DI and HDI were identified. Herb-drug interactions alone were identified in 13 diabetic patients with hypoglycemia (52%) indicating the risk of hypoglycemia with concurrent use of herbs along with diabetic medications.

Table 7: Frequency of interactions in hypoglycemic patients while using herbs (n=25)

Type of interactions	No. of patients (with low blood glucose)	Percentage (%)
Only Drug-Drug Interaction (DI)	2	8.00
Only Herb-Drug Interaction (HDI)	13	52.00
Both DI and HDI	10	40.00
Total	25	

DISCUSSION

The study showed that most of the socio-demographic factors related to diabetic patients were similar to other related studies. The distribution of family history among 350 patients had 121 patients with a family history of diabetes mellitus and 229 patients without a family history of diabetes mellitus. This was contradictory to the study conducted by [9], where 147 patients had a family history of diabetes mellitus. The common misconceptions about etiology and general concepts were 'diabetic patients should keep their feet warm' and 'high blood glucose level is worse than the high sugar level in urine'. The result of the study by [6], showed that 'excessive sugar intake is a primary cause of DM' and 'DM was mainly an inherited disease. Similarly, among the misconceptions related to diet, the most common was 'diabetic patients on medication can eat any type of food'. Whereas, the most common misconception in our study was 'honey is good for diabetes'. In the study related to the treatment of diabetes and its misconception, the most common was the statement 'anti-diabetic drugs are addictive'. However, the study by [6], showed the statement 'oral hypoglycemic drugs are more effective than insulin' was the most common misconception about diabetes treatment.

The results from our study when compared with similar studies reflect the difference in misconceptions about diabetes mellitus and their related factors such as general concepts, etiology, diet, and treatment differed with the socio-demographic factors. There was a contrast in the responses from our study group which reflects the influence of the cultures and beliefs surrounding them. The study had a larger population with little or no education, but the misconceptions about diabetes were moderate among them. This highlights the importance of awareness and patient counseling, which was done with the interest of their consulting physician (diabetologist). This indicates that there would be no significant association with the socio-demographic factors if the knowledge about the disease is well conveyed to the patients.

The study also analyzed the use of herbs in the same population of people with diabetes mellitus. The results showed that despite their knowledge about the disease condition, they had lesser knowledge about herb use and related hypoglycemia. Most of the study population using herbs were not aware of the relation of hypoglycemic symptoms with concurrent herb use while taking their normal anti-diabetic medications. This result shows the further significance of patient counseling among diabetic patients.

CONCLUSION

In this study carried out in a study population of 350 patients, the majority of the population which contributes to about 94% had high to moderate knowledge about their condition of diabetes mellitus. The misconceptions about diabetes mellitus were high in 6.57% of the study population. Despite taking diabetic medications, 255 patients out of 350 patients were observed to take herbs along with the ongoing medications, for the same anti-diabetic effects. Among these patients using herbs, 13 cases of hypoglycemia were confirmed to be caused only due to the herb-drug interactions. The results from the study show that even if a minority of the population, the misconceptions were relatively very high. The majority belonging to the moderate misconception category also required more awareness about their disease condition. The study also shows that more than half of the patients were not aware of the risk of

taking herbs along with their diabetic medications. Both the results about misconceptions as well as herb usage reflect the need for patient counseling and awareness about DM.

LIMITATIONS

This study could be done in an extended population. In our study there is no separate category to assess the misconceptions about the lifestyle of diabetic patients and sources of misconceptions were not assessed. HbA1C values if recorded for all the patients under the study could give a clearer and accurate picture of the misconceptions. There was no follow up or review in this study. Only natural herbs were assessed. Herbal products and other supplements were not used by anyone in the study population.

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AUTHORS CONTRIBUTIONS

All authors have contributed equally to this piece of work.

CONFLICT OF INTERESTS

The authors have no conflict of interest to disclose.

REFERENCES

1. Diabetes. WHO. Int; 2020. Available from: https://www.who.int/health-topics/diabetes#tab=tab1 [Last accessed on 13 Jul 2020]
2. Rajkumar Patil, Nisha Nasrin A, Shib Sekhar Datta, Abhijit V Boratne, Lokeshmaran. Popular misconceptions regarding diabetes management: Where should we focus our attention?. J Clin Diagn Res 2013;7:287-91.
3. Harsh Mohan. Textbook of pathology. 8th ed. Ivan Damjanov: Jaypee Brothers Medical Publishers; 2018.
4. Akshadha Easwar, Aditya Gaudani, Arohi Gandhi, Milav Patel, Donald S Christian. A study on the myths and misconceptions of Diabetes Mellitus among diabetic patients attending tertiary care institute of Ahmedabad City, Gujarat. GCSMC J Med Sci 2018;VII:22-7.
5. Naila Akbar, Taleiha Aqeel, Noman Ul-Haq, Aqeel Naseem, Sameer Dhingra. Assessment of knowledge and dietary misconceptions among diabetic patients. J Pharm Practice Community Med 2016;2:9-15.
6. Sabra AA, Taha AZ, Al-Zubicr AG, Al-Kurashi NY. Misconceptions about diabetes mellitus among adult male attendees of primary health care centres in Eastern Saudi Arabia. SA Fam Pract 2010;52:344-9.
7. Sonia Verma, Madhu Gupta, Harvinder Popli, Geeta Agarval. Diabetes mellitus treatment using herbal drugs. Int J Phytomed 2018;10:1-10.
8. Ramesh C Gupta, Dennis Chang, Srinivas Nammi, Alan Bensoussan, Kellie Bilinski. Interactions between antidiabetic drugs and herbs: an overview of mechanisms of action and clinical implications. Diabetol Metab Syndr 2017;9:1-12.
9. Ahmed A Alsunni, Waleed I Albaker, Ahmed Badar. Determinants of misconceptions about diabetes among Saudi diabetic patients attending diabetes clinic at a tertiary care hospital in Eastern Saudi Arabia. J Family Community Med 2014;21:93-9.
10. Olamoyegun A Michael, Ajani O Gbadebo, Akinlade AT. Prevalence, pattern and determinants of myths and misconceptions among patients with Diabetes Mellitus in southwest Nigeria. Annals Med Health Sci Res 2018;8:62-7.
11. Devin M Mann, Diego Ponieman, Howard Leventhal, Ethan A Halm. misconceptions about diabetes and its management among low-income minorities with diabetes. Diabetes Care 2009;32:591-3.
12. Manisha Modak, Priyanjali Dixit, Jayant Londhe, Saroj Ghaskadbi, Thomas Paul A, Devasagayam. Indian herbs and herbal drugs used for the treatment of diabetes. J Clin Biochem Nutr 2007;40:163-73.
13. Debashish Paramanick, Neeraj Sharma. A review on herbs which are used in diabetes mellitus. Int J Drug Dev Res 2017;9:12-7.
14. Omobhude Fidelis Aluefua, Aminu Chika, Abubakar Amali Muhammad, Aminu Usman. Interactions between herbs and antidiabetic drugs: a systematic review. Res J Pharmacol 2017;11:6-17.
15. Chandraprakash Dwivedi, Swarnali Daspaul. Antidiabetic herbal drugs and polyherbal formulation used for diabetes: a review. J Phytopharmacol 2013;2:44-51.
16. Noura Al-Mousa, Amr Sabra. Adherence to the American diabetes association standards of care in Saudi Arabia. J Am Sci 2013;9:446-51.
17. Arun Kumar, Manish K Goel, Ram Bilas Jain, Pardeep Khanna, Vikas Chaudhary. India towards diabetes control: Key issues. Austarlasian Med J 2013;6:524-31.
18. Ganesh S Anusuya, S Gopalakrishnan, Rama Ravi, Stephen T, Krishnakumar J, Ezhil R, *et al*. Prevalence of type 2 diabetes mellitus among people attending medical camps in South Chennai, India. Int J Public Health Res 2015;2:63-8.
19. Vimal Pahuja, Genevie Fernandes, Nilesh Chatterjee. Knowledge of the disease among type 2 diabetes patients in a tertiary care hospital in Mumbai, India. Asian J Pharm Clin Res 2018;11:234-40.
20. Sheeba S, Sneha AK, Veena Biju. Knowledge and self-care practices among diabetics. Asian J Pharm Clin Res 2017;10:234-7.
21. Mani Rupeshkumar, Kunchu Kavitha, Pallab Kanti Haldar. Role of herbal plants in the diabetes mellitus therapy: an overview. Int J Appl Pharm 2014;6:1-3.
22. Rajni Jain, Piyush Jain, Poorva Jain. A review on treatment and prevention of diabetes mellitus. Int J Curr Pharm Res 2016;8:16-8.