



A survey to validate the traditional Siddha perception of diabetes mellitus

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Abstract

Aim To investigate the influence of gender, marital status, specific food, and lifestyle habits that could possibly be the causative factor according to ancient medical texts. Exploring the alternative medicinal knowledge about diabetes mellitus (DM) and validating its authenticity by carrying out a modern-day study with a scientific perception in identifying the specific food and lifestyle causing DM.

Subjects and methods Our study was conducted during the period 2015 to 2017 in Tamil Nadu and Kerala States, South India. Data was collected from 1206 individuals aged between 18 and 89 years through a predesigned questionnaire which included seven novel questions acquired from the traditional Indian texts of Siddha medicine.

Results A questionnaire-based study conducted using which a total of 1206 subjects (men: 55.4%; women: 44.6%) were evaluated with a mean age of 42.88 ± 13.212 years. A higher number of males were affected than females. It is also evident that married people get more affected by Type 2, whereas unmarried subjects were found to be more affected by Type 1. There is a significant effect of gender and marital status, and also the influence of specific food and lifestyle habits listed is evident.

Conclusions The antiquity of early descriptions of diabetes underscores the importance of the observation and recording of medical conditions as humans evolve; more similar studies should be conducted to validate the data in ancient medicinal texts and to prove their authenticity in the modern scientific era.

Keywords Diabetes mellitus (DM) · Traditional medicine · Health survey · Data collection

Introduction

Diabetes mellitus (DM) is a serious chronic metabolic disorder characterized by a hyperglycaemic state, as a result of chronic insulin resistance, which leads to pancreatic beta cell dysfunction and subsequently a massive failure in insulin secretion (dos Santos et al. 2014); and older adults with diabetes represent a full spectrum of health statuses ranging from excellent or good health to very vulnerable or frail. Diabetes is a condition which if left untreated can develop womb-to-tomb

complications and increases the rate of mortality in diabetic patients. DM (Type 1, Type 2, and gestational) is one of the diseases most commonly encountered by the healthcare professionals. Type 1 diabetes is caused by autoimmune destruction of pancreatic β cells in genetically predisposed individuals, and results in severe insulin deficiency with a requirement for treatment with insulin. It is typically considered a disease of childhood and adolescence, but can occur at any age. Type 2 diabetes is predominantly a disease of adulthood and is associated with obesity, insulin resistance, and relative but not absolute insulin deficiency (Thomas et al. 2017). Gestational diabetes (GDM) is a temporary condition that occurs in pregnancy and carries a long-term risk of type 2 diabetes.

DM has emerged as a serious health-care problem worldwide. Diabetes progressively contains a larger proportion of patients newly diagnosed every year (Rashedi et al. 2017). As of 2015, 415 million adults have diabetes, and this number is estimated to increase to 642 million by 2040. Population growth and ageing have contributed to this increase, but are not solely responsible for it. The prevalence (age-standardized) of diabetes

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is growing in all regions. This is especially the case in India, with its fast-growing economy and diverse population, with varying levels of literacy, income, traditional and cultural beliefs, and varieties of diet pattern (Tharkar et al. 2015), and diabetes is one of the most prevalent chronic diseases. Over 40% of children fewer than 5 years are malnourished, and it has also become known as a “diabetes capital” of the world, with an estimated 65+ million diabetic patients aged 20–79 years in 2013, and substantial further increases anticipated (Wells et al. 2016). There were over 72 million cases of diabetes in India in 2017; subsequently, this number is set to increase to 592 million by 2035 (Upadhyay et al. 2013).

Siddha is one of the ancient medical systems in India, considered as the mother medicine of ancient Tamils/Dravidians in South India. The word Siddha means established truth (Shukla and Saraf 2011; Piet 1952). The Siddha system is a treasure house of secret science, embodying the results of the ardent pursuit thereof by the ancient Siddhars. This civilization dates back to 12,000 years B.C. Two thousand years ago, the traditional medical system of the Tamils was known as Marunthu (medicine) (Shukla and Saraf 2011). Thousands of examples of Siddha literature still remain in the form of palm-leaf manuscripts. Of late, Siddha is slowly gaining recognition in the world of complementary/ alternative medicine. Modern medicine recognizes Siddha medicine as an alternative East Indian medical system prevalent among Tamil-speaking people (Stephen 2005). The Ayurvedic concept appeared and developed between 2500 and 500 BC in India (Subhose et al. 2005). The literal meaning of Ayurveda is “science of life,” because the ancient Indian system of health care focused on views of man and his illness. It has been pointed out that positive health means metabolically well-balanced human beings. Ayurveda is also called the “science of longevity” because it offers a complete system for living a long healthy life (Pandey et al. 2013).

The ancient Indian physician Sushruta and the surgeon Charaka (400–500 A.D.) were able to identify the two types, later to be named Type I and Type II diabetes. A disease characterised by the ‘too great emptying of urine’ finds its place in antiquity through Egyptian manuscripts dating back to 1500 B.C. Indian physicians called it *madhumeha* (‘honey urine’) because it attracted ants. The term *prameha* has two parts: ‘pra’ meaning abundant and ‘meha’ meaning ‘passing of large quantity of urine’. Incidentally the term diabetes was derived from the Greek term *diabainein* to mean ‘to cross through a siphon’ meaning ‘continuous free flow of water’, and applied to mean elimination of large quantity of urine. Thus it can be seen that the terms ‘prameha’ and ‘diabetes’ are synonymous, while the terms ‘madhumeha’ and ‘diabetes mellitus’ have a similar meaning: madhu and mellitus mean honey and thus madhumeha and diabetes mellitus mean passing of large

quantity of sweet urine (Lakhtakia 2013). Mehanoi and prameha are the two words coined by the Siddha and Ayurveda system of medicines: they are also classified into 21 types and 20 types each and description of the disease's signs and symptoms are clearly mentioned in Thirumoolarkarukidainikandu, Mehanoinidhanam (Siddha medical text book) and in Carahanidhana (Ayurveda medical text book) respectively. The script in detail mentions the root cause of why mehanoi (diabetes) arises, and its symptoms and causative agents are explained. The personal, social, and economic costs of diabetes are huge, and are likely to adversely affect India's economic development over the next couple of decades. Unless urgent steps are taken to thwart this burgeoning epidemic, more and more young and middle-aged Indians will fall prey to diabetes in the prime of their lives.

Hence, the prime aim of the current study is to understand the correlation and to validate the knowledge of Indian ancient manuscripts which mention types of meham and prameha, its symptoms and contributory agents that lists food as well as lifestyle habits together as one of the reasons explained for DM. Therefore and additional seven new questions were created to evaluate the credibility and judge the legitimacy of the texts with respect to modern trends in food and lifestyle, and to assess the possibility of their correlation. We also try at the same time to evaluate the ubiquity of DM and its tie-in with respect to age, gender, and marital status.

Materials and methods

Study design

A questionnaire-based cross-sectional and descriptive study was conducted in the regions of Tamil Nadu and Kerala during the period 2015–2017. The study areas were mainly Coimbatore, Erode, Tirupur, Vellore, and some regions in Kerala which included Palakkad, Kozhikode, and Malappuram. The study included inhabitants aged 18–89 years of the two states. We had screened out 1206 subjects with Type 1, Type 2, and gestational diabetes (668 men and 538 females), out of 4500 subjects that we surveyed. A questionnaire was designed which consisted of 58 descriptive questions covering their general information, diabetic knowledge, food style followed before being diagnosed with diabetes, physical activity, blood sugar monitoring, and type of medication was used to collect the data of patients with regard to their follow-up.

Study population

The study began in 2015 when males and females 18 to 89 years of age responded to a questionnaire designed

according to the prescribed format. The study sample was randomly selected from lists of all inhabitants in the age range 18–89 years (reflecting the overall focus on healthy aging). The questionnaire included an overall assessment of the patient’s health, medical history, lifestyle, and socioeconomic indicators. All questions were translated from English into both Tamil and Malayalam languages and back into English in order to check for accuracy. Subjects were consecutively recruited until quotas for sex, age, and marital status were addressed. Any subject who, when asked, stated that they were non-diabetic was excluded from recruitment. Subjects were asked to complete a survey on socioeconomic status, health, and lifestyle and food habits. All subjects were provided with proper knowledge about the study before being analysed.

Inclusion and exclusion criteria

The inclusion criteria for the patients who participated were:

They were aged above 18 years, regardless of their caste, gender, and religion or socio-economic status. They had been diagnosed with either type of diabetes for at least 1 year. They were taking diabetes medication, and they were able to speak, read, and write either in English or their native language.

On the other hand, the exclusion criteria were: participants who were non-diabetic or had any conditions other than diabetes, and those who were not able to read or write in English or their native language.

Study sampling and data collection

A 55-item study instrument that consisted of 11 sections (A, B, C, D, E, F, G, H, I, J, K) in total was developed for data collection. Section A contained 11 questions that were related to respondent’s general details (age, gender, current height, current weight, occupation, and family system were independent variables of the study). Section B contained two questions regarding their diabetic history. Section C contained seven questions that were designed to evaluate their previous food and lifestyle before they were been diagnosed with DM. Section D contained five questions related to medical and health conditions. Section E contained three questions that were used to evaluate the details regarding pregnancy, which were to be answered only by women respondents. Section F contained two questions to assess their diabetic knowledge. Section G contained a total of ten questions that dealt with their blood sugar monitoring details (including the details of tests performed by the individuals). Section H consisted of four questions about their physical wellbeing. Section I consisted of questions regarding their stress. Section J contained 11 questions regarding their food style and nutrition. Lastly, section K contained

Table 1 General characteristics of the subjects screened

Characteristics	F	%
General information		
Age (years)		
16–35	428	35.4
36–55	573	47.51
56–75	180	14.9
76–95	25	2.07
Gender		
Male	668	55.4
Female	538	44.6
Marital status		
Unmarried	168	13.9
Married	1038	86.1
Family		
Nuclear	891	73.9
Joint	314	26
Socio-economic status		
Upper middle class	219	18.1
Middle class	618	51.4
Lower middle class	208	17.2
Unanswered	161	13.3
Diabetic history		
– Type of diabetes affected with?		
Type 1	288	23.9
Type 2	785	65.1
Gestational	127	10.5
– Age at which you were diagnosed with?		
10-29	448	37.14
30-59	709	58.7
60-89	14	1.16
Unanswered	35	2.90
Medical and health information		
– Do you smoke?		
Yes	142	11.8
No	1063	88.1
Former smoker		
– Do you drink alcohol?		
Daily	32	2.7
Weekly	32	2.7
Monthly	61	5.1
Rarely	207	17.2
Never	872	72.3
Diabetes questions and knowledge		
– Have you received your diabetic education before?		
Yes	1174	97.3
No	29	2.4
Unanswered	3	0.2
– How would you rate your understanding of diabetes?		
Very good	52	4.3
Good	857	71.1
Fair	244	20.2
Poor	53	4.4
Description of physical activity		
Heavy	172	14.2
Moderate	273	22.6
Light	289	23.9
None	472	39.1

F = frequency, % = percentage

queries regarding the medication used. Questions were designed in multiple choice format; some questions were measured using a nominal scale (yes/no). For the purpose of achieving optimum results, both English, Tamil, and

Table 2 Relationship within the study samples: cross-tabulation between gender and the type of diabetes affected with

Gender		Type of diabetes affected with				Total
		Not known	Gestational	Type 1	Type 2	
Female	Count	1	128	109	300	538
	% within gender	0.2%	23.8%	20.3%	55.8%	100.0%
	% within type of diabetes affected with	16.7%	100.0%	38.0%	38.2%	44.6%
	% of total	0.1%	10.6%	9.0%	24.9%	44.6%
Male	Count	5	0	178	485	668
	% within gender	0.7%	0.0%	26.6%	72.6%	100.0%
	% within type of diabetes affected with	83.3%	0.0%	62.0%	61.8%	55.4%
	% of total	0.4%	0.0%	14.8%	40.2%	55.4%
Total	Count	6	128	287	785	1206
	% within gender	0.5%	10.6%	23.8%	65.1%	100.0%
	% within type of diabetes affected with	100.0%	100.0%	100.0%	100.0%	100.0%
	% of total	0.5%	10.6%	23.8%	65.1%	100.0%

% = percentage

Malayalam (regional languages of Tamil Nadu and Kerala) versions of the questionnaires were developed. The questionnaire was translated into the regional languages, and translated back into English to ensure that the essential meaning of questionnaire remained preserved.

Data analysis

All data were analysed using Microsoft Excel (Microsoft Corporation, Redmond, WA, USA) and SPSS version 21. Random checks were performed to detect errors in data entry.

Table 3 Relationship within the study samples: cross-tabulation between marital status and the type of diabetes affected with

Type of diabetes affected with		Marital status		Total
		Married	Unmarried	
Unanswered	Count	3	3	6
	% within type of diabetes affected with	50.0%	50.0%	100.0%
	% within marital status	0.3%	1.8%	0.5%
	% of total	0.2%	0.2%	0.5%
Gestational	Count	127	0	127
	% within type of diabetes affected with	100.0%	0.0%	100.0%
	% within marital status	12.2%	0.0%	10.5%
	% of total	10.5%	0.0%	10.5%
Type 1	Count	181	107	288
	% within type of diabetes affected with	62.8%	37.2%	100.0%
	% within marital status	17.4%	63.7%	23.9%
	% of total	15.0%	8.9%	23.9%
Type 2	Count	727	58	785
	% within type of diabetes affected with	92.6%	7.4%	100.0%
	% within marital status	70.0%	34.5%	65.1%
	% of total	60.3%	4.8%	65.1%
Total	Count	1038	168	1206
	% within type of diabetes affected with	86.1%	13.9%	100.0%
	% within marital status	100.0%	100.0%	100.0%
	% of total	86.1%	13.9%	100.0%

% = percentage

Table 4 Relationship within the study samples: cross-tabulation between gender and the consumption of following food stuffs in excess

Gender		Had any of the following food stuffs in excess				
		Buttermilk	Curd	Ghee	Milk	None
Female	Count	50	153	40	114	181
	% within gender	9.3%	28.4%	7.4%	21.2%	33.6%
	% who had any of the following foodstuffs in excess	18.6%	67.7%	45.5%	45.1%	48.9%
	% of total	4.1%	12.7%	3.3%	9.5%	15.0%
Male	Count	219	73	48	139	189
	% within gender	32.8%	10.9%	7.2%	20.8%	28.3%
	% who had any of the following foodstuffs in excess	81.4%	32.3%	54.5%	54.9%	51.1%
	% of total	18.2%	6.1%	4.0%	11.5%	15.7%
Total	Count	269	226	88	253	370
	% within gender	22.3%	18.7%	7.3%	21.0%	30.7%
	% who had any of the following foodstuffs in excess	100.0%	100.0%	100.0%	100.0%	100.0%
	% of total	22.3%	18.7%	7.3%	21.0%	30.7%

% = percentage

Student’s *t*-test and the chi-square test were applied as appropriate.

at cross-checking the causative factors of DM as mentioned in traditional medical texts.

Prameha and madhumeha

Interestingly, a great deal of knowledge is available in traditional Indian medicine, both Siddha and Ayurveda, but still it is not validated due to lack of scientific research and evidence-based follow-up. In this study, the unique criteria is the set of questions we incorporated in the questionnaire which enquire about the subject’s health and lifestyle conditions before they were diagnosed with DM. The questions were mainly aimed

Statistical analysis

We performed the data analysis using IBM® SPSS® Complex Sample version 21. Descriptive statistics were used, while frequencies (f) and percentages (%) were examined for categorical variables. The chi-square statistic is used for testing relationships between categorical variables, and the null hypothesis of the chi-square test is that no relationship exists on the categorical variables in the population; they are independent.

Table 5 Relationship within the study samples: cross-tabulation between gender and the habit of eating of too much sweet content

Gender		Had an habit of eating too much sweet content		Total
		No	Yes	
Female	Count	197	341	538
	% within gender	36.6%	63.4%	100.0%
	% who had a habit of eating too much sweet content	38.5%	49.1%	44.6%
	% of total	16.3%	28.3%	44.6%
Male	Count	315	353	668
	% within gender	47.2%	52.8%	100.0%
	% who had a habit of eating too much sweet content	61.5%	50.9%	55.4%
	% of total	26.1%	29.3%	55.4%
Total	Count	512	694	1206
	% within gender	42.5%	57.5%	100.0%
	% who had a habit of eating too much sweet content	100.0%	100.0%	100.0%
	% of total	42.5%	57.5%	100.0%

% = percentage

Table 6 Relationship within the study samples: cross-tabulation between gender and regular consumption of meat with high fat content

Gender		Consumed meat with high fat regularly		Total
		No	Yes	
Female	Count	454	84	538
	% within gender	84.4%	15.6%	100.0%
	% who consumed meat with high fat regularly	49.6%	29.0%	44.6%
	% of total	37.6%	7.0%	44.6%
Male	Count	462	206	668
	% within gender	69.2%	30.8%	100.0%
	% who consumed meat with high fat regularly	50.4%	71.0%	55.4%
	% of total	38.3%	17.1%	55.4%
Total	Count	916	290	1206
	% within gender	76.0%	24.0%	100.0%
	% who consumed meat with high fat regularly	100.0%	100.0%	100.0%
	% of total	76.0%	24.0%	100.0%

% = percentage

Results

Table 1 depicts the general characteristics of the subjects screened with diabetes.

Table 2 shows that the highest number of subjects (785: 65.1%) were affected with type 2, compared to type 1 with 287 (23.8%) followed by gestation diabetes with 128 (10.6%) and six (0.5%) unanswered. Among a total of 668 male candidates, 485 (72.6%) were affected with type 2 diabetes and 178 (26.6%) with type 1; five respondents (0.7%) did not answer the question. Among a total of 538 female candidates, if the 118 affected with gestational diabetes are excluded and we consider 410 as 100%, 73.0% (300) were affected with

type 2, followed by 109 (26.6%) affected with type 1 and one (0.24%) who did not respond to this question.

Table 3 shows that of total sample size of 1206 subjects, 1038 (86.1%) were married and 168 (13.9%) were unmarried. Of the married category total of 1038, 727 (70%) were affected with type II, 181 (17.4%) with type I, and 127 (12.2%) with gestational diabetes. Of the unmarried subjects total of 168, 107 (63.7%) were affected with type I, and 58 (34.5%) with type II.

Table 4 shows that of 668 male subjects in the total study group, 479 (71.7%) had consumed one or more of the food items mentioned in section C to excess, and 189 (28.3%) of the group had not taken any of the food

Table 7 Relationship within the study samples: cross-tabulation between gender and consumption of water with high salt content

Gender		Consumed water with salt content borewell water		Total
		No	Yes	
Female	Count	335	203	538
	% within gender	62.3%	37.7%	100.0%
	% who consumed water with salt content borewell water	38.8%	59.2%	44.6%
	% of total	27.8%	16.8%	44.6%
Male	Count	528	140	668
	% within gender	79.0%	21.0%	100.0%
	% who consumed water with salt content borewell water	61.2%	40.8%	55.4%
	% of total	43.8%	11.6%	55.4%
Total	Count	863	343	1206
	% within gender	71.6%	28.4%	100.0%
	% who consumed water with salt content borewell water	100.0%	100.0%	100.0%
	% of total	71.6%	28.4%	100.0%

% = percentage

Table 8 Relationship within the study samples: cross-tabulation between gender and habit of eating late

Gender		Ever had an habit of eating late		Total	
		No	Yes		
Female	Count	242	296	538	
	% within gender	45.0%	55.0%	100.0%	
	% who ever had an habit of eating late	39.1%	50.4%	44.6%	
	% of total	20.1%	24.5%	44.6%	
Male	Count	377	291	668	
	% within gender	56.4%	43.6%	100.0%	
	% who ever had an habit of eating late	60.9%	49.6%	55.4%	
	% of total	31.3%	24.1%	55.4%	
Total	Count	619	587	1206	
	% within gender	51.3%	48.7%	100.0%	
	% who ever had an habit of eating late	100.0%	100.0%	100.0%	
	% of total	51.3%	48.7%	100.0%	
Chi-square tests					
	Value	Df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson chi-square	15.654 ^a	1	.000		
Continuity correction ^b	15.199	1	.000		
Likelihood ratio	15.683	1	.000		
Fisher's Exact test				.000	.000
N of valid cases	1206				

% = percentage

^a 0 cells (.0%) have expected count less than 5. The minimum expected count is 261.86

^b Computed only for a 2 × 2 table

Df, degrees of freedom; Asymp., asymptotic; Sig., significance

items mentioned. Of 538 female subjects in the total study group, 357 (66.3%) had consumed one or more of the food items mentioned in section C to excess, and 181 (33.6%) of the group had not taken any of the food items mentioned. Among the 479 male consumers

above, the highest consumed food stuff was buttermilk with 219 (45.7%), and the least was ghee with 48 (10.0%). Of the 357 female consumers, the highest consumed foodstuff was curd with 153 (42.8%) and the least was ghee with 40 (11.0%).

Table 9 Relationship within the study samples: cross-tabulation between gender and habit of walking too much as a daily routine

Gender		Too much walking as a daily routine		Total
		No	Yes	
Female	Count	460	78	538
	% within gender	85.5%	14.5%	100.0%
	% who do too much walking as a daily routine	50.4%	26.5%	44.6%
	% of total	38.1%	6.5%	44.6%
Male	Count	452	216	668
	% within gender	67.7%	32.3%	100.0%
	% who do too much walking as a daily routine	49.6%	73.5%	55.4%
	% of total	37.5%	17.9%	55.4%
Total	Count	912	294	1206
	% within gender	75.6%	24.4%	100.0%
	% who do too much walking as a daily routine	100.0%	100.0%	100.0%
	% of total	75.6%	24.4%	100.0%

% = percentage

Table 10 Relationship within the study samples: cross-tabulation between gender and habit of sleeping late at night

Gender		Habit of sleeping late at night		Total
		No	Yes	
Female	Count	145	393	538
	% within gender	27.0%	73.0%	100.0%
	% with habit of sleeping late at night	31.2%	53.0%	44.6%
	% of total	12.0%	32.6%	44.6%
Male	Count	320	348	668
	% within gender	47.9%	52.1%	100.0%
	% with habit of sleeping late at night	68.8%	47.0%	55.4%
	% of total	26.5%	28.9%	55.4%
Total	Count	465	741	1206
	% within gender	38.6%	61.4%	100.0%
	% with habit of sleeping late at night	100.0%	100.0%	100.0%
	% of total	38.6%	61.4%	100.0%

% = percentage

Table 5 shows that of the total sample size of 1206, 694 (57.5%) responded ‘yes’ and 512 (42.5%) responded ‘no’.

Table 6 shows that 916 (76.0%) of people responded ‘no’ for consumption of meat with high fat content and 290 (24.0%) responded ‘yes’.

Table 7 shows that of the total subjects surveyed, 863 (71.6%) responded ‘no’ to “consuming water with high salt content” and 343 (28.4%) responded ‘yes’.

Table 8 shows that 619 (51.3%) of people responded ‘yes’ to the question “habit of eating late” and 587 (48.7%) responded ‘no’.

Table 9 shows that of the total subjects screened, 912 (75.6%) responded ‘no’ and 294 (24.4%) responded ‘yes’ to the question “habit of walking too much as a daily routine”.

Table 10 shows that 741 (61.4%) responded ‘yes’ and 465 (38.6%) responded ‘no’ to the question “habit of sleeping late at night”.

Discussion and conclusion

Diabetes mellitus is one of the most prominent non-communicable diseases that are undermining the health of the people of India and placing additional burdens on health systems (Hilawe et al. 2013). India is the diabetes capital in terms of percentage, as home to 69.1 million people with DM, the second highest number of cases after China. Recent epidemiological evidence indicates a rising DM epidemic across all classes, both the affluent and the poor in India (Tripathy et al. 2017). Diabetes is also one of the most prevalent chronic diseases in India. India is a gigantic, heterogeneous country with an approximate population of 1.1 billion people, a complex

socio-political history, and immense diversity of culture, dialects, and customs, and it has varying levels of literacy, income, traditional and cultural beliefs, and varieties of diet pattern.

In our study, we examined the population-based associations between gender, age, marital status, and the prevalence of DM in some of the districts of Tamil Nadu and Kerala. The study reported significant gender difference in the prevalence of DM, which is supported by evidence from other studies, which show a male preponderance (Anjana et al. 2011; Meshram et al. 2016; Tesfaye et al. 2016), although a few studies have reported no gender differences (Ramachandran et al. 2001; Barik et al. 2016; Goswami et al. 2016; Tripathy et al. 2017). Some studies found a relationship between DM and gender (Lidfeldt et al. 2007; Robbins et al. 2001); however, data from other studies agree with our finding (Azimi-Nezhad et al. 2008; Bosi et al. 2009).

From the results we obtained, it is clear that irrespective of age and gender, people were aware of knowing the risk of consuming high-fat food, and that is visible in the values for consuming ghee as the least preferred, followed by curd, milk, and buttermilk. But as per the traditional Siddha texts, consuming too much of any of this four items gives a high risk of acquiring DM, and that is evident in our study. The lifestyle changes also give us an idea about the authenticity of the result of our study. One of the most consistent findings in the Indian epidemiology studies dealing with diabetes is that the prevalence of Type 2 diabetes increases with age (Zargar et al. 2000; Ramachandran 2005; Ramachandran et al. 1988, 1997, 2001; Mohan et al. 2001; Iyer et al. 2001; Asha et al. 2001; Sadikot et al. 2004). Studies conducted in different countries other than India also give similar data which showed a significant difference in the prevalence of DM with respect to increasing

age (Azimi-Nezhad et al. 2008; Dray-Spira et al. 2008; Rahmanian et al. 2013).

Our study is limited by the cross-sectional nature of the data, which does not provide any indication of the direction of effect or causality. This limitation also prevents any measure of temporal changes in prevalence of DM and factors associated with DM. Longitudinal studies would complement the present study to determine causality and directional effect of the factors. In addition, in this study we have tried to incorporate both traditional as well as scientific knowledge on diabetes, and have attempted to create a correlated study with the incorporation of certain novel questions which according to the traditional Siddha medical text are mentioned among the various causes of this particular condition. As far as we are aware, the present trial is the first study which has tried to utilise both science and traditional medical knowledge in the case of diabetes mellitus.

In this study, there was a significant difference observed in the prevalence of DM between the married and the unmarried group, whereas in other studies no significant difference has been reported (Azimi-Nezhad et al. 2008; Rahmanian et al. 2013; Tesfaye et al. 2016). Even though association was established between diabetes mellitus and physical activity, it is difficult to prove the causal relationship as the number of physically active subjects with the disease was very low. However, it is evident that many cross-sectional (WHO 2008; Abu-Aisha et al. 2008; Enang et al. 2014; Olatunbosun et al. 1998) and cohort studies (Willi et al. 2007; Wang et al. 2013; Jee et al. 2010; Kamaura et al. 2011; Baliunas et al. 2009) have documented lack of physical activity as an established factor for having diabetes mellitus. The first step to combating any epidemic is to gather all available information about it. Until recently, efforts to tackle the diabetes epidemic in India were hamstrung by the lack of quality original data emanating from the country itself. It was also evident to researchers in this field that the data obtained from Western populations could not be directly extrapolated to Indians, since the natural history of diabetes in Indians is quite different from other ethnic groups.

The antiquity of early descriptions of diabetes underscores the importance of the observation and recording of medical conditions as humans evolve. Early physicians used whatever was there in their pursuit of knowledge, skills, and diagnosis. From unrecorded accounts to published knowledge, this human scourge is, simply put, a modern-day epidemic. We, and future generations from the field of life science and medicine, share the task of taking this history forward. Additional similar studies should be conducted to validate the information in ancient medicinal texts and to prove its authenticity in the modern scientific era.

In our case-control study, the subjects were selected randomly with respect to age, gender, and socio-economic and work conditions. Educational level may be related to a better working and living environment with exposure to awareness about the problem, hence selection bias is a possibility in our

data. Lifestyle exposure data was collected by face-to-face interview, with an extensive review of the range of food and lifestyle choices followed by the subjects before they were affected by DM, with an intention to understand which unique habits were common among all the subjects. The stress factor was self-reported by the patients themselves, and the severity of stress was studied. To best of our knowledge, this is the first study of this type which extracts ideas from the traditional Siddha and Ayurveda systems in DM and trying to validate them with modern-life parameters, taking them into consideration for further study to find out the causes of DM, and trying to understand the modus operandi of how DM originates.

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Compliance with ethical standards

Ethical approval All adopted procedures and methodology used were in agreement with the ethical standards for research at the university.

Conflict of interest All authors declare that they have no conflict of interest.

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