

# Ayurpharmacoepidemiology Perspective: Health Literacy (Knowledge and Practice) Among Older Diabetes Patients Visiting Ayurveda Teaching Hospitals in India

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## Abstract

Older Indian diabetics lack proper health literacy making them vulnerable to complications. Assessment of health literacy was done by hospital-based cross-sectional study. Face-to-face interview was conducted by pretested structured questionnaires. Diabetes patients aged  $\geq 60$  years consisted of 56.22% males and 43.78% females; in addition, 34.2% respondents were without formal schooling. Diabetes was known to 63.56% respondents. Total knowledge and practice score of the respondents was good (18.9% and 35.1%), average (30.7% and 46.9%), and poor (50.4% and 18%), respectively. Knowledge and practice score was strongly associated ( $P < .01$ ) with religion, educational status, and diabetes duration with positive relationship ( $R^2 = 0.247$ ,  $P < .01$ ) between knowledge and practice score. The study highlights lack of health literacy among older diabetics undergoing ayurveda management. Baseline statistics will pave the way toward ayurpharmacoepidemiology.

## Keywords

health literacy, knowledge, practice, diabetes, ayurpharmacoepidemiology

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Diabetes is posing a major threat to global public health on adults in developing countries.<sup>1</sup> The International Diabetes Federation indicates that the number of people living with diabetes is expected to rise from 382 million in 2013 to 592 million by 2035, if no essential action is taken. This equates to approximately almost 10 million cases per year with as many as 175 million people being unaware that they have diabetes.<sup>2</sup> In the developing nations, diabetes is responsible for 1 in 10 deaths among adults aged 35 to 64 years.<sup>3</sup> India, the world's second most populous country harboring 61.3 million people with diabetes is the diabetes capital.<sup>4,5</sup> The World Health Organization estimated that India will lose US\$237 billion by 2015 from premature deaths due to heart disease, stroke, and diabetes.<sup>6</sup> Our world has exploding numbers of older people due to advances in health care. Older people command a far greater proportion of the global population because of declining birth rates.<sup>7,8</sup> By 2050, the worldwide population of persons older than 60 years will reach 1.1 billion.<sup>9</sup> Three-fourths of them will be residents of developing countries.<sup>10</sup> It is predicted that by 2030 there will be 196 million people with diabetes aged older than 60 years.<sup>11</sup> The demographic change in form of increasing

proportion of the elderly in the Indian population life expectancy was projected to be 67 years for males and 69 years for females.<sup>12</sup>

Management of diabetes typically depends on the combination of drug, diet, physical activity, and lifestyle

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modification.<sup>13</sup> Diabetes associated complications are augmented among the vulnerable older diabetic subjects<sup>14</sup> with evidence indicating that proper control of blood glucose reduces the diabetes complications.<sup>15,16</sup> Older diabetes subjects have different needs as compared with young diabetes subjects, thus aging and life expectancy affect diabetes management and comorbidities.<sup>17</sup> Numerous studies on interventions regarding self-management of chronic conditions have revealed that health-related behaviors, health status, and health care use gets better if patients are involved in daily care responsibilities.<sup>18,19</sup> Information provided by health care providers associated with active patient-provider communication tends to improve the patients' health literacy and mechanisms of diabetes care.<sup>20-25</sup>

Effective preventive strategies already exist, but are not being rationally or widely utilized.<sup>26</sup> Indians, despite increased prevalence of diabetes mellitus and its associated high morbidity and mortality, significantly lack awareness about the proper management and treatment in patients.<sup>27</sup> This lack of awareness may be the underlying factor affecting attitudes and practices toward its care. Traditional medicine is used by 70% to 95% of global population particularly in developing countries for their health care.<sup>28</sup> Since traditional medicine is used by many nations at the primary level health care it may perhaps be a sensible strategy to influence the millions affected. Locally available treatment measures could be utilized and arranged at their vicinity.<sup>29</sup> Ayurpharmacoepidemiology deals with the use of and the effects of ayurvedic drugs in large numbers of people with the purpose of supporting a rational and thereby cost-effective use of safe and effective treatment in the population. The current ayurpharmacoepidemiological study is connected with the use of ayurvedic medicinal products on large populations of diabetics in order to describe and analyze the practices and conditions of use, and to evaluate the effectiveness in a routine situation connected to knowledge and practice.<sup>30</sup>

Indian diabetics effectively harness this strategy as traditional systems like ayurveda, which is widely accepted and practiced nationwide. The integrated and holistic approach involving ayurveda in the mainstream for diabetes prevention and control may be incorporated globally. Studying health disparities in type 2 diabetes seems urgent in order to identify education, practice, and factors amenable to intervention, and so on. This study tried to evaluate diabetes related knowledge and practices among geriatric diabetes patients providing a baseline for evolving suitable and culturally acceptable health education program. Efforts in this direction are likely to benefit all older individuals with diabetes.

## Materials and Methods

### Study Design, Period, and Place

The descriptive cross-sectional study was conducted between November 2010 and September 2011 at 2 centers: (a) Institute of Post Graduate Ayurvedic Education & Research at SVSP Hospital, Kolkata and (2) Rajiv Gandhi Memorial Ayurvedic College and Hospital, Beli-Shankarpur, 24 Paraganas (North), West Bengal. These 2 hospitals

**Table 1.** Sociodemographic Characteristics of the Study Respondents (n = 450).

Variable	Sex		Total (%)
	Male, n (%)	Female, n (%)	
Age group			
60-65 years	151 (33.56)	136 (30.22)	287 (63.78)
66-70 years	76 (16.89)	47 (10.44)	123 (27.33)
>70 years	26 (5.78)	14 (3.11)	40 (8.89)
Religion			
Hindu	150 (33.33)	121 (26.89)	271 (60.2)
Muslim	103 (22.89)	75 (16.67)	178 (39.6)
Others	0 (0.00)	1 (0.22)	1 (0.22)
Education			
Informal	57 (12.67)	97 (21.56)	154 (34.2)
Primary	41 (9.11)	46 (10.22)	87 (19.3)
Secondary	58 (12.89)	25 (5.56)	83 (18.4)
Higher secondary	49 (10.89)	15 (3.33)	64 (14.2)
Graduation and above	48 (10.67)	14 (3.11)	62 (13.8)
Marital status			
Married	205 (45.56)	120 (26.67)	325 (72.22)
Unmarried	11 (2.44)	2 (0.44)	13 (2.89)
Widower/widow	28 (6.22)	70 (15.56)	98 (21.78)
Divorcee	4 (0.89)	10 (2.22)	14 (3.11)
Occupation			
Retired	125 (27.78)	17 (3.78)	142 (31.56)
Service	23 (5.11)	1 (0.22)	24 (5.33)
Business	68 (15.11)	7 (1.56)	75 (16.67)
Labor	36 (8.00)	10 (2.22)	46 (10.22)
Homemaker	0 (0.00)	162 (36.00)	162 (36.00)
Diabetes duration			
≤3 years	158 (35.11)	123 (27.33)	281 (62.44)
>3 years	95 (21.11)	74 (16.44)	169 (37.56)

belong to urban and suburban regions of Kolkata, West Bengal, having postgraduate and undergraduate teaching facilities, respectively.

### Sample Size Calculation

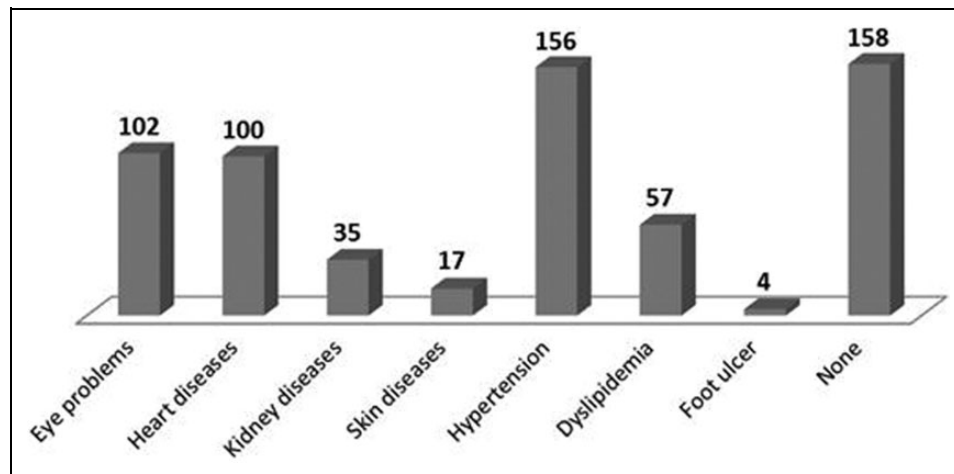
Considering prevalence of 15% of diabetes among adults in West Bengal with an absolute precision of 5% and 95% confidence level, estimated sample was 196 participants. Since 2 hospitals were selected, the final sample size needed was 392 participants. Altogether 450 respondents were enrolled and completed the study.

### Sample Selection

The respondents were selected from the outpatient departments of both the hospitals, who were aged 60 years and older with history of diabetes and had willingness to participate.

### Data Collection Tool

A pretested structured questionnaire which was compiled adapting questions from published studies and adding questions that were considered value based. The questionnaire covered four sections. Section 1 provided socio demographic information which included name, age, sex, address, religion, level of education, occupation, marital status. Section 2 contained questions related to duration of diabetes, age of detection of diabetes, way of diagnosis, family history, level of blood



**Figure 1.** Distribution of the frequency of diabetic complications among the respondents ( $n = 450$ ). \*Respondents had multiple complications, so total percentage cannot be calculated.

glucose at the time of diagnosis and testing of glucose in urine was done or not at the time of diagnosis. Section 3 included questions regarding knowledge on diabetes and its risk factors, symptoms, prevention, control, complication, relation with hypertension, and prognosis. Section 4 emphasized on practices related to health checkups, physical activities, medications used, and diabetic complications present.

### Data Collection Method

Data were collected by 5 trained interviewers through face-to-face interviews. The questionnaire was pilot tested on 10 patients from the same clinics for assessment of the questions.

### Scoring and Analysis

A scoring system was developed for each component: each correct answer was given a score of 1 and wrong or no answer was given 0. For multiple answers, score of 1 was divided by total number of possible answers, and the answers respondents gave was added, for example, a question having 5 possible answers so each answer was allotted 0.20 ( $1/5$ ) now a respondent gives 2 answers among the 5 so he was given 0.40. Then all the answers for questions on knowledge and practice were added up. Three categories were defined on the basis of the score obtained by each participant: poor ( $<40\%$  of the total score); average ( $40\%$  to  $60\%$  of the total score); and good ( $>60\%$  of the total score). Data were analyzed by using SPSS version 11. One-way analysis of variance, multiple regression analysis, and correlation were used.

### Ethics

The study was conducted according to the ethics on human population in accordance with the Declaration of Helsinki. The study protocol was approved by the Ethical Review Committee of Diabetic Association of Bangladesh, Dhaka, and Institutional Ethics Committee of Institute of Post Graduate Ayurvedic Education & Research at SVSP Hospital, Kolkata, gave permission for the study. Participants were included after verbal informed consent, which included the right to withdraw at any stage of the study they felt to do so or restrict using

the data for analysis obtained from them. All information and data collected for the study were kept confidential.

### Results

A total of 253 (56.22%) males and 197 (43.78%) females were enrolled for the final analysis. The mean age ( $\pm$  standard deviation) of the respondents was  $64.86 \pm 4.650$  years, and among them majority (60.22%) followed Hinduism. Literacy rate was not satisfactory, since 34.2% had no formal education. Details of sociodemographic data are shown in the Table 1. Diabetes-associated complications were found among 64.89% (292) respondents, and among the complications, hypertension topped the list with 156 respondents being affected (Figure 1). Diagnosis of diabetes after crossing the age of 60 years were found among 56.44% (254) respondents, showing evidence of old age-related geriatric complications.

We found that 36.44% (164) respondents did not know actually what is diabetes and 53.56% (241) respondents could not say a single symptom of diabetes. The respondents showed good adherence to regular doctor visits, adherence to medicine intake, and blood glucose and blood pressure monitoring. The knowledge and practice levels of respondents on the domains related to diabetes are shown in Tables 2 and 3, respectively. The overall good knowledge and practice level was found to be 18.9% and 35.1% among the respondents (Table 4). Distribution of knowledge and practice level in comparison with gender, religion, and education is shown in Table 5.

Diabetic knowledge score had significant ( $P < .001$ ) difference with religion ( $F = 117.61$ ), education ( $F = 207.78$ ), and occupation ( $F = 39.72$ ). Diabetes-related practice score also showed statistically significant difference ( $P < .001$ ) with religion ( $F = 33.43$ ), education ( $F = 43.40$ ), occupation ( $F = 26.05$ ), and duration of diabetes ( $F = 34.30$ ) (Table 6). Knowledge score of diabetes (dependent variable) had significant difference with religion, educational status, and duration of diabetes (independent variables) at  $P < .01$  levels. Likewise,

**Table 2.** Distribution of Knowledge Levels According to Domains (n = 450).

Level of Knowledge	Frequency	Percentage
Concept of diabetes		
Good	286	63.56
Poor	164	36.44
Symptoms of diabetes		
Good	35	7.8
Average	52	11.6
Poor	363	80.7
Risk factors of diabetes		
Good	23	5.1
Average	47	10.4
Poor	380	84.4
Prevention of diabetes		
Good	26	5.8
Average	46	10.2
Poor	378	84.0
Control measures of diabetes		
Good	48	10.7
Average	80	17.8
Poor	322	71.6
Complication due to uncontrolled diabetes		
Good	39	8.7
Average	87	19.3
Poor	324	72.0
Diabetes worsening hypertension		
Good	104	23.1
Poor	346	76.9
Curability of diabetes		
Good	271	60.2
Poor	179	39.8

practice score of diabetes (dependent variable) differed significantly with religion, educational status, occupation, duration of diabetes, and diabetic complication (independent variables) at the  $P < .01$  level (Table 7). Positive relation ( $R^2 = 0.247$ ,  $P < .01$ ) was found between knowledge score and practice score. It was observed that with knowledge score of respondents there was 24.7% variation in practice score (Figure 2).

## Discussion

Global diabetes prevalence (8.3%)<sup>2</sup> has mounted rapidly indicating the pandemic is initiated due to social and economic development associated with enhancement in life expectancy.<sup>31</sup> Betterment of health care facilities has steered an upsurge of elderly population exceeding more than half of diabetics (53%) aged 60 years and older.<sup>32</sup> Population-based diabetes health literacy evaluation is the basic stride toward formulation of a prevention program.<sup>33</sup> This exploration was a step en route to knowledge and practice estimation of elderly diabetes patients from urban and suburban hospitals undergoing ayurvedic health management. Availability of data related to diabetes perception and practices are extremely significant to plan the public health policies and implementations in diabetes control programs in India. The foremost findings of

**Table 3.** Distribution of Practice Levels According to Domains (n = 450).

Level of Practice	Frequency	Percentage
Blood glucose check-up		
Good	219	48.7
Average	176	39.1
Poor	55	12.2
Blood pressure check-up		
Good	305	67.8
Average	88	19.6
Poor	57	12.7
Eye check-up		
Good	91	20.2
Average	43	9.6
Poor	316	70.2
Foot care		
Good	28	6.2
Poor	422	93.8
Visit to physician		
Good	418	92.9
Poor	32	7.1
Adherence to prescribed medication		
Good	416	92.4
Poor	34	7.6
Physical activity (regular walking)		
Good	171	38.0
Poor	279	62.0

**Table 4.** Overall Knowledge and Practice Level of Respondents (n = 450).

Level	Knowledge, n (%)	Practice, n (%)
Good	85 (18.9)	158 (35.1)
Average	138 (30.7)	211 (46.9)
Poor	227 (50.4)	81 (18.0)

this study revealed lack of diabetes knowledge among the elderly. Inadequate knowledge and awareness of diabetes was at par with few studies conducted in different regions of India.<sup>34-42</sup> These results also coincided with few studies done elsewhere at the global perspective of developing or underdeveloped nations.<sup>43-59</sup> However, interesting reports were published from 2 studies from the Indian subcontinent stating knowledge of diabetes among the study subjects were moderately good.<sup>60,61</sup>

In the present context, only 63.56% (286) could answer correctly that increase in blood glucose level is diabetes. Recently, a study from Kolkata also reported that 51% of the respondents had satisfactory knowledge of diabetes, whereas a study conducted in Gujarat stated that 63% did not know about diabetes. It was disturbing to note that our study respondents' poor knowledge made them unable to answer anything regarding symptoms (54.9%, 247), risk factors (42%, 189), preventive measures (60.4%, 272), or control measures (38.4%, 173) for diabetes. In spite of this, 60.2% could say that diabetes cannot

**Table 5.** Distribution by Knowledge Score and Practice Score of the Respondents According to Sex, Religion, and Education (n = 450).

Variable	Knowledge Score			Practice Score		
	Good (%)	Average (%)	Poor (%)	Good (%)	Average (%)	Poor (%)
Sex						
Male	13.55	19.56	23.11	12.89	21.33	9.56
Female	5.33	11.11	27.33	22.22	25.56	8.44
Religion						
Hindu	16.88	25.55	17.78	30.44	21.11	8.67
Muslim	2.00	4.89	32.67	4.67	25.56	9.33
Others	0.00	0.22	0.00	0.00	0.22	0.00
Education						
Informal education	0.00	3.55	30.67	3.56	19.33	11.33
Primary education	0.44	4.22	14.67	5.78	12.22	1.33
Secondary education	4.67	9.56	4.22	5.78	8.44	4.22
Higher secondary	6.44	7.11	0.66	8.67	4.44	1.11
Graduation and above	7.23	6.22	0.22	11.33	2.44	0.00

**Table 6.** Association of Diabetes Knowledge and Practice With Sociodemographic Characteristics Using One-Way Analysis of Variance of Variables With Knowledge and Practice.

Variables	Categories	Knowledge Score			Practice Score		
		Mean $\pm$ SD	F	P	Mean $\pm$ SD	F	P
Sex	Male	0.41 $\pm$ 0.25	28.51*	<.001	0.55 $\pm$ 0.13	15.57*	<.001
	Female	0.27 $\pm$ 0.26			0.50 $\pm$ 0.14		
Religion	Hindu	0.47 $\pm$ 0.22	117.61*	<.001	0.57 $\pm$ 0.14	33.43*	<.001
	Muslim	0.15 $\pm$ 0.20			0.47 $\pm$ 0.11		
	Others	0.49 $\pm$ 0.00			0.55 $\pm$ 0.00		
Education	Informal	0.11 $\pm$ 0.16	207.78*	<.001	0.45 $\pm$ 0.14	43.40*	<.001
	Primary	0.25 $\pm$ 0.19			0.53 $\pm$ 0.09		
	Secondary	0.50 $\pm$ 0.14			0.51 $\pm$ 0.13		
	Higher secondary	0.58 $\pm$ 0.11			0.61 $\pm$ 0.09		
	Graduation and above	0.68 $\pm$ 0.16			0.66 $\pm$ 0.10		
Occupation	Retired	0.47 $\pm$ 0.26	39.72*	<.001	0.61 $\pm$ 0.12	26.05*	<.001
	Service	0.51 $\pm$ 0.18			0.52 $\pm$ 0.14		
	Business	0.43 $\pm$ 0.20			0.52 $\pm$ 0.12		
	Labor	0.05 $\pm$ 0.12			0.40 $\pm$ 0.10		
	Housewife	0.26 $\pm$ 0.24			0.50 $\pm$ 0.13		
Duration	$\leq 3$ years	0.31 $\pm$ 0.25	13.09*	<.001	0.50 $\pm$ 0.15	34.30*	<.001
	>3 years	0.41 $\pm$ 0.29			0.578 $\pm$ 0.10		
Complication	None	0.25 $\pm$ 0.02	6.024*	<.001	0.47 $\pm$ 0.14	13.23*	<.001
	1 complication	0.26 $\pm$ 0.02			0.53 $\pm$ 0.13		
	2 complications	0.26 $\pm$ 0.02			0.57 $\pm$ 0.11		
	3 complications	0.30 $\pm$ 0.04			0.60 $\pm$ 0.08		
	4 complications	0.27 $\pm$ 0.09			0.50 $\pm$ 0.11		
	5 complications	0.00 $\pm$ 0.00			0.53 $\pm$ 0.00		

\*Significant at level of .001.

be cured and only 6% thought it is curable. Respondents' knowledge about complications was very poor, since 46.89% (211) respondents did not have any idea that uncontrolled diabetes leads to complications. Monitoring of blood glucose level by the respondents was found to be good with 219 (48.7%) who checked blood glucose every 7 to 15 days and 176 (39.1%) monitored blood glucose level every 15 to 30 days. This variation of glucose level monitoring varied and also there is no standard protocol followed for blood glucose monitoring. A

total of 292 (64.9%) respondents visited their physicians regularly every 15 days. Because of the same reason, blood pressure monitoring also showed regularity among 305 (67.8%) respondents. Findings further revealed that with education, occupation, and increasing duration of diabetes, knowledge had significant ( $P < .001$ ) difference (Table 6). This may be due to the respondents' level of education where graduates who had better knowledge than the respondents not attending school. Similarly, occupation also influenced knowledge as

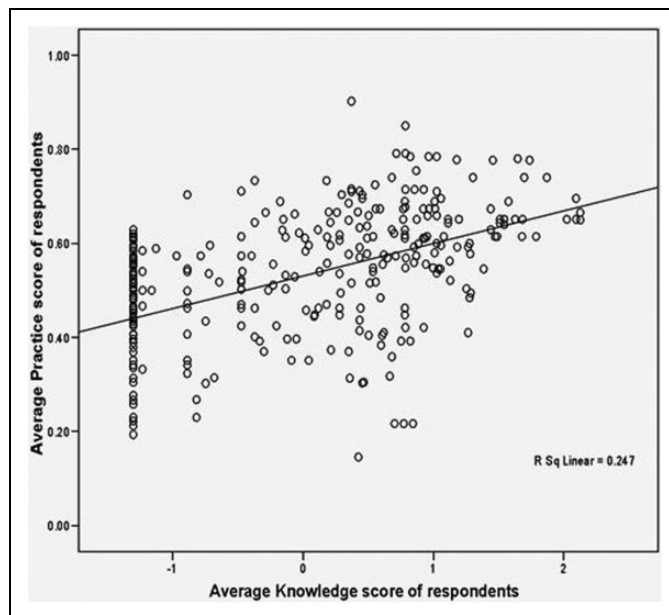
**Table 7.** Multiple Regression Analysis of Sociodemographic Variables With Knowledge Scores and Practice Scores.<sup>a</sup>

Variables	Average Knowledge Score (Y)		$R^2$	Average Practice Score (Y)		$R^2$
	Coefficients ( $\beta$ )	P		Coefficients ( $\beta$ )	P	
Constant (a)	0.220*	.003*	0.684	0.640*	.001*	0.368
Religion ( $b_1$ )	-0.061*	.001*		-0.019*	.005*	
Sex ( $b_2$ )	-0.010	.635		0.015	.352	
Educational status ( $b_3$ )	0.119*	.001*		0.031*	.001*	
Occupation ( $b_4$ )	-0.006	.408		-0.016*	.002*	
Duration of diabetes ( $b_5$ )	0.023*	.001*		0.017*	.001*	
Diabetic complication ( $b_6$ )	-0.108	.057		-0.204*	.001*	

<sup>a</sup> $\beta$  for standardized regression coefficients, percentage of total knowledge and practice score was taken as dependent variable whereas others were taken as independent variables.

$Y = 0.220 - 0.061X_1 - 0.01X_2 + 0.119X_3 - 0.006X_4 + 0.023X_5 - 0.108X_6$  (Equation of Regression line);  $R^2$  = coefficient of determination.

\*Significant at .01 levels.

**Figure 2.** Scatter diagram showing correlation between knowledge score as independent variable and practice score as dependent variable.

interactions of higher educated persons in better work culture tend to influence awareness. Likewise, increased duration of diabetes plays a major part associated with improved knowledge.<sup>62</sup>

Practice also showed statistically significant difference ( $P < .001$ ) with respondents' education and duration of diabetes (Table 6). Since health education creates awareness and also with passing time patients tend to gather information which in the long run reflects in their practices. Blood glucose monitoring, blood pressure monitoring, visit to physician, and adherence to medicine could also be attributed to government policies and patient compliance and not to knowledge and awareness alone. Government hospitals in India provide medicines and blood glucose tests at a very cheap price and wherever possible free of cost. So, to avail these opportunity,

patients should make physician visits regularly. Patients have to follow the physicians' recommendations for glycemic monitoring and to strictly comply with the medication regimens. Strong association of knowledge and practice with respondents, sociodemographic characteristics was found to be significant ( $P < .01$ ), reflecting the above-described statements. Finally, it was shown that with increasing patients' knowledge about diabetes practice also increased by 24% ( $R^2$  linear = 0.247) (Figure 2) supports the theory that proper and continuing health education can bring about desired changes in practice. The lack of knowledge and practice of diabetes among the respondents underscores the urgent need to improve the knowledge and practice about diabetes. Knowledge about diabetes, including complications of diabetes, was poor, indicating that the majority of patients had not been taught about diabetes by their physicians. This was due to several factors such as inappropriate ways of providing information, and most important, lack of time due to the huge patient loads and lack of appropriately trained support staff like educators in government setup.

Diabetes creates diverse complications as the aged diabetes patients carry diabetes lifelong, which demands for patient health care not only focused to adhering metabolic goals but also to maintain psychosocial well-being as well as secondary prevention.<sup>63,64</sup> Many previous studies have shown that educating the older patients eventually leads to better glycemic status.<sup>65-69</sup> Patients' reduced emphasis on diet and exercise may be related to a traditional provider focus on risk factor control or medication management, practical limitations of comorbid illnesses, and the challenges of implementing diet and exercise regimens. To help patients realize the importance of adherence to such behaviors, physicians may need to recommend diet and exercise plans that are culturally sensitive and individualized to the individual patient.<sup>70,71</sup>

There rests a major task in preventive medicine for the diabetes, community, and elderly care services. Diabetes and its complications can largely be prevented if appropriate and timely measures are taken. Integrated approach toward diabetes management, including mainstream medical therapeutics

associated with ayurveda and yoga, which includes personalized medicine approach can pave a path toward holistic health. To date, very few studies from India have unambiguously tackled the health needs of this old age group representing the majority of the diabetic population. Even after extensive literature search, equivalent studies focused on geriatric diabetes persons was found wanting. The current study only reveals the tip of the iceberg.<sup>35</sup>

Health education plays a very crucial role where repeated health education/reinforcement and motivation are bound to bring about a positive change in self-care practices with regard to diabetes control. Since there is a gap between knowledge, attitudes, and practices among diabetics, it is important to formulate strategies so that positive attitudes can be converted into beneficial practices. Ayurveda and its pharmacoepidemiological research can correlate the relationship of people's awareness and practices of ayurveda focused toward public health. The present cross-sectional study can be helpful in designing a larger cohort study to understand the acceptance of ayurveda and patient behavior.

Continuing medical education programs on diabetes for medical and paramedical personnel focused toward use of ayurveda should be held regularly in order to update their knowledge regarding diabetes so that better diabetes care and education can be imparted to the patients. The results of path-breaking clinical trials percolates down to the community very slowly and extra efforts must be made to transmit important public health messages through the form of mass media campaigns, public lectures, and door-to-door campaigns on a massive scale in both urban and rural India. These types of studies will form the basis for ayurpharmacoepidemiological research in the near future.

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### Author Contributions

PD contributed toward intellectual content, conception and design, analysis, reviews of literature, and manuscript preparation. NK contributed toward overall monitoring, conception and design, and manuscript preparation. LA contributed toward mentoring, concept and design, analysis, and interpretation of data. TB contributed toward analysis and data collection. TKR contributed toward data collection and reviews of literature. SB contributed toward data collection and manuscript preparation. DM contributed toward analysis and interpretation of data. SD contributed toward data collection and reviews of literature.

### Declaration of Conflicting Interests

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### Ethical Approval

The study protocol was approved by the Ethical Review Committee of Diabetic Association of Bangladesh (DAB), Dhaka, Bangladesh, and Institutional Ethics Committee of Institute of Post Graduate Ayurvedic Education & Research at SVSP Hospital, Kolkata, India, gave permission for the study.

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