

Knowledge, Attitude and Practices regarding Diabetes Mellitus among General Public of Bareilly region in Northern India: A Pilot Study

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ABSTRACT

The global prevalence of diabetes is increasing exponentially and expected to reach 783 million by the end of year 2045. The burden of complications of diabetes can be mitigated if the disease is diagnosed early and treated adequately. A cross-sectional pilot study from July 2021 to October 2021 on 52 participants from diverse areas of Bareilly (Northern India) was conducted. Only 38.46% of participants found to have good knowledge (knowledge score ≥ 19). Characters like 'level of education', 'close relative with diabetes', 'income' and 'education in the medical field' were having significant association with good knowledge score ($p < 0.05$). Around 67.28% population showed positive attitude towards diabetes. Although 'the education related to medical field' and 'level of education' were found significantly associated with positive attitude ($p < 0.05$) and binary logistic regression showed both the variable as the predictor of positive attitude. The mean knowledge score of participants possessing positive practices in relation to 'doing regular exercise' was higher compared with who do not do regular exercise ($p < 0.001$). Conclusively, the current study can be considered as a baseline for nationwide diabetes awareness programs to revamp the knowledge of population towards diabetes emphasizing the development of attitude & practices.

Key words: Pilot study, Diabetes, Knowledge, Attitude, Practices, India

INTRODUCTION

The 10th edition of the IDF (International Diabetes Federation) Diabetes Atlas reports a continual global rise in diabetes prevalence, affirming diabetes as a significant global risk to human health and well-being of peoples, families, and societies. Diabetes mellitus (DM) is becoming uncontrollable, affecting one out of every ten global adults while almost half of them are undiagnosed [1]. The overall number of diabetic patients is likely to reach 643 million by the end of 2030 and it will reach up to 783 million by the year 2045 [2]. Global prevalence of DM among adult is increasing frightfully with the estimation to reach 7.7% by the end of 2030 [3]. The prevalence of DM in India was found to be 11.8% during last four years as per the survey report released by National Diabetes and Diabetic Retinopathy (NDDR), health and family welfare ministry in October 219 [4]. The symptoms like increased thirst & hunger along with frequent urination are classically associated with DM resulting in long term micro & macro vascular complications [5]. Furthermore, untreated complications can result in death [6].

The burden of complications of diabetes can be mitigated if the disease is diagnosed early and treated adequately [7]. Weight loss, regular exercise, healthy diet, in addition to the prescribed pharmacological treatment can help achieving in optimal glycemic control [8].

Subsequently, knowledge regarding the diabetes with its complications also intervene in the better management of the disease [9]. Patients who have a thorough knowledge of diabetes and its complications may seek appropriate therapy and available health-care facilities [10].

A survey focused on knowledge, attitudes and practices (KAP) is a useful maneuver for accessing the quantitative & qualitative information possessed by the individuals [11-13]. A KAP questionnaire is such a tool that is used to establish a scale for future assessment and to help assess the efficacy of implemented educating programs regarding the aspects of health [14, 15]. A KAP-based questionnaire has been used in several research to examine people's knowledge, attitudes, and practices towards diabetes mellitus [16, 17] and advocated the necessity for better awareness on controlling the risk factors as well as prevention of DM [18]. There are substantial evidences that diabetics who are well educated and have a high level of health literacy have better disease control and management with the involvement of pharmacological and non-pharmacological interventions [19-22].

Despite of exhaustive literature survey, no research was found to assess the knowledge, attitude & practices regarding diabetes mellitus amid general public of Bareilly district, a city located within the state of Uttar Pradesh in the Northern India. Determining the KAP associated with diabetes mellitus in general population may be beneficial in gaining a better understanding of the disease and developing viable preventive interventions specific to Bareilly region. Consequently, the current pilot study was performed to explore the KAP towards diabetes mellitus among general population of Bareilly region in India.

METHODOLOGY

Study design

A cross-sectional study was conducted among diverse areas of Bareilly district.

Ethical approval

Ethical approval to conduct the study was obtained from the TMU Moradabad Institutional Ethics Committee (TMU-IEC), Teerthanker Mahaveer University, Moradabad, India (TMU/IEC/2-21/081; Dated: 28/07/2021).

Recruitment procedure

The current study was conducted at different geographical areas of district Bareilly, Uttar Pradesh, India. The questionnaire was disseminated among the participants through the principal investigator and research assistant. Target sample size for this pilot study was 52 as a small scale preliminary study to evaluate the potential for large scale quantitative research [23-27]. The study was conducted from July 2021 to October 2021. The peoples aged more than 18 years along with eligible to read & write Hindi or English language were included in this study. Research assistant interviewed and assessed the eligibility for participation by means of identifying the peoples having difficulty in understanding the consent as well as purpose of the study. The participants were randomly recruited from public places at different areas of Bareilly region and questionnaire was administered to them by the research assistant. Questionnaire contained the preface explaining about the purpose & nature of the study together with the statement of consent. Participants were free to read and consent to participate in the study. The procedure was approved by the College research committee (CRC).

Development of questionnaire

The questionnaire employed in the current study was formed on the basis of previously conducted studies to gather information on participants knowledge about diabetes, its risk factors, and management. Following an exhaustive analysis of similar and validated sets of questionnaires used in other contexts, the primary domains associated to KAP were identified [28,29]. The essential changes were made in consideration of the north Indian population's lifestyle, social, cultural, and economic aspects. The questionnaire's face validity was independently verified by professionals working with diabetic patients in Teerthanker Mahaveer Medical College & Research Centre (TMMC&RC), Teerthanker Mahaveer University (TMU), Moradabad, India. The questionnaire was presented before the Institutional Ethical Committee of Teerthanker Mahaveer Medical College & Research Centre, Teerthanker Mahaveer University, Moradabad, India and got validated after some suggested modifications by the committee members. Additionally, lingual validity of questionnaire for English & Hindi languages were obtained from the respective experts of English & Hindi languages in Hindu College, Moradabad, India. Subsequently, to enhance the clarity of questions in the questionnaire, the questionnaire was administered to five individuals. The concluded version of questionnaire was finally utilized in the settings of current study.

The very first section of questionnaire contained the respondent's demographic information, such as their age, education level, gender, average monthly income, & occupation. If the participant worked as a pharmacy staff, nurse, physician, hospital staff, dentist, or as a medical laboratory staff, their profession was considered relevant to the medical field. Medical college students/graduates, pharmacy students/graduates, nursing students/graduates, laboratory science students/graduates, and dentistry students/graduates were all considered to have degrees in the healthcare domain.

25 questions about risk factors, prevention, diagnosis, and complications of DM were used to assess participants' diabetes knowledge. "Yes," "No," and "Don't know" were the three categorical responses to each question. For each accurate response, one point was assigned, with a total score of 25. Poor, moderate, and good knowledge were allocated the score ranges of 0–12, 13–17, and 18–25, respectively.

Seven questions related to treatment were used to evaluate the public's attitude toward diabetes. Participants' responses were grouped into three types: "Yes," "No," and "I

don't know." Positive attitudes were categorized as those who received more than or equal to 4 points out of a possible 7 points.

Four questions were used to assess DM related practices. Positive and negative practices were assessed from the responses to the individual questions. These questions were about 'seeking the treatment if any family member of participants diagnosed with diabetes' and 'screening of blood glucose level once in a year'. "Yes," "No," and "Don't know" were the three categorical responses to the questions. Respondents who replied yes were characterized as having a positive practice, while those who answered no were considered to have the negative practices.

The types of herbs consumed by individuals, such as fenugreek, cinnamon, and ginger, are well known to be utilized among the Indian population, hence the question modified accordingly, while in the adopted questionnaire, Karivila (*Momordica dioica*) or Thebu leaves (*Costus speciosus*) were used, which are not soundly recognized in India [30].

Statistical analysis

SPSS (Statistical Package for the Social Sciences), version 24, was utilized to analyze the data statistically. The gender, level of education, income, and age of the participants were analyzed by means of descriptive statistics. The t-test for continuous variables whereas chi-square test for categorial variables was used in univariate analysis. Backward LR was used to perform binary logistic regression, and a p-value of < 0.05 was considered significant.

The Cronbach's alpha coefficient for the questionnaire scales was used to examine the questionnaire's internal consistency. Cronbach's Alpha for Participants' knowledge of DM scored 0.839, attitude toward DM scored 0.760, and practices toward DM scored 0.611.

RESULTS and DISCUSSION

Demographic characteristics

Out of total 52 respondents, 53.8% & 46.2% were female & male respectively. Average age was 32.61 ± 0.1616 years. 9.6% of participants were belonging to medical field. 59.6% peoples were from urban areas where as 40.4% respondents were belonging to rural areas. 46.2% respondents were having the postgraduate degree while 40.4% were undergraduate in their education level. 69.2% participants were belonging to economically weaker section, having the monthly income below

than 20,000 rupees. 53.8% respondents revealed that they have very close relatives with diabetes. 90.4% respondents were non diabetic, 1.9% participants were having diabetes while 7.7% were unaware whether they had diabetes. These demographic characteristics are presented in the Table 1.

Table 1: Demographic characteristics of respondents (n=52)

		Number	Percentage
Gender	Male	24	46.2
	Female	28	53.8
Age (years)	18-24	16	30.8
	25-34	20	38.5
	35-44	6	11.5
	45-54	8	15.4
	55 and above	2	3.8
Place of residence	Urban	31	59.6
	Rural	21	40.4
Highest level of education	Highschool	2	3.8
	Intermediate	2	3.8
	Graduate	21	40.4
	Postgraduate	24	46.2
	Doctorate	3	5.8
Average monthly income in rupee	Less than 20,000	36	69.2
	21,000 to 40,000	6	11.5
	41,000 to 60,000	9	17.3
	61,000 to 80,000	1	1.9
Very close relatives with diabetes	Yes	28	53.8
	No	15	28.8
	Don't know	9	17.3
Body weight (kg.)	41 -50	13	25.0
	51-60	15	28.8
	61-70	12	23.1
	71-80	8	15.4
	Above 81	4	7.7
Working in the medical field	Yes	5	9.6
	No	47	90.4

Suffering from diabetes	Yes	1	1.9
	No	47	90.4
	Don't know	4	7.7

Knowledge assessment

Knowledge of the study participants was assessed by means of 25 questions related to the diagnosis, prevention, complications and risk factors of the diabetes. Mean knowledge score of the participants was found to be 15.88 ± 0.782 .

Only 38.46% of participants found to have good knowledge (knowledge score ≥ 19) whereas 32.69% participants scored poor on the knowledge scale (Knowledge score 13 to 18). Less than half of the respondents were aware of the classical symptoms of diabetes e.g., increased thirst, poor appetite, frequent urination and slow healing of wounds (Figure 1).

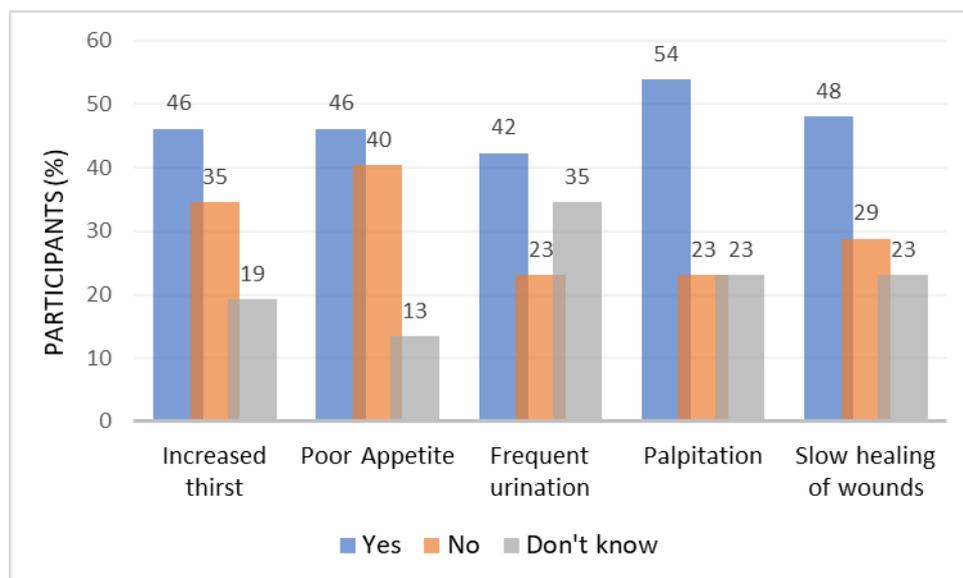


Figure 1: Knowledge about classical symptoms of Diabetes (n=52)

Participants were asked regarding the complications of diabetes and only 50% agreed that there might be any serious complication due to diabetes. Around 54% responded the kidney failure to be major complication associated with diabetes mellitus. Nearly 44% participants disagreed that diabetes may lead to stroke while almost 46% responded the heart attack to be a complication of diabetes (Figure 2).

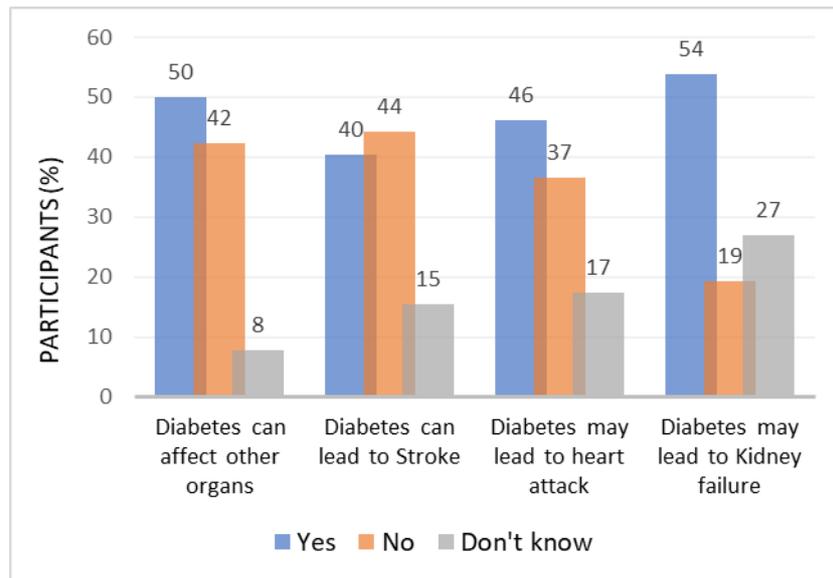


Figure 2: Knowledge about the complication of diabetes (n=52)

Around 67 % participants responded the consumption of more sugar as a high-risk factor towards diabetes. 62% responded the family history, 58% accepted the obesity, 48% marked stress while 42% replied sedentary life as risk factor for diabetes. Around 54% participants answered that dysfunction of pancreas leads to diabetes (Figure 3).

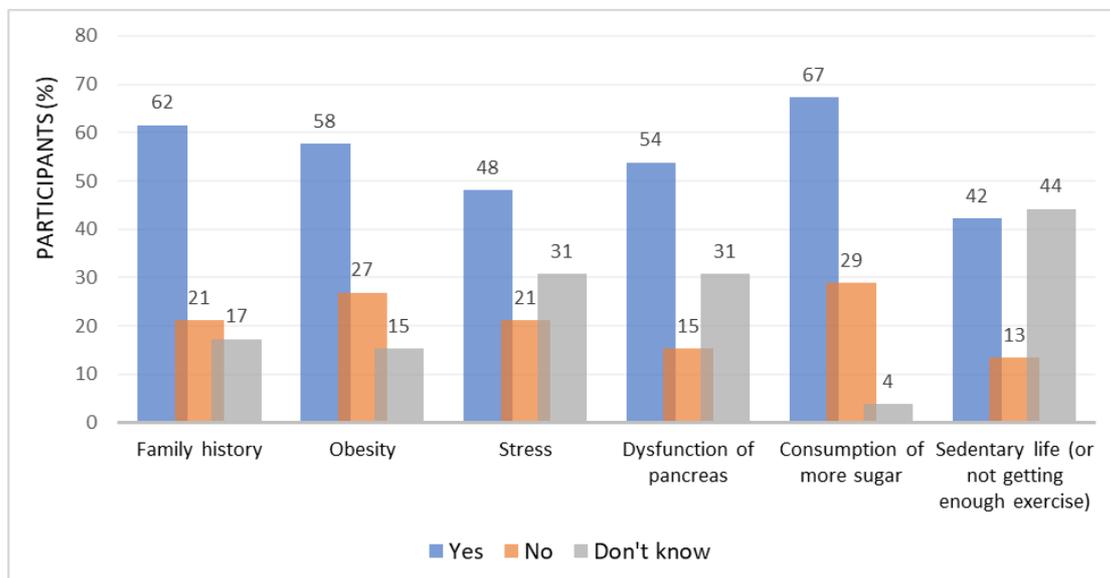


Figure 3: Knowledge regarding risk factors of DM (n=52)

The good knowledge score (≥ 19) association in relation to sociodemographic characters was assessed using the chi-square test. No significant association was found between marital status and gender with knowledge score ($p > 0.05$). Characters

like level of education, close relative with diabetes, income and education related with medical field were found to be significantly associated with good knowledge score ($p < 0.05$).

Therefore, binary logistic regression analysis was applied to these significant characters and results revealed that higher education along with having a medical degree, close relatives with diabetes and higher income lead to good knowledge score (Table 2).

Table 2: Predictors of good knowledge about DM (Binary logistic regression)

Independent variable	β	SE	OR	CI (95%)	<i>p</i> -value
Income higher than ₹ 20,000	0.57	0.21	1.76	1.39-2.77	<0.073*
Education related to the medical field	2.43	0.18	6.87	5.35-7.75	<0.001*
Higher education	1.17	0.16	2.12	2.03- 2.76	<0.390*
Close relative(s) with DM	0.11	0.19	2.81	1.96-4.37	<0.001*

* $p < 0.05$, good knowledge score = 1; Poor and moderate knowledge score = 0; OR = Odds ratio; CI = confidence interval; β = regression coefficient; SE = standard error associated with regression coefficient β

Attitude assessment

Respondent's attitude was assessed by means of seven questions. Scores < 3 was considered the negative attitude while scores ≥ 4 considered the positive attitude of respondents.

Around 67.28% population showed positive attitude towards DM. Less than half of the participants (44%) responded 'Yes' when asked that controlling glucose with diet alone is superior to that of controlling with diet & medication. Around 37% responded that insulin could have harmful effect on body. Nearly 58% participants advocated herbal approaches like ginger, cinnamon and fenugreek is better for treating diabetes than prescription drugs. Around half of the participants (48%) responded the alternatives like acupuncture, yoga & exercise to be better than allopathic treatment. 61% accepted that long term use of medication could result in organ failure. 42% participants responded yes to the question that there is 'no point in trying to control blood sugar well as the complications of diabetes will occur anyway' (Figure 4).

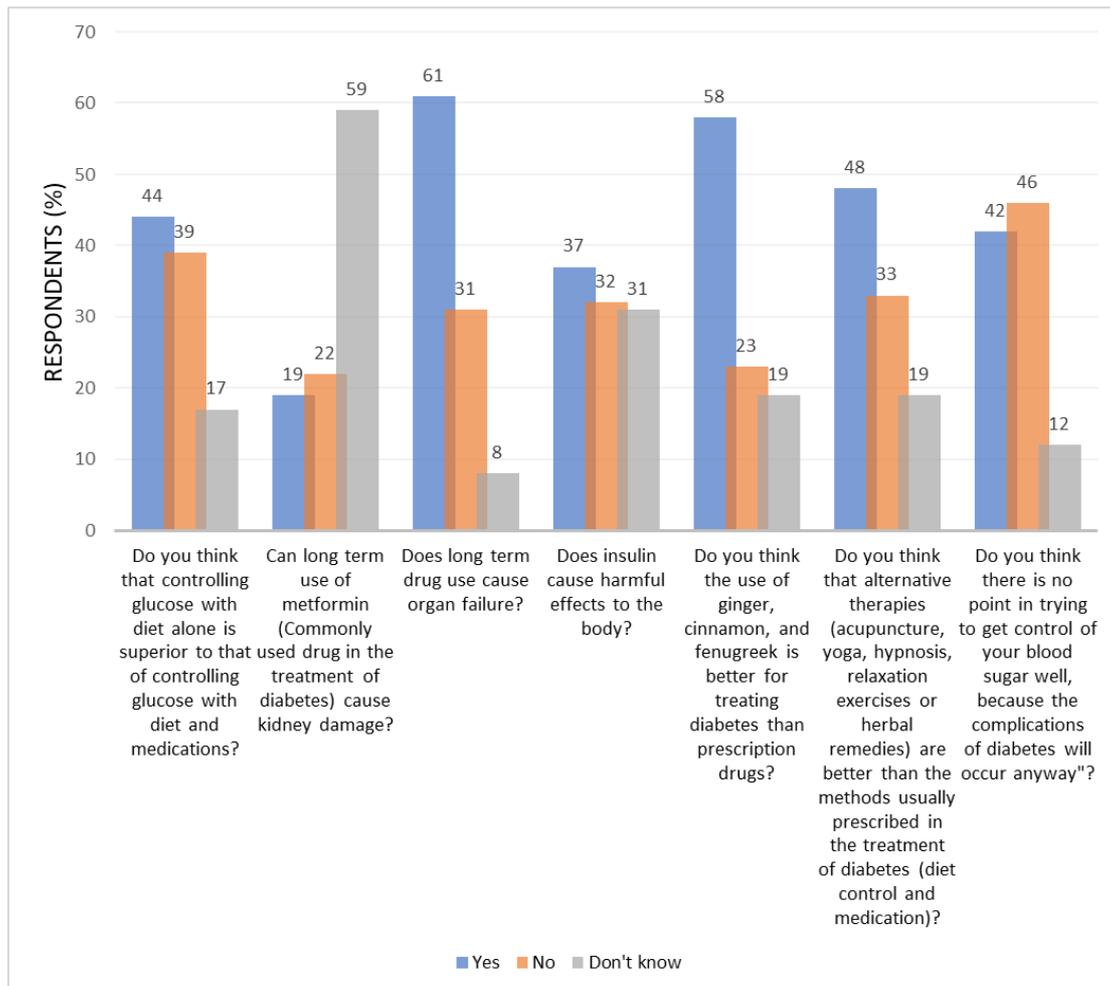


Figure 4: Participant's responses toward attitude questions (n = 52)

Knowledge score of the respondents was correlated with attitude score significantly (Pearson's correlation, 0.264, $p < 0.001$).

Univariate analysis was performed to explore the factors associated with positive attitude of the respondents. Results revealed no significant correlation with gender, age & marital status. Although the education related to medical field and level of education were found significantly associated with positive attitude ($p < 0.05$). Binary logistic regression showed both the variable as the predictor of positive attitude (Table 3).

Table 3: Predictors associated with positive attitude of the respondents

Independent variable	β	SE	OR	CI (95%)	<i>p</i> -value
Education related to the medical field	1.43	0.18	4.27	3.99-4.89	<0.001*
Level of education	0.87	0.16	2.53	2.35-3.75	<0.001*

* $p < 0.05$; Positive attitude score = 1; Negative attitude score = 0; β = regression coefficient; SE = standard error associated with regression coefficient β ; OR = Odds ratio; CI = confidence interval

Practice assessment

Four questions based on treatment, preventive measures, and screening of blood glucose level were used to assess the practices of respondents. Majority of participants (98%) responded to seek treatment if they or any of their family member diagnosed with DM. Only 40% among the study population responded to have daily physical activity for 30 -60 minutes. Majority of participants (71%) denied to regularly check their blood glucose level at least once in a year. About 65% participants even did not avoid refined sugar or the products made with refined sugar (Figure 5).

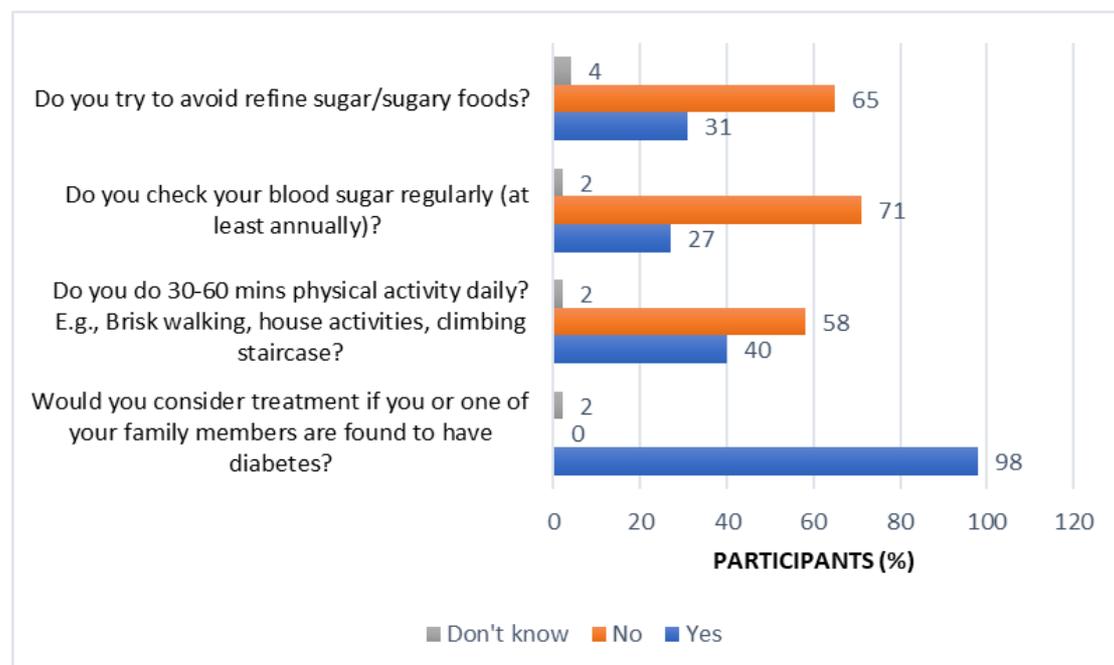


Figure 5: Participant's responses towards attitude questions

The mean knowledge score of participants having positive practices in relation to doing regular exercise was higher compared with who do not do regular exercise ($p < 0.001$). While statistically analyzing the factors associated with respondent's practices regarding checking blood glucose level at least annually, those having degree related to the medical field, aged more than 40 years along with close relative with DM, were found to screen their blood glucose level regularly (Table 4).

Table 4: Predictors of participant's positive attitudes toward DM (Binary logistic regression)

Independent variable	β	SE	OR	CI (95%)	p-value
Education related to the medical field	0.98	0.17	2.36	3.57-5.28	<0.001*
Close relative(s) with DM	0.86	0.13	3.23	2.98-5.64	<0.001*
Age more than 40 years	0.93	0.19	3.18	2.48-3.19	<0.001*

*p<0.05; Screening of blood glucose level at annual basis coded = 1; Poor; Do not screen for blood glucose level annually coded = 0; CI = confidence interval; OR = Odds ratio; β = regression coefficient; SE = standard error associated with regression coefficient β

WHO (World Health Organization) global report (2014) on diabetes revealed 1.5 million mortalities as well as 89 million disabilities in 2012 [31]. Around 537 million global adult population aged from 20 to 79 years are diabetic and the projection of diabetes prevalence from 643 million till the year 2030 is expected to rise 783 million by the year 2045 according to the 10th edition of International Diabetes Federation (IDF) atlas 2021 [32]. In 2014, the global diabetes prevalence was predicted to be 9% (as per fasting glucose concentrations higher than 126 mg/dl or consuming blood glucose-lowering medicines [33]). The prevalence of DM in the South Asian region, which includes India, is considerably greater than the global rate approaching to be risen from 7.1% in 2009 to 8.9% in 2019 [34]. Because of high prevalence and the long-term complications of DM of, health care providers must devise the diabetes preventive and management strategies. Such approaches should be focused on the population's fundamental knowledge, attitudes, and practices.

The mean knowledge score of population was 15.88 ± 0.782 that represented moderate knowledge of the participants. The resources of knowledge acquired by the respondents, was not evaluated in the current study. This score was found comparable (16.5 ± 0.51) to the previous study conducted in Sri Lanka [30]. In addition to this, there are numerous studies conducted previously revealing the poor knowledge of the population within developing countries [35-37].

A precise comparison of knowledge outcomes of the current study with others would not be significant due to varied population under the study (as most of the researchers has investigated the knowledge in diabetics rather than in general population [38-40]), method of scoring and scaling patterns.

Significant association between knowledge and education level was statistically observed in the current study which was found to be similar to the other studies [41,42].

Close relative(s) with diabetes was also found to be a predictor of good knowledge regarding DM as revealed by this study. This is because persons having family history of any chronic medical condition, such as diabetes or hypertension, may grow a delicate intellect of susceptibility, which may intensify their awareness regarding the disease [43]. Their practices also reflected the same as they used to measure their blood glucose level at annual basis.

More than half of participants (67.28%) showed positive attitude. The knowledge of the participants was shown to be strongly correlated with their attitudes, implying that good knowledge is associated with positive attitudes. Around 37% participants responded the insulin administration harmful and 61% respondents believed that long term of drug use causes organ failure. These false beliefs may have a substantial influence on the management of diabetes in the Bareilly region. As a result, additional strategies to enhance the knowledge and devise an educational tools and model reinforcing the general public's attitude are required.

More than half of the participants (58%) governed the use of “complementary and alternative medicines” (CAM) like fenugreek, cinnamon and ginger were better in the treatment of DM rather than prescription drugs [44,45]. Few studies have reported the use of CAM in various ailments in diverse geographical areas of India [46,47]. One such study conducted within Uttar Pradesh state of India found that 68 % of diabetes patients used CAM [48]. Such practices of using CAM to manage diabetes lacking appropriate medical supervision can be hazardous [49]. It is not possible to conclude the extent of disclosure about the use of CAM by the patients, in spite of that, future educational endeavors should spread cognizance regarding the negative as well as positive outcomes of CAM use in the management of many chronic diseases including diabetes, in addition to encourage patients to reveal use of CAM by them with their health care provider.

In this study, respondents who reported positive practices for example exercise, had a higher knowledge level, but it is also imperative to note that the positive knowledge does not necessarily transform into positive practices. As a consequence, future efforts must concentrate on improving awareness regarding disease and perpetuating the positive practices.

Current study stated that around 2/3rd of the participants had not examined their blood glucose level at least once in a year. Participants over the age of 40 and/or with a medical education were having significant association with practice of diagnosis for diabetes on an annual basis. As people grow older, they may become more conscious of or concerned regarding their health, which may bring about regular health checkups, including blood glucose tests. It is significant to note that such health screenings can be costly for some peoples, who may regard them as an expensive expense.

CONCLUSION

The current pilot study presents an overview of the existing scenario regarding knowledge, attitude & practices related to diabetes among general population of Bareilly region (A district of state of Uttar Pradesh in Northern India). The general population of Bareilly region has a low level of knowledge about diabetes management, care and risk factors. The knowledge level increases with education level and having close relatives with diabetes. To provide the greatest benefit to the community, intervention programs should target those who do not have education related to medical field and do not have close relative with diabetes. People with sufficient financial resources have a more positive attitude toward availing treatment. Peoples with limited resources should be offered free screenings and should be fortified with awareness to attend the same. The current study seems to be the first to study these issues in Bareilly's public. The study has emphasized upon the emergence of adequate educational tools to encourage healthy lifestyle practices along with consistent health checkups, particularly amid certain subgroups of peoples, such as those without a medical education and without first-degree relatives with diabetes. Conclusively, this pilot study can be considered as a precedent for nationwide diabetes awareness programs to revamp the knowledge of population towards diabetes giving more stress on the transformation of attitude & practices.

LIMITATIONS OF THE STUDY

The study included the random selection of the participants. Nevertheless, optimized efforts were considered while collecting the data from various geographical areas of Bareilly. More than half of the respondents were found to have very close relative with diabetes that has been proven as high predictor of positive attitude which could

indicate biasness during randomized selection of the participants in the study. The study was performed on pilot basis and hence the sample size may not be considered as the representative of the whole population, although the participants were chosen at random from a wider geographical area, so they can be considered as being the representative of the population. This study was focused in Bareilly region of Uttar Pradesh in India and it can't be generalized to the whole state or country as India has diverse geographical, cultural & religious distribution. In addition, the sources of the participant's health related information were not investigated in the current study. Knowledge of valid sources could have aided in determining the most suitable intervention to promote the health of the general public of Bareilly. Despite its limitations, the current pilot study exhaustively evaluated the knowledge, attitude, and practices regarding diabetes among general public of Bareilly region.

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STATEMENT OF ETHICS

Ethical approval to conduct the study was obtained from the TMU Moradabad Institutional Ethics Committee (TMU-IEC), Teerthanker Mahaveer University, Moradabad, India (TMU/IEC/2-21/081; Dated: 28/07/2021).

CONFLICT OF INTEREST STATEMENT

The authors declare that they have no conflict of interest..

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AUTHOR CONTRIBUTIONS

All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by Neelanchal Trivedi. The first draft of the

manuscript was written by Piyush Mittal and Anurag Verma commented on previous versions of the manuscript. All authors read and approved the final manuscript.

REFERENCES

1. Wahengbam PP, Kshetrimayum N, Wahengbam BS, Nandkeoliar T, Lyngdoh D. Assessment of oral health knowledge, attitude and self-care practice among adolescents-a state wide cross-sectional study in Manipur, North Eastern India. *J Clin Diagn Res.* 2016; 10(6): ZC65. doi: 10.7860/JCDR/2016/20693.8002.
2. Shah VN, Kamdar PK, Shah N. Assessing the knowledge, attitudes and practice of type 2 diabetes among patients of Saurashtra region, Gujarat. *Int J Diabetes Dev Ctries.* 2009; 29(3): 118. doi: 10.4103/0973-3930.54288.
3. Wang H, Li N, Chivese T, Werfalli M, Sun H, Yuen L, et al. IDF Diabetes Atlas: Estimation of Global and Regional Gestational Diabetes Mellitus Prevalence for 2021 by International Association of Diabetes in Pregnancy Study Group's Criteria. *Diabetes Res Clin Pract.* 2022; 183:109050. <https://doi.org/10.1016/j.diabres.2021.109050>.
4. Pradeepa R, Mohan V. Epidemiology of type 2 diabetes in India. *Indian J Ophthalmol.* 2021; 69(11):2932. doi: 10.4103/ijo.IJO_1627_21.
5. Bytzer P, Talley NJ, Hammer J, Young LJ, Jones MP, Horowitz M. GI symptoms in diabetes mellitus are associated with both poor glycemic control and diabetic complications. *Am J Gastroenterol.* 2002; 97(3): 604-11. [https://doi.org/10.1016/S0002-9270\(01\)04099-0](https://doi.org/10.1016/S0002-9270(01)04099-0).
6. Chawla A, Chawla R, Jaggi S. Microvascular and macrovascular complications in diabetes mellitus: Distinct or continuum?. *Indian J Endocrinol Metab.* 2016; 20(4): 546. doi: 10.4103/2230-8210.183480.
7. Zhang Y, Dall TM, Mann SE, Chen Y, Martin J, Moore V, et al. The economic costs of undiagnosed diabetes. *J Health Manag.* 2009; 12(2): 95-101. <https://doi.org/10.1089/pop.2009.12202>.

8. Al-Khawaldeh OA, Al-Hassan MA, Froelicher ES. Self-efficacy, self-management, and glycemic control in adults with type 2 diabetes mellitus. *J Diabetes Complications*. 2012; 26(1): 10-6. <https://doi.org/10.1016/j.jdiacomp.2011.11.002>.
9. Al-Qazaz HK, Hassali MA, Shafie AA, Sulaiman SA, Sundram S. Perception and knowledge of patients with type 2 diabetes in Malaysia about their disease and medication: a qualitative study. *Res Social Adm Pharm*. 2011; 7(2): 180-91. <https://doi.org/10.1016/j.sapharm.2010.04.005>.
10. Lewis CP, Newell JN. Patients' perspectives of care for type 2 diabetes in Bangladesh—a qualitative study. *BMC Public Health*. 2014; 14(1): 1-7. <https://doi.org/10.1186/1471-2458-14-737>.
11. Al Amin MA, Adrianto L, Kusumastanto T, Imran Z. Community knowledge, attitudes and practices towards environmental conservation: Assessing influencing factors in Jor Bay Lombok Indonesia. *Mar Drugs*. 2021; 129:104521. <https://doi.org/10.1016/j.marpol.2021.104521>.
12. Perumal N, Cole DC, Ouédraogo HZ, Sindi K, Loechl C, Low J, et al. Health and nutrition knowledge, attitudes and practices of pregnant women attending and not-attending ANC clinics in Western Kenya: a cross-sectional analysis. *BMC Pregnancy Childbirth*. 2013; 13(1): 1-2. <https://doi.org/10.1186/1471-2393-13-146>.
13. Rakotosamimanana S, Rakotoarimanana FJ, Raharimanga V, Taglioni F, Ramamonjisoa J, Randremanana RV, et al. Influence of Sociospatial determinants on knowledge, attitudes and practices related to the plague in a population living in endemic areas in the central highlands, Madagascar. *BMC Public Health*. 2021; 21(1): 1-1. <https://doi.org/10.1186/s12889-021-11101-3>.
14. Sun H, Saeedi P, Karuranga S, Pinkepank M, Ogurtsova K, Duncan BB, et al. IDF Diabetes Atlas: Global, regional and country-level diabetes prevalence estimates for 2021 and projections for 2045. *Diabetes Res Clin Pract*. 2022; 183:109119. <https://doi.org/10.1016/j.diabres.2021.109119>.
15. Folasayo AT, Oluwasegun AJ, Samsudin S, Saudi SN, Osman M, Hamat RA. Assessing the knowledge level, attitudes, risky behaviors and preventive practices on

sexually transmitted diseases among university students as future healthcare providers in the central zone of Malaysia: a cross-sectional study. *Int J Environ Res Public Health*. 2017; 14(2): 159. <https://doi.org/10.3390/ijerph14020159>.

16. Memon MS, Shaikh SA, Shaikh AR, Fahim MF, Mumtaz SN, Ahmed N. An assessment of knowledge, attitude and practices (KAP) towards diabetes and diabetic retinopathy in a suburban town of Karachi. *Pak J Med Sci*. 2015; 31(1):183. doi: 10.12669/pjms.311.6317.

17. Islam FM, Chakrabarti R, Dirani M, Islam MT, Ormsby G, Wahab M, et al. Knowledge, attitudes and practice of diabetes in rural Bangladesh: the Bangladesh Population based Diabetes and Eye Study (BPDES). *PLoS One*. 2014; 9(10): e110368. <https://doi.org/10.1371/journal.pone.0110368>.

18. Knight KM, Dornan T, Bundy C. The diabetes educator: trying hard, but must concentrate more on behaviour. *Diabet Med*. 2006; 23(5): 485-501. <https://doi.org/10.1111/j.1464-5491.2005.01802.x>.

19. Huang YM, Shiyabola OO, Chan HY, Smith PD. Patient factors associated with diabetes medication adherence at different health literacy levels: A cross-sectional study at a family medicine clinic. *Postgrad Med J*. 2020; 132(4): 328-36. <https://doi.org/10.1080/00325481.2020.1749499>.

20. Bohanny W, Wu SF, Liu CY, Yeh SH, Tsay SL, Wang TJ. Health literacy, self-efficacy, and self-care behaviors in patients with type 2 diabetes mellitus. *J Am Acad Nurse Pract*. 2013; 25(9): 495-502. <https://doi.org/10.1111/1745-7599.12017>.

21. Huang YM, Pecanac KE, Shiyabola OO. “Why am I not taking medications?” Barriers and facilitators of diabetes medication adherence across different health literacy levels. *Qual. Health Res.* 2020; 30(14): 2331-42. <https://doi.org/10.1177/1049732320945296>.

22. Stiles E. Promoting health literacy in patients with diabetes. *Nurs Stand*. 2011; 26(8). doi: 10.7748/ns.26.8.35.s49.

23. Introduction of a pilot study. *Korean journal of anesthesiology*. 2017; 70(6): 601. doi: 10.4097/kjae.2017.70.6.601.

24. Hertzog MA. Considerations in determining sample size for pilot studies. *Res Nurs Health*. 2008; 31(2): 180-91. <https://doi.org/10.1002/nur.20247>.
25. Kim J, Seo BS. How to calculate sample size and why. *Clin Orthop Surg*. 2013; 5(3): 235-42. <https://doi.org/10.4055/cios.2013.5.3.235>.
26. Eldridge SM, Costelloe CE, Kahan BC, Lancaster GA, Kerry SM. How big should the pilot study for my cluster randomised trial be?. *Stat Methods Med Res*. 2016; 25(3): 1039-56. <https://doi.org/10.1177/0962280215588242>.
27. Whittemore R, Melkus G, Wagner J, Northrup V, Dziura J, Grey M. Translating the diabetes prevention program to primary care: a pilot study. *Nurs. Res.*. 2009; 58(1): 2. doi: 10.1097/NNR.0b013e31818fcef3.
28. Remschmidt B, Pau M, Gaessler J, Zemann W, Jakse N, Payer M, et al. Diabetes Mellitus and Oral Cancer: A Retrospective Study from Austria. *Anticancer Res*. 2022; 42(4): 1899-903. <https://doi.org/10.21873/anticancer.15666>.
29. Chen L, Magliano DJ, Balkau B, Colagiuri S, Zimmet PZ, Tonkin AM, et al. AUSDRISK: an Australian Type 2 Diabetes Risk Assessment Tool based on demographic, lifestyle and simple anthropometric measures. *Med J Aust*. 2010; 192(4): 197-202. <https://doi.org/10.5694/j.1326-5377.2010.tb03478.x>
30. Herath HM, Weerasinghe NP, Dias H, Weerarathna TP. Knowledge, attitude and practice related to diabetes mellitus among the general public in Galle district in Southern Sri Lanka: a pilot study. *BMC Public Health*. 2017; 17(1): 1-7. <https://doi.org/10.1186/s12889-017-4459-5>.
31. World Health Organization. Global status report on noncommunicable diseases 2014. World Health Organization; 2014. <https://apps.who.int/iris/bitstream/handle/10665/148114/?sequence=6> (accessed April 13, 2022).
32. Sun H, Saeedi P, Karuranga S, Pinkepank M, Ogurtsova K, Duncan BB, et al. IDF Diabetes Atlas: Global, regional and country-level diabetes prevalence estimates for 2021 and projections for 2045. *Diabetes Res Clin Pract*. 2022; 183: 109119. <https://doi.org/10.1016/j.diabres.2021.109119>.

33. Chaudhury A, Duvoor C, Reddy Dendi VS, Kraleti S, Chada A, et al. Clinical review of antidiabetic drugs: implications for type 2 diabetes mellitus management. *Front Endocrinol.* 2017; 8: 6. <https://doi.org/10.3389/fendo.2017.00006>.
34. Pradeepa R, Mohan V. Epidemiology of type 2 diabetes in India. *Indian J Ophthalmol.* 2021; 69(11): 2932. doi: 10.4103/ijo.IJO_1627_21.
35. Gillani AH, Amirul Islam FM, Hayat K, Atif N, Yang C, Chang J, et al. Knowledge, attitudes and practices regarding diabetes in the general population: A cross-sectional study from Pakistan. *Int J Environ Res Public Health.* 2018; 15(9): 1906. <https://doi.org/10.3390/ijerph15091906>.
36. Mounica B. Study of knowledge, attitude and practice of general population of Guntur towards silent killer diseases: hypertension and diabetes. *Value Health.* 2015; 18(7): A398. <https://doi.org/10.1016/j.jval.2015.09.907>.
37. Demaio AR, Otgontuya D, de Courten M, Bygbjerg IC, Enkhtuya P, Oyunbileg J, et al. Exploring knowledge, attitudes and practices related to diabetes in Mongolia: a national population-based survey. *BMC Public Health.* 2013; 13(1): 1-7. <https://doi.org/10.1186/1471-2458-13-236>.
38. Rahaman KS, Majdzadeh R, Naieni KH, Raza O. Knowledge, attitude and practices (KAP) regarding chronic complications of diabetes among patients with type 2 diabetes in Dhaka. *Int J Endocrinol Metab.* 2017; 15(3): e12555 doi: 10.5812/ijem.12555.
39. Kusumo MP, Prabandari YS, Dewi FS. Measuring the Knowledge, Attitude and Practice of Patients With Diabetes Mellitus—The Design and Development Process. *Int Q Community Health Educ.* 2021; 0272684X211022173. <https://doi.org/10.1177/0272684X211022173>.
40. Chawla SP, Kaur S, Bharti A, Garg R, Kaur M, Sooin D, et al. Impact of health education on knowledge, attitude, practices and glyceimic control in type 2 diabetes mellitus. *J Family Med Prim Care.* 2019; 8(1): 261. doi: 10.4103/jfmpe.jfmpe_228_18.

42. Ross CE, Mirowsky J. Refining the association between education and health: the effects of quantity, credential, and selectivity. *Demography*. 1999; 36(4): 445-60. <https://doi.org/10.2307/2648083>.
43. Walter FM, Emery J, Braithwaite D, Marteau TM. Lay understanding of familial risk of common chronic diseases: a systematic review and synthesis of qualitative research. *Ann Fam Med*. 2004; 2(6): 583-94. <https://doi.org/10.1370/afm.242>.
44. Medagama AB, Bandara R. The use of complementary and alternative medicines (CAMs) in the treatment of diabetes mellitus: is continued use safe and effective?. *Nutrition journal*. 2014; 13(1): 1-9. <https://doi.org/10.1186/1475-2891-13-102>.
45. Alqathama A, Alluhiabi G, Baghdadi H, Aljahani L, Khan O, Jabal S, et al. Herbal medicine from the perspective of type II diabetic patients and physicians: what is the relationship?. *BMC Complement Med Ther*. 2020; 20(1): 1-9. <https://doi.org/10.1186/s12906-020-2854-4>.
46. Singh V, Raidoo DM, Harries CS. The prevalence, patterns of usage and people's attitude towards complementary and alternative medicine (CAM) among the Indian community in Chatsworth, South Africa. *BMC Complement Med Ther*. 2004; 4(1): 1-7. <https://doi.org/10.1186/1472-6882-4-3>.
47. Ray J, Chakrabarty D, Paul R, Som K. Prevalence of the use of complementary and alternative medicine in an eastern Indian population with emphasis on tribal/ethnic minority groups. *Journal of Taibah University medical sciences*. 2018; 13(4): 384-9. <https://doi.org/10.1016/j.jtumed.2018.04.001>.
48. Vishnu N, Mini GK, Thankappan KR. Complementary and alternative medicine use by diabetes patients in Kerala, India. *Glob Health Epidemiol Genom*. 2017; 2: E6. <https://doi.org/10.1017/ghg.2017.6>.
49. Alqahtani M, Almutairi FE, Albasseet AO, Almutairi KE. Knowledge, attitude, and practice of diabetes mellitus among the saudi population in Riyadh, Saudi Arabia: a quantitative study. *Cureus*. 2020; 12(1): e6601.. doi:10.7759/cureus.6601.