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Knowledge, attitudes and practices towards COVID-19 among young adults with Type 1 Diabetes Mellitus amid the nationwide lockdown in India: A cross-sectional survey

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ABSTRACT

Aims: To assess knowledge, attitude, and practices (KAP) of young adults with type 1 diabetes mellitus (T1DM) towards COVID-19 amid nationwide lockdown in India.

Methods: We conducted a cross-sectional web-based survey among young adults with T1DM (aged 18–30 years) in the North, Central, South, and West zones of India. It consisted of fifteen, five and eight questions pertaining to knowledge, attitude, and practices towards COVID-19, respectively. Certain questions relevant to T1DM were also incorporated.

Results: After exclusion, 212 participants were included (mean age = 25.1 ± 4.3 years; M: F = 10:11). The overall correct rate of the knowledge questionnaire was 83% (mean total knowledge score = 12.4 ± 1.9). Most (74%) had an average knowledge score (mean ± 1SD). Higher educational status, urban residence, and being married were associated with better knowledge scores; however, only urban residence was found to be statistically significant on multinomial logistic regression. Most (88%) felt that being a patient of T1DM, they were at higher risk of getting infected with COVID-19. At the same time, 98% were confident about self-protection. Fifty-one percent of respondents had left home amid lockdown mostly to procure insulin/injection needles/syringes/glucometer strips from the pharmacy. However, all were maintaining proper hand hygiene and majority were following routine dietary advice (95%) and administering prescribed insulin doses (99%). Seventy-two participants (34%) had experienced one or more episodes of hypoglycemia since the commencement of lockdown.

Conclusions: Young adults with T1DM have average knowledge, positive attitude, and healthy preventive practices towards COVID-19. Awareness campaigns targeted towards rural communities and providing doorstep delivery of insulin/needles/syringes may be more rewarding.

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1. Introduction

The novel coronavirus disease (COVID-19) has been on the rampage ever since its outbreak in December 2019, affecting over 4 million people and claiming >278,000 lives in over 200 countries all over the world [1]. The brunt of the disease has been borne by China, the United States of America, Europe, and Iran. The disease has also infiltrated the Indian borders. Considering a population of >1.3 billion people, India could very well become the next epicenter of the pandemic. In an attempt to prevent its spread, a nationwide lockdown has been imposed in the nation since March 25, 2020. Even then, the disease is spreading fast with 70,756 confirmed cases been reported from India as of May 12, 2020.

Although the overall mortality rate varies from 0.7% to 10.8% [2], COVID-19 tends to be severe and portend a poor prognosis especially in patients with advancing age and underlying co-morbidities [3]. Likewise, diabetes mellitus (DM) has emerged as a distinctive co-morbidity that is associated with severe disease, acute respiratory distress syndrome, and increased mortality in COVID-19 [4–7]. In the absence of any definite therapy against COVID-19, it becomes imperative that people with DM take extra precautions, stringently abide by advisories of social distancing and hand hygiene and ensure good glycemic control [4,8,9]. However, people's adherence to these control measures will be largely affected by their knowledge, attitude, and practices (KAP) towards COVID-19, in accordance with the “KAP theory”. The “KAP theory” is a health behavior change theory wherein the change in human behavior is divided into three successive processes, namely, acquisition of right knowledge, generation of attitudes and adoption of behavior (or practice) [10]. Several studies have shown that the KAP level in individuals is associated with effective prevention and management of illness and promotion of one's own health [10–13]. On the contrary, deficiencies in KAP are linked to poor health and maladaptive disease preventive behavior [10,14,15]. Thus, it is expected that KAP levels of people with DM will be the deciding factor in their battle against COVID-19.

Hence, the present study was undertaken to assess the knowledge, attitude, and practices with regard to COVID-19 in young adults with type 1 diabetes mellitus (T1DM) amid the nationwide lockdown in India.

2. Subjects, materials and methods

The cross-sectional survey was conducted from April 25, 2020 to May 2, 2020 amid the nationwide lockdown in India. Because it was not feasible to perform a community-based survey during this period, we conducted a web-based survey using the Survey Monkey platform. The survey link was mailed to non-profit organizations working for the betterment of people with T1DM in different parts of the country, namely, ADITI (Association of Diabetes in Tricity; <http://aditidiabetes.com>), DIYA (Diabetes India Youth in Action; <http://diya.org.in>) and JDF (Juvenile Diabetes Foundation; <https://www.jdfmumbai.org>). The survey link was then

disseminated by the respective organizations to their enrolled T1DM patients through social media (mainly WhatsApp). The survey link stated that all people with T1DM of at least 1-year duration, aged 18–30 years and able to read and write in English were eligible to take part in the survey. In addition, it was clearly mentioned that participation in the survey was entirely voluntary and that all the information would be kept strictly confidential. As an additional measure, the participants had to answer a ‘yes-no’ question to confirm their willingness to participate in the survey voluntarily. The survey was duly approved by the Institute Ethics Committee.

The questionnaire consisted of three parts: demographics, disease/therapy-related, and knowledge-attitude-practice (KAP). Demographic details included age, gender, residence (urban vs. rural including the name of city/village and state), highest educational status, employment status, monthly family income and present marital status. Disease/therapy-related details included duration of T1DM, latest value of glycated hemoglobin (HbA_{1c}) available over the past 6 months, ongoing insulin regimen, availability of glucometer at home, difficulty in procuring prescribed insulin preparations from pharmacy amid the prevailing lockdown, occurrence, and frequency of hypoglycemic episodes (documented capillary glucose on glucometer <70 mg/dl with or without typical symptoms) and any need and reason for hospitalization since the commencement of lockdown in the country.

The KAP questionnaire consisted of 15 questions pertaining to knowledge regarding the novel coronavirus disease (COVID-19), 5 questions catering to attitude towards COVID-19, and finally, 8 questions concerning practices towards COVID-19. The knowledge questionnaire was based on the ‘Awareness Material’ regarding COVID-19 being propagated by the Ministry of Health and Family Welfare, Government of India [16]. Moreover, some questions were specifically based on diabetes mellitus and COVID-19. In general, four questions were based on disease presentation and severity (K1-K4), six questions were based on disease transmission (K5-K10) and five questions were pertaining to disease prevention and control (K11-K15) (Table 1). Each question was provided with three options, ‘True/False/Do not know’. A correct answer was assigned 1 point and an incorrect/unknown answer was assigned 0 points. All the 15 answers were summed up to generate a Total Knowledge Score for each participant that ranged from 0 to 15.

The attitude of the participants towards COVID-19 was assessed using 5 questions that included their personal opinion about being anxious about COVID-19 (A1), the chances of getting infected with COVID-19 (A2-A3) and their confidence in being able to protect themselves and winning the battle against COVID-19 (A4-A5). The assessment of respondents' practices was composed of questions pertaining to their behavior regarding going out amid lockdown, use of mask while venturing out of their homes (P1-P4), use of self-protection measures to prevent COVID-19 (P5-P6) and diabetes self-care (P7-P8) (Table 1). The face and content validity of the questionnaire was established by expert opinions from five individuals in the fields of endocrinology and infectious

Table 1 – Table showing questionnaire of knowledge, attitude and practices towards the novel coronavirus disease/COVID-19.

Questions	Options
Knowledge (correct rate expressed as % of total sample)	
K1. People with coronavirus disease/COVID-19 have fever, tiredness, dry cough and shortness of breath. (98.1%)	True/False/Do not know
K2. All people infected with coronavirus develop symptoms and feel unwell. (59.4%)	True/False/Do not know
K3. All individuals infected with coronavirus develop serious or severe disease. (45.3%)	True/False/Do not know
K4. People with diabetes mellitus are more likely to develop serious disease and even die. (87.7%)	True/False/Do not know
K5. People can catch the infection from others who have the virus. (97.6%)	True/False/Do not know
K6. The coronavirus spreads when you breathe in the respiratory droplets that are coughed out or exhaled by an infected person. (94.8%)	True/False/Do not know
K7. Coronavirus in respiratory droplets can land on surrounding surfaces and objects and can remain alive for a long time. (87.2%)	True/False/Do not know
K8. You can catch the coronavirus if you touch your face, eyes, nose and mouth after touching objects and surfaces where coronavirus is present. (95.2%)	True/False/Do not know
K9. People infected with coronavirus cannot spread the disease when they have no fever. (58.6%)	True/False/Do not know
K10. The coronavirus does not spread though use of insulin injection needles. (40%)	True/False/Do not know
K11. Young adults have good immunity and hence do not need to take precautions to protect against coronavirus. (91%)	True/False/Do not know
K12. At present there is no vaccine or effective treatment for coronavirus disease/COVID-19. (91.5%)	True/False/Do not know
K13. Regularly and thoroughly washing your hands with soap and water or cleaning them with an alcohol-based hand rub can protect against coronavirus. (98.6%)	True/False/Do not know
K14. Avoiding crowded places and maintaining a minimum distance of 1 m from others can prevent spread of coronavirus. (100%)	True/False/Do not know
K15. If you have accidentally come in contact with a person with coronavirus disease/COVID-19, you should immediately self-isolate for a minimum period of 14 days and report immediately to your nearest doctor/hospital if you feel unwell. (97.6%)	True/False/Do not know
Attitudes	
A1. Do you feel anxious when you think of coronavirus disease/COVID-19?	Yes/No
A2. Do you think that being a diabetic you are at a higher risk of getting infected from coronavirus?	Yes/No
A3. Do you feel that following the routine dietary advice will weaken your immune system and make you more prone to get infected with coronavirus?	Yes/No
A4. Do you think that regular hand washing, maintaining social distancing and use of masks can protect you from coronavirus?	Yes/No
A5. Do you think lockdown will be helpful in controlling the coronavirus disease/COVID-19 in India?	Yes/No
Practices	
P1. Have you left your home since nationwide lockdown was announced in India?	Yes/No
If yes, for how many days?	≤5 days/6–10 days/>10 days
P2. If you had left your home, did you wear a facemask while going outside?	Yes/No
If yes, what type of mask you used?	Homemade cloth mask/Medical (surgical-grade) mask
P3. If you had left your home, did you visit a medical store to purchase insulin or insulin injection needles/syringes or glucometer strips?	Yes/No
P4. If you had left your home, did you go out for walking in the park or playing with your friends?	Yes/No
P5. If you had left your home, did you consciously maintain a distance of at least 1 m from others?	Yes/No
P6. Are you regularly washing you hands with soap and water?	Yes/No
P7. Are you properly following your routine dietary advice?	Yes/No
P8. Are you regularly injecting your prescribed doses of insulin?	Yes/No

disease. The questionnaire was pilot tested before being circulated for the survey.

2.1. Statistical analysis

Statistical analysis was performed using the Statistical Package for Social Sciences (SPSS) 23.0 software program (SPSS Inc., Chicago, IL, USA). Kolmogorov-Smirnov test was used to check the normality of data. Normally distributed data were expressed as mean \pm standard deviation (SD), while non-parametric data were expressed in median (interquartile range, IQR). Correlations between total knowledge scores and continuous demographic variables (participant's age, monthly family income, duration of T1DM) were made using Pearson/Spearman correlation coefficient based on normality of data. Similarly, comparisons between total knowledge score and categorical demographic variables (gender, educational status, employment status, marital status) were made using Independent Student's t-test or one-way analysis of variance (ANOVA). Subsequently, a participant was classified as having poor knowledge (total knowledge score $<$ Mean $-$ 1 SD), average knowledge (total knowledge score = Mean \pm 1 SD) and good knowledge (total knowledge score $>$ Mean $+ 1$ SD) [17,18]. Multinomial logistic regression analysis was used to find out the statistically significant predictors of average and good knowledge (as compared to poor knowledge). The degree of association was quantified using odds ratio (OR) (95% confidence intervals). A p-value $<$ 0.05 was considered significant.

3. Results

A total of 224 participants completed the survey questionnaire. Twelve participants were excluded (two were below 18 years of age, four were above 30 years, six had incomplete data). The final sample thus consisted of 212 participants of whom 101 were men (male:female ratio 10:11). The mean (\pm SD) age of the participants was 25.1 \pm 4.3 years. Most of the participants were from the North Zone of India (49%). The demographic profile of the participants has been summarized in Table 2. The median (IQR) monthly family income was Indian Rupee (INR) 45,000 (20,500–80,000). The median (IQR) duration of T1DM was 11.5 (7.0–16.0) years. The last HbA1c available over the past 6 months was 7.6 (6.9–8.4) % [median (IQR)]. The ongoing insulin regimens of the participants have been summarized in Table 3. Twenty-three participants (11%) were facing problems in procuring their prescribed insulin preparations from the pharmacy. All except two participants had glucometer at home (99%). Seventy-two participants (34%) had one or more episodes of hypoglycemia (documented capillary glucose on glucometer $<$ 70 mg/dl with or without symptoms) since the commencement of lockdown. Thirteen participants (6%) had required hospital admission for hypoglycemia.

3.1. Knowledge regarding novel coronavirus disease/COVID-19

The correct answer rates of the 15 questions pertaining to knowledge about COVID-19 were 40–100% (Table 1). The mean (\pm SD) COVID-19 total knowledge score was 12.4 \pm 1.9 (range: 5–

Table 2 – Table showing demographic details of the study participants (N = 212).

Characteristics	Value
Age (mean \pm SD)	25.1 \pm 4.3 years
Gender	
Men	101 (48%)
Women	111 (52%)
Residence	
Urban	179 (84%)
Rural	33 (16%)
Belonging to which zone of India	
North	104 (49%)
Central	31 (14.5%)
South	31 (14.5%)
West	46 (22%)
Educational status	
Illiterate	0 (0%)
Educated upto 10th standard	19 (9%)
Educated upto 12th standard	39 (18%)
Graduate	86 (41%)
Post-graduate	68 (32%)
Employment status	
Student	82 (39%)
Unemployed	21 (10%)
Employed in government sector	22 (10%)
Employed in private sector	51 (24%)
Self-employed	27 (13%)
Daily wager	0 (0%)
Farmer	0 (0%)
Housewife	9 (4%)
Marital status	
Married	60 (28%)
Single	148 (70%)
Widowed	2 (1%)
Separated	2 (1%)

15) amounting to an overall correct rate of 83% (12.4/15 * 100%). Total knowledge scores showed a positive correlation with participant's age ($r = 0.206$, $p = 0.003$), monthly family income ($r_s = 0.329$, $p < 0.001$), and duration of T1DM ($r_s = 0.148$, $p = 0.032$). In addition, knowledge scores significantly differed across marital status, educational status, and place of residence (urban vs. rural) (Table 4).

When the level of knowledge was classified according to the score, poor knowledge corresponded to score $<$ 10.5 (approximately ≤ 10), average knowledge to score between 10.5 and 14.3 (approximately between 11 and 14) and good knowledge referred to score $>$ 14.3 (approximately > 14). Accordingly, the number of participants with poor, average and good knowledge was 30 (14%), 157 (74%) and 25 (12%), respectively (Fig. 1). Multinomial logistic regression analysis showed that only urban residence [vs. rural residence, OR 3.6 (95% confidence intervals: 1.4–9.3), $p = 0.007$] was significantly associated with average knowledge (as compared to poor knowledge). None of the parameters were significantly associated with good knowledge.

3.2. Attitudes towards novel coronavirus disease/COVID-19

Fifty percent of the participants felt anxious when they thought of COVID-19. The majority of the participants (88%)

Table 3 – Table showing ongoing insulin regimens of the study participants (N = 212).

Type of insulin regimen	Number of participants (%)
•Biphasic conventional insulin	26 (12%)
•Biphasic insulin analogue	22 (10%)
•Basal-bolus regimen	
◦Long-acting insulin analogue + Regular insulin	42 (20%)
◦Long-acting insulin analogue + Rapid-acting insulin analogue	102 (48%)
◦Ultra long-acting insulin analogue + Rapid-acting insulin analogue	5 (2.5%)
◦Long-acting insulin analogue + Ultra rapid-acting insulin analogue	4 (2%)
◦Biphasic insulin analogue (Degludec + Aspart) + Rapid-acting insulin analogue	5 (2.5%)
•Insulin pump	6 (3%)

Table 4 – Table showing comparison of knowledge scores based on demographic characteristics of the study participants.

Characteristics	Knowledge score (mean ± SD)	p value
Gender		
Men	12.4 ± 1.7	0.869
Women	12.4 ± 2.0	
Residence		
Urban	12.6 ± 1.7	0.011
Rural	11.4 ± 2.2	
Belonging to which zone of India		
North	12.3 ± 2.0	0.368
Central	12.1 ± 2.0	
South	12.8 ± 1.7	
West	12.6 ± 1.7	
Educational status		
Educated upto 10th standard	11.5 ± 2.4	0.002*
Educated upto 12th standard	11.5 ± 2.1	
Graduate	12.8 ± 1.7	
Post-graduate	12.7 ± 1.6	
Marital status		
Married	13.2 ± 1.4	<0.001 [#]
Single	12.1 ± 2.0	
Others [^]	13.0 ± 1.6	

[^]Others include widowed and separated.

*Graduate vs. Educated upto 10th standard: p = 0.021.

Graduate vs. Educated upto 12th standard: p = 0.004.

Post-graduate vs. Educated upto 10th standard: p = 0.046.

Post-graduate vs. Educated upto 12th standard: p = 0.015.

[#]Married vs. Single: p < 0.001.

did think that being a patient of diabetes mellitus they were at a higher risk of getting infected with COVID-19. Three-fourth of the participants (75%) did not feel that abiding by their routine dietary advice would weaken their immunity and in turn, make them more prone to COVID-19. The attitude towards success in being able to prevent oneself from COVID-19 was positive in the majority of the participants (98%). Likewise, 95% of the participants were confident that the prevailing lockdown would be successful in controlling COVID-19 in India. Other than the mean knowledge scores, the attitude towards COVID-19 of the study participants did not differ with respect to gender, place of residence, educational or marital status (supplementary Table 1).

3.3. Practices towards novel coronavirus disease/COVID-19

The practices of the study participants have been summarized in Table 5. Of note, half of the participants had left their homes amid the lockdown. Most of them (64%) had to leave the safe confines of their homes for ≤5 days, while 21% and 15% had been out for 6–10 times and >10 times, respectively. Amongst them, 51% of the participants had to visit a pharmacy for procuring insulin or insulin injection needles or glucometer strips. However, all the 108 participants who had ventured out of their homes had used a facemask. The survey showed that the participants preferred to use a medical mask

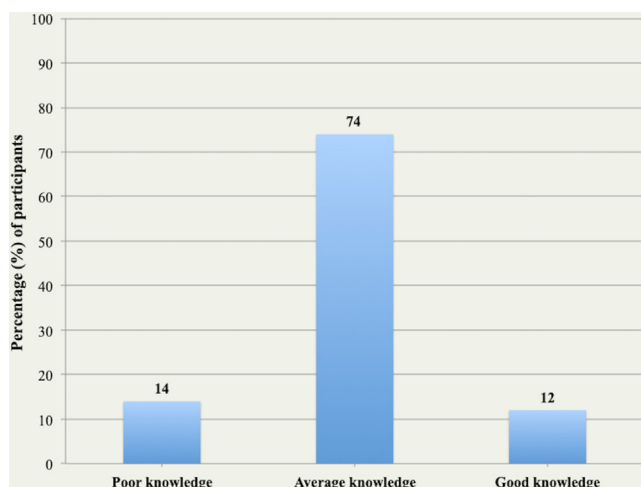


Fig. 1 – Bar diagram showing percentage of participants with poor knowledge (total knowledge score ≤ 10), average knowledge (total knowledge score 11–14) and good knowledge (total knowledge score > 14).

(surgical-grade mask) (81%) to a homemade cloth mask (19%). Regarding the management of T1DM, most of the participants were following their routine dietary advice (95%) and administering their prescribed doses of insulin (99%). Comparison with the total knowledge scores showed that people who preferred not to venture out of their homes had a better knowledge score compared to those who did go out of their homes (supplementary Table 2).

4. Discussion

To the best of our knowledge, this is first ever study assessing the knowledge, attitude, and practices of young adults with T1DM towards COVID-19 amid the ongoing pandemic. In this predominantly well-educated, urban-residing population, we found an overall correct rate of 83% on the knowledge questionnaire. The majority of the participants (74%) had average knowledge. Their knowledge was reflected in their attitude, as 98% of the participants were confident in being able to protect themselves from COVID-19. Similarly, all the participants were abiding by the practice of regular hand washing, how-

ever, as much as 51% of the respondents had left home on one or more occasions amid the lockdown, mostly to procure insulin/insulin needles/glucometer strips from the pharmacy.

Ample data exist to suggest that underlying DM, although not associated with an increased risk of infection, does augur a poor prognosis in patients with COVID-19 [4,6,19]. A study comprising of 1590 COVID-19 patients from China showed that DM was an independent predictor of admission to ICU or invasive ventilation or death (Hazard Ratio 1.59, 95% CI: 1.03–2.45) [20]. Although most of the available studies have made no distinction between type 1 and type 2 diabetes mellitus (T2DM), it is likely that the risks hold true for both the disease entities [21]. Hence, people with T1DM and T2DM should be extra-cautious and take all necessary precautions to prevent COVID-19. However, the effective adoption of self-protection measures (practices) will be largely dictated by their knowledge and attitude towards COVID-19. This is in accordance with the “Knowledge-Attitude-Practice (KAP) theory” which states that a change in human behavior (or practice) is a step-wise process that involves the acquisition of knowledge, subsequent generation of attitudes and finally adoption of behavior (or practice) [10]. In other words, increasing personal knowledge will influence a change in behavior. Similarly, the knowledge of a person with DM regarding COVID-19 will be the main factor that will decide whether the individual will be able to protect himself/herself from the pandemic.

We conducted a cross-sectional survey to assess the KAP of people with T1DM in India. Although the large majority of people with DM in India fall under the category of T2DM, the incidence of type 1 diabetes mellitus (T1DM) in India is on the rise with an estimated 3–5% increase per annum [22,23]. Furthermore, India stands first in terms of the estimated number of incident cases of T1DM in children and adolescents, per annum [24]. We had intentionally excluded children and adolescents (<18 years) with T1DM, as we wanted to assess the KAP of the patients and not their parents/caregivers. Besides, young adulthood represents a critical period for those with T1DM. Only 17% and 30% of early (18–25 years) and late (26–30 years) young adults with T1DM, respectively, meet the current recommendations for glycemic control ($HbA_{1c} \leq 7.0\%$) [25]. Young adults with T1DM with a history of significant hypoglycemia or hyperglycemia are also

Table 5 – Table showing practices of the study participants towards COVID-19.

Practices	P1	P2*	P3*	P4*	P5*	P6	P7	P8
Yes	108 (51%)	108 (100%)	55 (51%)	10 (9%)	104 (96%)	212 (100%)	202 (95%)	209 (99%)
No	104 (49%)	0 (0%)	53 (49%)	98 (91%)	4 (4%)	0 (0%)	10 (5%)	3 (1%)

P1. Have you left your home since nationwide lockdown was announced in India?

P2. If you had left your home, did you wear a facemask while going outside?

P3. If you had left your home, did you visit a medical store to purchase insulin or insulin injection needles/syringes or glucometer strips?

P4. If you had left your home, did you go out for walking in the park or playing with your friends?

P5. If you had left your home, did you consciously maintain a distance of at least 1 m from others?

P6. Are you regularly washing you hands with soap and water?

P7. Are you properly following your routine dietary advice?

P8. Are you regularly injecting your prescribed doses of insulin?

* For calculation of percentages, only those participants who had left home since the commencement of lockdown in India have been considered as a denominator (n = 108).

at a slightly increased risk of poor neuropsychological performance in terms of working memory and mental efficiency [26]. Moreover, the early adult age group represents a period of transition from pediatric to adult medical care that can, in turn, lead to inconsistent engagement with healthcare facilities [27]. In addition, young adults tend to engage in risky behaviors that may negatively impact health. This is reflected by the relatively high rates of emergency department use among young adults with T1DM [28]. Thus, young adults with T1DM represent an extremely vulnerable section of the society amid the ongoing pandemic.

In this survey catering to T1DM patients from four zones of India (North, Central, West, and South), we found an overall correct rate of 83% on the knowledge questionnaire with almost three-fourth of the participants having average knowledge. The questionnaire was strategically prepared to include all aspects of COVID-19, namely symptoms, modes of transmission, and means of prevention. In addition, some of the questions were customized to specifically cater to people with DM (K4, K10). A recently conducted online cross-sectional survey assessing KAP towards COVID-19 among Chinese residents found an overall knowledge rate of 90%. However, most of the participants were females (65.7%) and belonged to a relatively high socioeconomic status, thereby, might not be representative of the Chinese population at large [29]. Another cross-sectional survey conducted amongst the general Iranian population also found an overall correct knowledge rate of 90%. However, most of the study participants were educated and had an academic degree [30].

Hitherto, surveys assessing KAP regarding COVID-19 in selective disease populations, like ours, are very limited. A cross-sectional survey conducted among 630 adults with chronic medical conditions at the onset of the COVID-19 outbreak in the United States of America found that almost one-third of the participants could not correctly identify the symptoms or means to prevent the infection [31]. Another survey conducted in Pakistan among 242 patients with diabetes mellitus (mean age being 50.78 ± 11.24 years) found that only 78.5% of the participants were aware of the modes of transmission of COVID-19 [32]. On the contrary, 94.8% and 95.2% of the participants of the present study could right state that COVID-19 spreads via respiratory droplets and fomites, respectively. However, many participants were not aware of the fact that even asymptomatic patients with COVID-19 can spread the infection and that the virus does not spread through the use of insulin injection needles. Similarly, as many as 13% of the respondents were not aware of the fact that in spite of having T1DM, they are at an increased risk of severe disease and mortality from COVID-19. It is thus necessary that health education programs and social support organizations catering to people with T1DM lay more emphasis on these aspects while imparting awareness about COVID-19.

We found that the participants who were living in urban areas, having a higher educational status and who were married had higher total knowledge scores. That higher educational status correlates with better knowledge scores is well known [29,30]. Likewise, married people have been shown to have higher knowledge scores compared to unmarried counterparts [30], likely attributable to an addi-

tional source of knowledge from the spouse. People living in the urban community tend to have better and more ready access to awareness campaigns propagated through social, digital, or print media and hence are more likely to have higher knowledge scores compared to people living in remote and rural areas. Based on these findings, it would be prudent to target awareness programs regarding COVID-19 towards certain demographic groups such as unmarried individuals, those with lower educational status and those residing in rural areas are required. We found no gender difference in knowledge scores as was seen in the Chinese study where females had higher knowledge scores compared to males [29].

As per as attitudes of the participants towards COVID-19 were concerned, most of them (98%) were positive that they would be able to protect themselves from COVID-19 through social distancing and regular hand washing. Similarly, 95% of the participants were confident that lockdown would be able to control the pandemic in India. The confidence would have stemmed from the Government's robust response in order to contain COVID-19. Fifty percent of the participants felt anxious at the thought of COVID-19. Although it can affect the psychological well-being of an individual [9], being worried or anxious about COVID-19 ensures that they are aware of the disease and in turn will make them more cautious. In fact, it has been shown that people having low health literacy are more likely to be less worried about COVID-19 and thereby deny the fact that they would get infected and be less prepared for the outbreak [31]. With regard to T1DM, 88% of the participants felt that being patients of DM, they are at a high risk of getting infected with COVID-19. Although the available literature denies this fact [19], it would be prudent on the part of a patient to err on the side of caution.

Regarding respondents' practices, all had stated that they were regularly washing their hands with soap and water. However, 51% of the participants had to leave the safe confines of their homes in spite of prevailing nationwide lockdowns. Half of them had to visit a pharmacy to procure insulin or insulin injections needles/syringes or glucometer strips. This might have been circumvented through the use of online pharmacies and social support organizations providing insulin preparations at the doorstep on demand. Nevertheless, all the participants who had left home had used a facemask and 96% of them had maintained a distance of 1 m or more from others, thereby reflecting healthy preventive practices. Similarly, the majority of the participants were continuing their prescribed doses of insulin. However, as many as 34% of the respondents had experienced one or more episodes of hypoglycemia over the last 1 month ever since the commencement of lockdown on March 25. A study conducted in Tayside, Scotland found that 82% of people with T1DM had one or more self-reported episodes of hypoglycemia over a period of 1 month. Most of the patients in the study were however on biphasic or intermediate and short-acting insulin preparations that could have been one of the major contributing factors underlying hypoglycemia [33]. However, in the DIALOG study that had included 1317 people with T1DM, 31.5% of whom had been on insulin pump, 85.3% reported experiencing at least one confirmed hypoglycaemic event over 30 days [34]. Thus, a self-reported hypoglycemia rate of

34% amongst the study participants represents good diabetes self-care on part of the patients.

4.1. Limitations

The majority of the study participants were well educated with 73% of the participants having a graduate or post-graduate degree. This is in stark contrast to India's literacy rate of 74% [35]. In addition, the median monthly family income of the respondents stands above the average income of an Indian household [36]. Besides, 84% of the participants belonged to an urban community; on the contrary, 66% of the native population lives in rural India [37]. Thus, it would be prudent to say that the study population represented a relatively well-educated and well-to-do section of the community and hence might not be representative of the common Indian masses. Moreover, the East zone of the country was not represented in the study, thereby making it more difficult to generalize the findings of the present study.

5. Conclusions

Young adults with T1DM in India have average knowledge regarding COVID-19. It is reflected in their positive attitude and healthy preventive practices towards COVID-19. This will ultimately help protect them from COVID-19, as the disease tends to be more severe and lethal in people with underlying diabetes mellitus. However, limitation in the representativeness of the study sample warrants additional surveys among people with T1DM residing in rural areas and belonging to a low socio-economic status.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Appendix A. Supplementary material

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.diabres.2020.108344>.

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