

## Knowledge, attitude, and practices of insulin use among type 1 diabetes patients in North India – A cross-sectional study

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Received - 5 December 2020

Initial Review - 15 December 2020

Accepted - 27 December 2020

### ABSTRACT

**Background:** Prevalence of Type 1 diabetes (T1DM) is increasing world-wide. A thorough understanding of the insulin administration including correct injection techniques, proper storage, insulin dose adjustment, meal timing, site rotation, and compliance are necessary for optimal treatment. **Objective:** The objective of the study was to assess knowledge, attitude, and practices (KAP) of insulin use and its effects in T1DM patients. **Materials and Methods:** This cross-sectional observational questionnaire-based survey was carried out among 105 T1DM patients at a tertiary care hospital during August to September 2020. A questionnaire consisting of 32 questions was formulated to assess the knowledge of diabetes, awareness of insulin use along with attitude and practices of insulin use. The responses were scored, converted into percentages, and summarized with descriptive statistics. **Results:** The mean scores in Knowledge, Attitude and Practices domains of KAP were 25.5±7.8, 2.6±3.9, and 8.9±1.7, respectively. We found deficiency of knowledge regarding type of insulins (31.4%), side effects of insulin (78%), and insulin injection sites (37%). Around 43% subjects had a negative attitude toward insulin and 35% were prone to use clumped insulin, 65% of subjects were aware of correct insulin injection techniques, and 77% were aware of correct insulin timing while 68.5% were aware of insulin handling during travel. **Conclusion:** There is an unmet need to enhance KAP domains of T1DM care and insulin administration, as the deficiencies in each domain are quite prevalent despite long term insulin use. Regular interactions with patients in the form of group meetings, patient to patient interaction and live demonstrations may alleviate fear of injection, poor compliance and incorrect techniques.

**Key words:** Attitude, Insulin technique, Knowledge, Lipohypertrophy, Practice, Type 1 diabetes mellitus

India is known as “Diabetic Capital of the world” with approximately 63 million total diabetic population. Type 1 diabetes (T1DM) is one of the subclassified groups of diabetes with never ending demands. The incidence of T1DM is 15 per 100,000 with a prevalence of 9.5% (95% CI: 0.07–0.12) in the world [1] According to 6<sup>th</sup> International Diabetes Federation Atlas, approximately 1.1 million children and adolescents are living with T1DM and India being home to an estimated 97,700 children with T1DM [2]. India has incidence rate of 01/100,000 children of 0–14 years while prevalence was found to be 17.93 cases/100,000 children in Karnataka, 3.2 cases/100,000 children in Chennai, and 10.2 cases/100,000 children in Karnal (Haryana). The Karnataka state T1DM registry listed an incidence of 3.7/100,000 in boys and 4.0/100,000 in girls over 13 years of data collection [2]. T1DM lack endogenous insulin production; thus, early identification and treatment are important for optimal glycemic control and reduction of complications [3].

Long-term treatment of T1DM requires adequate knowledge, attitude, and practices (KAP) regarding insulin administration, insulin dose adjustment, meal timing, physical activity,

hypoglycemia management, and proper sick day management. One of the common areas of errors in T1DM management is insulin technique (IT) which is directly related to long-term glycemic control [4,5]. Poor IT is quite prevalent and the lipohypertrophy (LH), a common denominator of poor IT had been seen in greater than 40% of children and adolescents with diabetes in a study in which incidence of LH correlated well with hypoglycemia episodes and glycemic variability [6]. Moreover, a multicenter study focused on IT (rotation of injection sites and single use of needles) found a significant (0.5%) reduction in glycated hemoglobin (HbA1c) and decreased hypoglycemic episodes, glycemic variability, and LH after correct use [7]. Misnikova *et al.* observed a 1% reduction in HbA1c in the group receiving education on correct IT [8]. Thus, a good KAP toward diabetes self-management is directly related to glycemic control. However, limited studies are available on the KAP and IT among T1DM patients [6,9]. Hence, the present study was carried out with an objective to evaluate KAP of insulin use and its effects in T1DM patients and correlate its impact on overall diabetes control.

## MATERIALS AND METHODS

The present cross-sectional observational questionnaire-based survey was conducted among 105 T1DM patients presenting in endocrine outpatient department (OPD) at Department of Pediatrics at GSVM Medical College, Kanpur and Endocrine clinic at Regency Hospital, Kanpur. The study was approved by ethics committee of the institute (EC/105/JULY/2020 dated July 21, 2020). T1DM patients on insulin treatment, attending T1DM OPD run by endocrinologist (SV) or diabetologist (MG) during August 1–September 30, 2020, who were able to understand the questionnaire, were included in the study. Patients with significant diabetic complications or unable to understand the questionnaire were excluded from the study. As part of care, all patients had been receiving knowledge about insulin self-administration intermittently by a dedicated diabetes educator nurse at both the centers.

Pre-validated questionnaire used in a previous study on type 2 diabetic subjects [10] was adapted for the survey and was modified according to study population and type of diabetes. The construct validity and content validity were tested by SV. The questionnaire was translated to Hindi language and was validated among 30 T1DM subjects who were receiving insulin and had attended at least two sessions of insulin education by the diabetes educator. The questionnaire consisted of 32 questions divided into three domains namely KAP of use of insulin and its side effects. All questions contained multiple answers (many answers were right). Each correct answer in knowledge and practices domain was allotted a score of 1 (yes= 1, no= 0, partial response=0.5). The responses in the attitude domain were graded as follows: Strongly Agree: +2, Agree: +1, Unsure: 0, Disagree: -1, Strongly Disagree: -2.

The final score in the knowledge domain ranged from 7 to 39. The final score in the attitude domain ranged from -22 to +22. The final score in the practice domain ranged from 9 to 11. All domains scores were converted in to percentage for feasible assessment. The data were summarized and analyzed using statistical software SPSS version 25.0. The correlation of the scores in relation to various demographic variables was assessed. Kruskal–Wallis test was used to assess the distribution between KAP scores and Mann–Whitney U test was used to assess the significance of inter-domain difference.

## RESULTS

We studied 105 diabetic subjects with age range of 13–35 years; mean age of subjects was 23.2±4.69 years. Of these, 54 were female and 51 were male. All of our subjects had education up to eighth standard and were able to understand the questionnaire and respond through mobile phone. The mean HbA1c was 7.9±0.99% (range: 6.1–11%) with the mean duration of diabetes of 12.6±5.88 years (range 1–25 years). The total daily dose of insulin was around 50.9±14.36 units per day with very wide range partly due to wide variation in population involving both adolescent and adult subjects.

In our study, one-third subjects were on split mix regimen while only 3 subjects were on insulin pump and rest of the subjects were on basal bolus regimen. The most common concomitant autoimmune disorder in our cohort was hypothyroidism (22.9%). Around 3% of subjects had diabetic nephropathy and glaucoma primarily in those with long duration of diabetes. More than 80% of subjects were involved in regular physical activity (>45 min/day of aerobic activity) and 84% were aware of insulin correction factor. However, despite regular meetings with diabetes educator only 57% were able to calculate insulin to carbohydrate ratio (Table 1).

The mean score in knowledge domain was 25.5±7.8. Most of the subjects had good knowledge regarding diabetes and insulin with >80% answered correctly but the knowledge about type of insulin (short acting/long acting/premixed) was known only to 65% of subjects and thus 35% patients were prone for wrong insulin dose adjustment. The median score in attitude domain was only 3 (mean=2.6±3.9) which suggests that the attitude toward diabetes self-care was inferior compared to knowledge as the mean and median were closer to lower limit. The mean practice score was 8.9±1.7 which appears satisfactory as upper limit of practice score was 11 and most of the subjects (>80%) responded correctly in all but two important questions: regarding technique of insulin self-injection and storage during transportation were correctly addressed by only 65%. When asked about reason to stop/skip insulin, 52.5% never left insulin from the day of initiation while 22.5% left/skipped due to financial constraints and 12.5% were reluctant to take insulin for the fear of hypoglycemia.

## DISCUSSION

The study was carried out exclusively on T1DM subjects to assess their KAP regarding insulin treatment. Limited studies are available from India focusing on KAP assessment of T1DM patients. We found a good score in knowledge domain (25.5±7.8)

**Table 1: Description of type 1 diabetes status of study subjects**

Variables		Frequency (%)
Insulin regimen	Split mix regimen	33 (31.4)
	Basal bolus	69 (66)
	Insulin Pump	3 (2.8)
Co-morbidities	Celiac disease	03 (2.9)
	Autoimmune hypothyroidism	24 (22.9)
	Diabetic nephropathy	3 (2.9)
	Vitiligo	3 (2.9)
Correction factor	Glaucoma	3 (2.9)
	Know	84 (80)
	Don't know	21 (20)
Insulin to carbohydrate ratio	Know	60 (57.1)
	Don't know	45 (42.9)
Physical activity (at least moderate activity 45 min daily)	Regular	63 (88.6)
	Irregular	12 (11.4)

which was found to be better than earlier studies conducted in India on type 2 diabetes subjects at Trichy [10] and Bengaluru [11]. This might be due to more frequent interaction with educators and group meetings which are routine for T1DM patients.

When specific questions were analyzed (Table 2), the knowledge about types of insulin was adequate in 68.6% which was inferior to the cohort of T1DM studied in Ethiopia (83.6%) [12]. When asked about different insulin delivery devices, 71.4% knew about it which is better than study by Choudhury *et al.* where only 39% respondents were aware of it [13]. In our study, only 11% were aware of all side effects of insulin and another 11% had partial knowledge thus 78% needed to understand the risks associated with insulin such as hypoglycemia, swelling, LH, and allergy, this finding was similar to the study from Ethiopia [12] where only 10.6% had adequate information regarding insulin related side effects. Regarding sites of insulin administration, 37% had answered correctly while, two studies from Ethiopia on KAP in T1DM reported that 39% and 69% of T1DM subjects, respectively, had adequate knowledge of insulin administration sites [9,12]. Thus, our cohort of T1DM had poor information regarding available insulin injection sites. Around 63% subjects were aware of hypoglycemic symptoms as compared to 81% in a study done by Choudhury *et al.* [13].

The mean and median (2.6±3.9 and 3, respectively) score of attitude domain in our cohort was lower than the score observed by a study done at Trichy (7.42±4.85) [10]. This could be due to younger age as we had exclusively T1DM subjects, probably lesser education level and stress related to multiple daily injections in our cohort. The correct responses to individual questions were heterogeneous (Table 3). When asked for possibility of mixing insulins in the same syringe 45.7% responded correctly. However, this might be due to the fact that only 33% of our subjects were using split mix regimen and rest were never told of this practice. Surprisingly, 35% of subjects were not aware that clumped insulin should not be used and this might be one of the reasons of poor

glycemic control. Moreover, 43% had thinking that insulin can be harmful which reflects the inherent negative attitude toward insulin use. However, our subjects had good attitude regarding insulin self-injection (85.7%) and injection site rotation (97.1%) which was better when compared to the study conducted at Puducherry, India, where 93% were practicing it properly (15).

The mean score of practice domain was 8.9±1.7, which was better than study from Trichy, India (6.56±1.91) [10]. The correct responses under practice domain are presented in Table 4. We found that 77% of subjects were aware of correct timing of insulin in relation to meal which is quite similar to the two studies from Ethiopia [9,12]. The study from Puducherry reported that median time interval between regular insulin injection and meal intake was 10 min instead of recommended 30 min [14] implies the significant lack of practice in terms of timing of insulin injections. The practice of rotation of insulin injections was 88.6% which was better than study from Ethiopia where only 76.4% were practicing it [9] while study from India reported 92.9% were practicing injection site rotation [14]. The other important aspect regarding storage of insulin was practiced correctly by 85.7% of patients which was better than earlier studies [9,12,15]. Moreover, the practice of checking the expiry date and discarding it was satisfactory in our cohort. However, only 65% of our patients were aware of correct angulation and skin fold during insulin injection which was quite similar to study from Puducherry where 69% of subjects were aware of skin fold (for longer needles) and 55% were aware about correct angulation based on needle length.

We found a statistically significant difference ( $p < 0.0001$ ) between the three domains of KAP using Kruskal–Wallis test, suggesting heterogeneity in the three domains, thus KAP domains are not same in an individual and it is necessary to address each separately. However, when we analyzed correlation of KAP scores with HbA1c levels using ordinal regression analysis by PLUM technique, there was no statistical significance which might be due to various other factors (diet, exercise, insulin

**Table 2: Correct responses in knowledge domain**

Questionnaire on knowledge of diabetes and insulin	Correct answer (%)
General knowledge about diabetes	82.9
Which of the following are the symptoms of diabetes?	100
Which one of the following systems is involved in the complications of diabetes?	100
Are you aware of the various types of insulin?	68.6
Are you aware of the various insulin delivering devices?	71.4
Which of the following is/are the side effects of Insulin therapy?	22
Which of the following are the preferred sites of injection of Insulin?	37
Source of information about insulin	100
Which of the following are symptoms of low blood glucose?	63
Are you aware of HbA1c, the blood test used for long term control of blood glucose?	97.1

HbA1c: Glycated hemoglobin

**Table 3: Correct responses in attitude domain**

Attitude domain	Correct answer (%)
Insulin can be pre-mixed in the same syringe	45.7
Insulin is the only cure for diabetes	97
Insulin can be stopped once blood glucose is controlled	91.4
Once Insulin is started diet and exercise are not needed	91.4
Diabetes can be controlled by diet alone	77.1
Insulin can be administered even if the vial is having clumps	65.7
Diabetes is a lifelong disease	85.7
Insulin can cause harm	57
Insulin should not be administered at the same site	97.1
Too high or too low insulin can cause drastic alterations in blood glucose	80
I can self-administer Insulin	85.7

**Table 4: Correct responses in practice domain**

Practices domain	Correct responses (%)
When do you inject insulin?	77.1
Do you practice rotation of sites?	88.6
How often do you check your eyes?	94.3
How often do you check your blood glucose and HbA1c?	80
How often do you check your lipid profile and serum creatinine?	82.9
How do you store Insulin?	85.7
Do you check for expiry date before using insulin?	91.4
What will you do to the expired insulin?	85.7
How do you inject insulin?	65.7
Do you keep a readily available source of blood glucose available when you go out?	68.5

HbA1c: Glycated hemoglobin

omission, lack of carbohydrate counting, etc.) not conveyed by KAP questionnaires.

Our study had limitations of having a relatively small cohort of T1DM subjects, paucity of adequate number of diabetic educators (only one at each center), lack of structured audio-visual based meetings, and possibly non-availability of continuous contact with patients through telephone, email, etc., which could have improved KAP. The overall findings point toward a need to improve diabetes awareness among patients as well as health care providers. This can be accomplished by more widespread training programs for nurses and physicians targeted toward insulin related issues. Short term courses at dedicated centers and online programs may help improve overall self-care among T1DM patients.

## CONCLUSION

There is a need to focus on enhancing knowledge about different types of insulin, their side effects, particularly hypoglycemia, LH, and the injection sites. The attitude toward insulin use should be given even more focus especially checking of expiry date and discarding of clumped insulin. Furthermore, fear of insulin must be addressed by more frequent interactions and live demonstration. In terms of practices, patients must be educated about the correct timing of insulin administration in relation to meals, correct use of skin fold (for longer needles), and angulation during insulin injection. Since, insulin administration is a multistep process and each step has its significance. Frequent regular interactions with patients in the form of group meetings comprising doctor-patient, nurse-patient, and patient-patient interactions can enhance the precision in this often-neglected practice.

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*Funding: None; Conflict of Interest: None Stated.*

**How to cite this article:** Gupta M, Verma S, Agarwal S. Knowledge, attitude, and practices of insulin use among type 1 diabetes patients in North India – A cross-sectional study. *Eastern J Med Sci.* 2021;6(1):9-12.

Doi: 10.32677/EJMS.2021.v06.i01.002