The Incidence of Hypoglycemia among Insulin-Treated Patients with Type 1 or Type 2 Diabetes: Bangladeshi Cohort of International Operations-Hypoglycemia Assessment Tool Study

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Abstract

Objectives: The objective of this study was to assess the incidence of hypoglycemia in patients with type 1 diabetes mellitus (T1DM) or type 2 diabetes mellitus (T2DM) in Bangladeshi cohort of the International Operations-Hypoglycemia Assessment Tool study. **Materials and Methods:** Patients diagnosed with either T1DM or T2DM, aged ≥18 years, treated with insulin (any regimen) for >12 months, and completed self-assessment questionnaires (SAQs) to record demography, treatment information, and hypoglycemia during the 6-month retrospective and 4-week prospective periods (a total of 7 months) were enrolled in the study. **Results:** A total of 1179 patients were enrolled and completed the SAQ1 (T1DM, $n = 25$; T2DM, $n = 1154$). Almost all patients (T1DM: 100.0% [95% confidence interval (CI): 86.3%, 100.0%] and T2DM: 97.0% [95% CI: 95.9%, 97.9%]) experienced at least 1 hypoglycemic event prospectively. The estimated rates of any and severe hypoglycemia were 26.6 (95% CI: 19.8, 35.0) and 14.1 (95% CI: 9.3, 20.4) events per patient-per year (PPY), respectively, for patients with T1DM and 18.3 (95% CI: 17.4, 19.2) and 12.1 (95% CI: 11.4, 12.9) events PPY, respectively, for patients with T2DM during the prospective period. At baseline, mean glycated hemoglobin (HbA1c) (±standard deviation) was 8.1 (±1.8%) for T1DM and 8.8 (±1.8%) for T2DM. Hypoglycemic rate was independent of HbA1c levels and types of insulin. **Conclusions:** This is the first patient dataset of self-reported hypoglycemia in Bangladesh; results confirm that hypoglycemia is underreported.

Keywords: Bangladesh, diabetes, hypoglycemia, hypoglycemic, insulin

Introduction

Hypoglycemia is a common complication in type 1 diabetes mellitus (T1DM) patients on lifelong insulin and insulin-treated patients with type 2 diabetes mellitus (T2DM).[1] Recently, an observational study in various regions within Eastern Europe, Latin America, Middle East, Northern Europe/Canada, Russia, and Southeast Asia have reported real-world hypoglycemic rates (T1DM: 73.3 events per patient-per year [PPY] and T2DM: 19.3 events PPY) which were much higher than previously reported rates from the randomized controlled clinical trials.[2-7]

Further, studies of hypoglycemic incidence in other geographical areas where previous data are not available, especially outside North America and Europe, will be helpful to evaluate risk factors of hypoglycemia and its impact on patients' lives in such regions.

Materials and Methods

Study design

The International Operations-Hypoglycemia Assessment Tool (IO HAT) study was a noninterventional, multicentric,

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real-world, 6-month retrospective, and 4-week prospective assessment on self-reported hypoglycemia using a two-part self-assessment questionnaire (SAQ1 and SAQ2) and the patient diary (PD) for 28 days [Figure 1], designed to assess the incidence of hypoglycemia in patients with diabetes mellitus (DM) treated with insulin (premix, short-acting, long-acting, or insulin pump) in Bangladesh, Colombia, Egypt, Indonesia, the Philippines, Singapore, South Africa, Turkey, and the United Arab Emirates.[8]

In this subanalysis, data on hypoglycemia were collected from all patients in Bangladeshi cohort of the IO-HAT study who responded to SAQ1. The patients were recruited across 28 sites in Bangladesh between October 30, 2014, and April 15, 2015. The study was approved by BIRDEM Ethical Review Committee and carried out in accordance with Good Pharmaco-epidemiological Practice and the Declaration of Helsinki: Ethical Principles for Medical Research Involving Human Patients.[9,10] The study materials were translated into local language, and data acquired were translated back into English for analysis.

Patients

Eligible Bangladeshi patients with T1DM or T2DM, ≥18 years of age at baseline, ambulatory, literate, and treated with insulin for >12 months, who had given informed consent to participate in the study, were included in the study. The patients were enrolled from primary or secondary care centers in Bangladesh during the course of their routine scheduled clinical consultation with their health-care provider.

Study assessments

The SAQ1 was used to record baseline demographics, treatment information, hypoglycemia unawareness, perceptions of hypoglycemia, history of severe hypoglycemia over the last 6 months, and any or nocturnal hypoglycemia over the previous 4 weeks leading up to the baseline study entry, whereas SAQ2
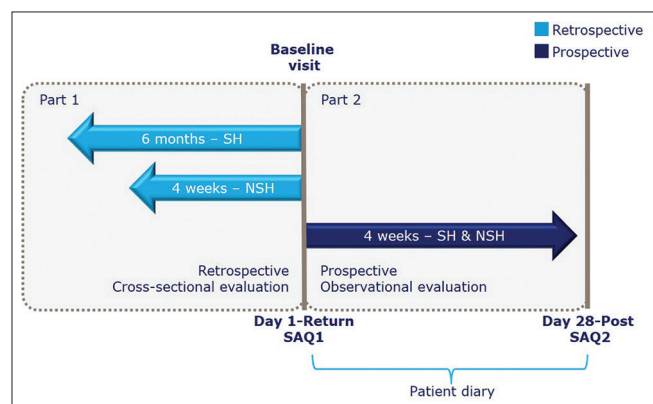
Figure 1: International Operations-Hypoglycemia Assessment Tool study design. Severe hypoglycemia: an event requiring assistance of another person to actively administer carbohydrate, glucagon, or other resuscitative actions nonsevere hypoglycemia: documented symptomatic (symptoms and blood glucose measurement ≤3.9 mmol/L [70 mg/dL]) and probable symptomatic (symptoms only) hypoglycemia. Nonsevere hypoglycemia; self-assessment questionnaire; severe hypoglycemia

was used to record the history of severe or any or nocturnal hypoglycemia during the 4-week prospective period based on symptoms or self-monitoring of blood glucose (SMBG) or both and the effect of hypoglycemia on work/studies and use of health system resources following hypoglycemia. The patients also recorded hypoglycemic events during the prospective period using the PD which was used to assist the recall of events.

Study end points

The primary focus of the study was to assess the percentage of patients experiencing at least one hypoglycemic event during the 4-week prospective period among insulin-treated patients with T1DM or T2DM.

The key secondary outcomes included the difference in the reported incidence of hypoglycemia between the 4-week retrospective (for any and nocturnal hypoglycemia)/6-month retrospective (for severe hypoglycemia) and the 4-week prospective period among insulin-treated patients with T1DM or T2DM, relationship between the incidence of hypoglycemia, and duration of diabetes in each quartile (1.0 to <7.0 years, 7.0 to <12.0 years, 12.0 to <18.0 years, and 18.0–60.0 years), glycated hemoglobin (HbA1c) at baseline (HbA1c level <7.0%, 7.0%–9.0%, and >9.0%), and insulin treatment. The use of health system resources following hypoglycemia and patient behaviors against hypoglycemia were also studied. Other secondary outcomes included patients' knowledge of hypoglycemia, hypoglycemic awareness, and impact of hypoglycemia on the work/studies. The use of health system resources following hypoglycemia was assessed on hypoglycemic events resulted in hospital admission, additional clinical appointments, and additional telephone contacts made. Behavior against hypoglycemia was assessed on the following parameters: consulted nurse/doctor; required any form of medical assistance, increased calorie intake, avoided physical exercise, reduced insulin dose, skipped insulin injections, and increased blood glucose monitoring.

Patient knowledge of hypoglycemia was assessed by checking if the patient's definition was consistent with the American Diabetes Association definition of hypoglycemia.[11]

Hypoglycemic awareness was evaluated through the self-assessment question: "Do you have symptoms when you have a low sugar level?" where the answers, "always" and "usually" denoted normal, "occasionally" denoted impaired awareness, and "never" denoted severely impaired awareness (unawareness).[12]

Classification of hypoglycemia

The following definitions of hypoglycemia were used to record the different types of hypoglycemia in SAQ1, SAQ2, and PD.

Severe hypoglycemia as an event requiring assistance of another person to actively administer carbohydrate, glucagon, or other resuscitative actions.[11] Nocturnal hypoglycemia as an hypoglycemic event occurring between midnight and

06:00 h. Any hypoglycemia is a combined measure based on the sum of all individual hypoglycemic events of any categories.

Statistical analysis

For the primary end point, the percentage of patients who experienced at least one hypoglycemic episode, during the prospective period among patients with insulin-treated DM, was calculated together with 95% confidence interval (CI). Hypoglycemic rates were reported as events PPY, calculated as the total number of events divided by the total follow-up time in patient-years along with 95% CI. Relationship between HbA1c at baseline and log-transformed number of events for patients experiencing hypoglycemia was shown by the scatter plot with regression line and 95% CI. Statistical tests were two sided and regarded as exploratory, with the criterion for statistical significance set at $P < 0.05$. No adjustments were made for multiple comparisons. No imputation of missing data was performed as majority of analyses were descriptive in nature. Baseline refers to data collected using the SAQ1 and follow-up refers to data collected using the SAQ2 and where applicable, PD.

RESULTS

Patient characteristics

Descriptive baseline characteristics of Bangladeshi cohort are provided in Table 1.

A total of 1179 patients (T1DM, $n = 25$; T2DM, $n = 1154$) were enrolled across study sites in Bangladesh and completed the SAQ1. Of these, 1178 patients (T1DM, $n = 25$ [100%]; T2DM, $n = 1153$ [99.9%]) completed the SAQ2 and 1091 patients (T1DM, $n = 24$ [96%]; T2DM, $n = 1067$ [92.5%]) completed the PD.

Frequency and rates of hypoglycemia

During the 4-week prospective period, a higher percentage of patients (T1DM: 100.0% [95% CI: 86.3%, 100.0%] and T2DM: 97.0% [95% CI: 95.9%, 97.9%]) participated for reporting at least one hypoglycemic event compared to fewer percentage of patients (T1DM: 64.0% [95% CI: 42.5%, 82.0%] and T2DM: 41.7% [95% CI: 38.8%, 44.6%]) in the 4-week retrospective period. For patients with T1DM, the rates of any hypoglycemia were 41.2 (95% CI: 32.6, 51.4) events PPY during the 4-week retrospective period and 26.6 (95% CI: 19.8, 35.0) events PPY during the prospective period. For patients with T2DM, the hypoglycemic rate increased significantly from the retrospective period to prospective period (from 11.8 [95% CI: 11.1, 12.6] events PPY to 18.3 [95% CI: 17.4, 19.2] events PPY, respectively; $P < 0.001$) [Figure 2].

During the prospective period, 16.0% (95% CI: 4.5%, 36.1%) of patients with T1DM and 8.5% (95% CI: 6.9%, 10.3%) of patients with T2DM experienced nocturnal hypoglycemic events. Patients with T1DM had reported comparable rates ($P = 0.010$) of nocturnal hypoglycemia between the

Table 1: Patient demographic characteristics

Characteristics	T1DM (N=25)	T2DM (N=1154)
Age (years)*	30.4 (8.1)	55.0 (10.5)
Male/female (%)	56.0/44.0	45.6/54.1
Duration of diabetes (years)*	8.4 (5.4)	12.6 (7.5)
Duration of insulin use (years)*	6.8 (5.3)	5.6 (4.9)
HbA1c (%)*	8.1 (1.9)	8.8 (1.8)
FBG (mmol/l)	7.3 (3.4)	8.7 (3.2)
PPG (mmol/l)	10.0 (3.5)	11.7 (3.9)
BMI (kg/m²)	21.2 (4.2)	25.8 (4.1)
Oral antidiabetic medications, *n* (%)†		
Alpha-glucosidase inhibitor	0 (0.0)	15 (1.3)
Metformin	6 (24.0)	448 (38.8)
Dipeptydyl peptidase-IV	3 (12.0)	377 (32.7)
Glucagon-like peptide-1	1 (4.0)	18 (1.6)
Metiglinides/glinides	0 (0.0)	19 (1.6)
SGLT2 inhibitors	0 (0.0)	3 (0.3)
Sulfonylurea	0 (0.0)	112 (9.7)
Thiazoledinediones/glitazones	0 (0.0)	7 (0.6)
None	17 (68.0)	401 (34.7)
Insulin treatment, *n* (%)†		
Short acting	3 (12.0)	110 (9.5)
Long acting	1 (4.0)	135 (11.7)
Pre-mix	8 (32.0)	562 (48.7)
Both short and long acting	12 (48.0)	286 (24.8)
Both short acting and pre-mix	1 (4.0)	44 (3.8)
Both long acting and pre-mix	0 (0.0)	13 (1.1)

*Data are presented as mean (SD) unless otherwise stated, N: Total number of patients participating, †Percentages based on number of patients with evaluable data, *n*: Number of participants in the data subset, SGLT2: Sodium-glucose co-transporter-2, T1DM: Type 1 diabetes mellitus; T2DM: Type 2 diabetes mellitus, SD: Standard deviation, BMI: Body mass index, FBG: Fasting blood glucose, HbA1c: Glycated hemoglobin, PPG: Postprandial glucose

retrospective (14.1 [95% CI: 9.2, 20.7] events PPY) and prospective periods (4.2 [95% CI: 1.8, 8.2] events PPY). For patients with T2DM, the rate of nocturnal hypoglycemia during the retrospective period was significantly higher than that in the prospective period (3.3 [95% CI: 2.9, 3.7] events PPY and 1.8 [95% CI: 1.6, 2.10] events PPY; respectively; $P < 0.001$) [Figure 2].

A higher percentage of patients during the prospective period (T1DM: 84.0% [95% CI: 63.9%, 95.5%] and T2DM: 82.3% [95% CI: 79.9%, 84.5%]) experienced at least one severe hypoglycemic event compared to the fewer percentage of patients during the retrospective period (T1DM: 60.0% [95% CI: 38.7%, 78.9%] and T2DM: 54.7% [95% CI: 51.7%, 57.6%]). For patients with T1DM, the incident rates of severe hypoglycemia increased from the retrospective period (7.0 [95% CI: 5.6%, 8.8%] events PPY) to prospective period (14.1 [95% CI: 9.3, 20.4] events PPY). For patients with T2DM, there was a significant increase in the rates of severe hypoglycemia from 2.4 (95% CI: 2.3, 2.5) events PPY in the retrospective period to 12.1 (95% CI: 11.4, 12.9) events PPY in the prospective period; $P < 0.001$ [Figure 2].
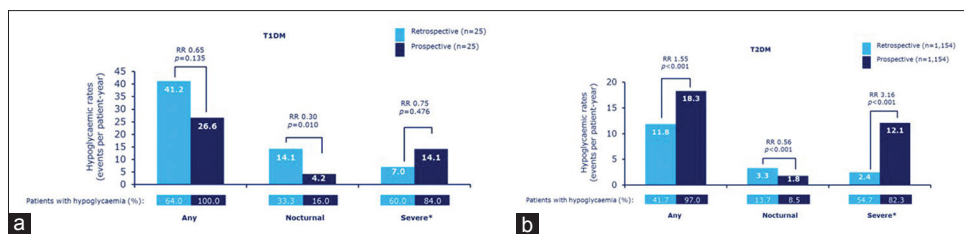
Figure 2: Percentage of patients and rates of hypoglycemia during retrospective and prospective periods (a) T1DM, (b) T2DM. "Any" and "Nocturnal" based on 4-week period for both retrospective and prospective analyses. *Retrospective data based on 6-month period and prospective data based on 4-week period. RR: Rate ratio; T1DM: Type 1 diabetes mellitus; T2DM: Type 2 diabetes mellitus

Incidence of hypoglycemia by duration of diabetes

Incidence of hypoglycemia by duration of diabetes in each quartile is shown in Figure 3a-c. For patients with T1DM, there was no association between the incidence of any or nocturnal hypoglycemia with each quartile for duration of diabetes (years) in any of the assessment periods. The rates of severe hypoglycemia increased with each quartile with longer duration of diabetes during both assessment periods, with a maximum increase observed in the last quartile (60.9 [95% CI: 40.5, 87.9] events PPY and 39.1 [95% CI: 8.1, 114.4] events PPY, respectively) [Figure 3c].

For patients with T2DM, the rates of any and nocturnal hypoglycemia increased with the duration of diabetes [Figure 3a and b]. The rates of severe hypoglycemia increased slightly with the duration of diabetes in the retrospective period and were almost similar in all the quartiles in the prospective period [Figure 3c].

Hypoglycemia by glycated hemoglobin levels

No association was seen between the percentages of patients with any hypoglycemia and baseline HbA1c in the 4 weeks before baseline period. All patients with T1DM experienced any hypoglycemia regardless of baseline HbA1c value in the 4 weeks after baseline period. For patients with T2DM, 97.6%, 91.6%, and 93.1% of patients had experienced any hypoglycemia in the HbA1c <7.0%, HbA1c 7.0%–9.0%, and HbA1c >9.0% categories, respectively, in the 4 weeks after baseline period.

In addition, scatter plot with regression line and 95% CI for patients with T1DM or T2DM showed no association between HbA1c levels and hypoglycemic events (data not shown).

Hypoglycemia by insulin types

For patients with T1DM, overall, there were higher rates of severe hypoglycemia during the prospective period when compared with that of the retrospective period. Moreover, the reported rates of severe hypoglycemia were almost similar in the prospective period, irrespective of treatment [Figure 4 c]. The overall rates of any and nocturnal hypoglycemia were higher in the retrospective period when compared with that of the prospective period [Figure 4a and b].

For patients with T2DM, there were higher reported rates of any and severe hypoglycemia during the prospective period when compared with that of the retrospective period (any: 18.3 [95% CI: 17.4, 19.2] events PPY vs. 11.8 [95% CI: 11.1, 12.6] events

PPY, respectively; severe: 12.1 [95% CI: 11.3, 12.9] events PPY vs. 2.4 [95% CI: 2.3, 2.5] events PPY, respectively). The reported rates of any and severe hypoglycemia were almost similar in the prospective period, irrespective of treatment [Figure 4a and c]. The overall rates of nocturnal hypoglycemia were higher in the retrospective period when compared with that of the prospective period [Figure 4b].

Use of health system resources

None of the hypoglycemic events in patients with T1DM resulted in hospital admission in both assessment periods. Mostly, the impact of hypoglycemia on the medical system (hospital admissions, additional clinic appointments, and telephone contacts) in the retrospective period was slightly higher than that in the prospective period (both T1DM and T2DM) (data not shown).

Behaviors against hypoglycemia

A higher proportion of patients of both T1DM and T2DM reported taking action following hypoglycemia during the retrospective period. The most common responses during retrospective and prospective assessment periods were as follows: consulted a doctor or nurse (T1DM/T2DM: 60.0%/46.4% and 28.0%/20.0%, respectively), requiring any form of medical assistance (T1DM/T2DM: 60.0%/46.5% and 28.0%/20.4%, respectively), and increased calorie intake (T1DM/T2DM: 56.0%/32.5% and 36.0%/17.4%, respectively) [Table 2].

Patient knowledge of hypoglycemia and hypoglycemic awareness

All (100.0%) patients with T1DM and 89.7% of patients with T2DM knew the overall definition of hypoglycemia before reading the SAQ1. The majority of patients in both groups defined hypoglycemia on the basis of symptoms alone (T1DM: 76.0%; T2DM: 54.2%) [Table 2]. More patients with T1DM than with T2DM had hypoglycemic awareness (80.0% and 62.7%, respectively) [Table 2].

Impact of hypoglycemia on work/studies

Patients with T1DM (*n* = 14) and T2DM (*n* = 330) were studying or in full- or part-time employment. More patients with T1DM or T2DM had an impact on work/study in the retrospective period when compared with that of the prospective period: absence from work or studies (T1DM/T2DM: 21.4%/7.1% vs. 14.8%/4.2%, respectively), late arrival to work or study (T1DM/T2DM: 35.7%/14.3%
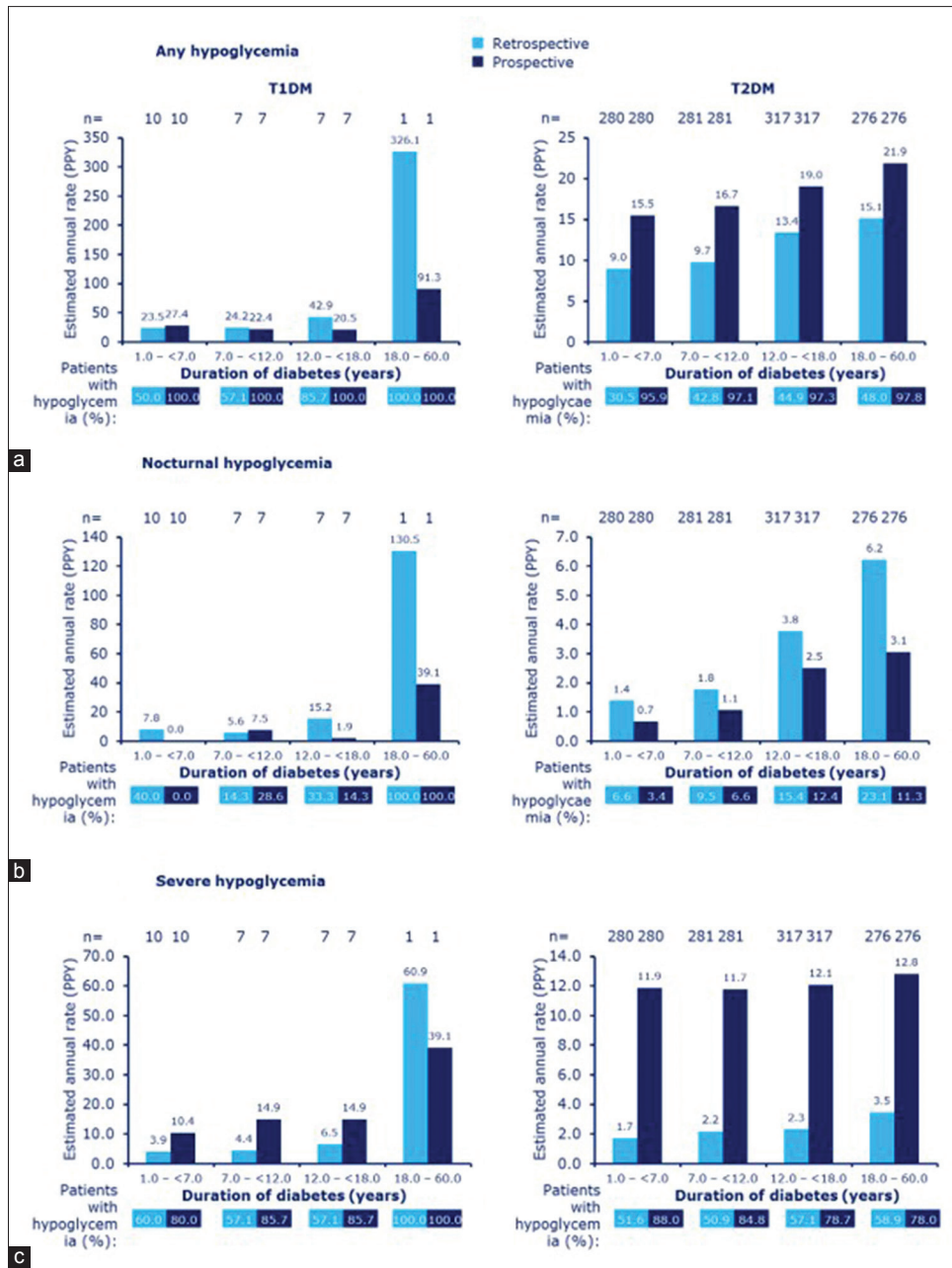
Figure 3: Percentage of patients and rates of (a) any, (b) nocturnal, and (c) severe hypoglycemia in each quartile during retrospective and prospective periods by duration of diabetes in T1DM and T2DM. Percentages represent percentage of patients with hypoglycemia in each quartile. Data for severe hypoglycemia based on the 6 months before baseline for the retrospective period and the 4 weeks after baseline for the prospective period; PPY: Per patient-year; T1DM: Type 1 diabetes mellitus; T2DM: Type 2 diabetes mellitus

vs. 10.0%/2.1%, respectively), or early departure from work or study (T1DM/T2DM: 21.4%/0.0% vs. 14.5%/3.9%, respectively). Overall, 14 and 324 days were taken off work or study in the year prior to baseline and 14 and 311 days were taken off work or study in the 4 weeks after baseline by patients with T1DM and T2DM, respectively.

Discussion

This subanalysis of the IO-HAT study presents the first data set of self-reported hypoglycemia that studied hypoglycemic

incidence and rates in insulin-treated patients with T1DM or T2DM in a Bangladeshi cohort.

The study reported higher rates of any hypoglycemia in patients with T1DM, both in the retrospective and prospective periods (41.2 and 26.6 events PPY, respectively). The reported incidence of hypoglycemia is quite high in comparison to the hypoglycemic rates (150 episodes/100 patient-years) previously reported in European studies,[13-15] the PREDICTIVE trial, the Hypo Ana trial, and the UK Hypoglycemia study.[16-19] Patients with T2DM reported significantly increasing rates of
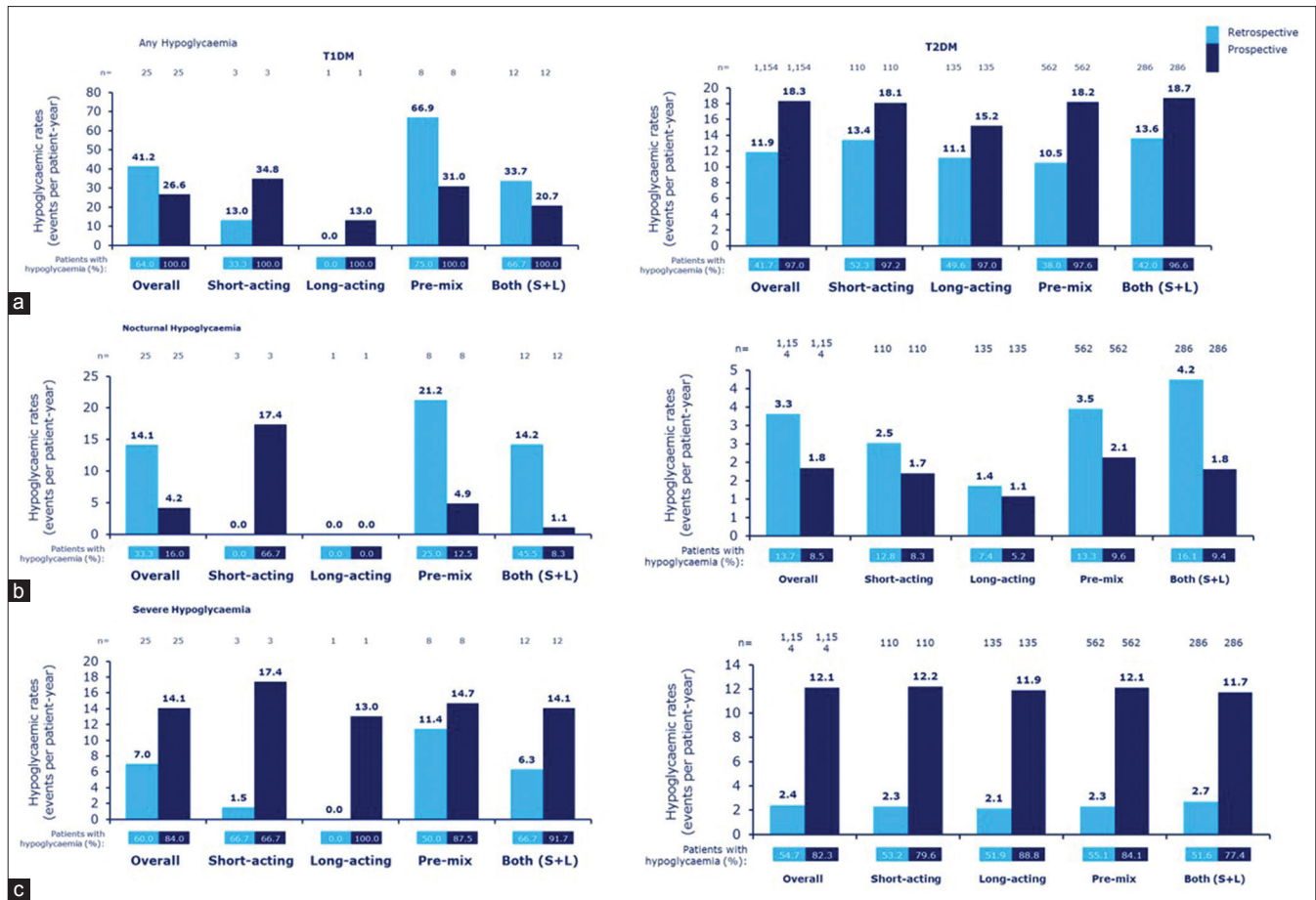
Figure 4: Percentage of patients and rates of (a) any, (b) nocturnal, and (c) severe hypoglycemia during retrospective and prospective periods, by insulin regimen in T1DM and T2DM. Percentages represent the percentage of patients with hypoglycemia with each insulin regimen. Data for severe hypoglycemia based on the 6 months before baseline for the retrospective period and the 4 weeks after baseline for the prospective period; PPY: Per patient-year; T1DM: Type 1 diabetes mellitus; T2DM: Type 2 diabetes mellitus

any hypoglycemia from retrospective period to prospective period ($P < 0.001$). The reported rates were much higher than previously reported hypoglycemic rates from PREDICTIVE trial, ACCORD, and the Veterans Affairs Diabetes Trial (383–1333/100 patient-years).[16,20,21]

The study also reported a higher rate of severe hypoglycemia (7.0 and 14.1 events PPY, respectively) during the retrospective and the prospective periods in patients with T1DM, compared to 1.0–1.6 events PPY reported in the European study.[14,15] Higher rate of severe hypoglycemia was also reported for patients with T2DM in this cohort (2.4 and 12.1 events PPY, respectively) during the retrospective and the prospective periods. Again, the rate was much higher than the severe hypoglycemic rates reported (3–9/100 patient-years) in patients with T2DM on insulin in the UK Hypoglycemia study.[18,21] The reported rates were also aligned with the rates observed in the Global HAT study (T1DM: 4.9 events PPY; T2DM: 2.5 events PPY).[2] The study reported higher rates of nocturnal hypoglycemia for patients with T1DM or T2DM than earlier reported rates.[13-18] The lower prospective reporting in case of nocturnal hypoglycemia in comparison to the retrospective period may be due to patients missing the entry of the

nocturnal events in the PD at night. The other perspective is that the impact due to fear of nocturnal hypoglycemia may have driven the patients to remember these events and hence, patients were able to recall accurately the nocturnal events in the retrospective period.

The study reported a higher percentage of patients (60% and 84.0%, respectively) with T1DM who experienced at least one severe hypoglycemic event during the retrospective and prospective periods. These data are much higher than the annual prevalence of up to 30% of severe hypoglycemia in patients with T1DM reported in Northern European populations.[14,15] Moreover, there was a similarity in the frequency of severe hypoglycemia between patients with T1DM and T2DM (84.0% vs. 82.3%, respectively) as reported in an earlier hypoglycemic survey.[22]

Overall, in this cohort, the percentages of patients with T1DM or T2DM who reported at least one hypoglycemic event were higher during the prospective period of the study than during the retrospective period. This could be due to the use of the PD, which served as a tool that assisted patients in recall of the events in the prospective period. In contrast, there could have been a recall bias while recollecting the retrospective

Table 2: Patients' perspectives on hypoglycemia

	T1DM (*n*=25)		T2DM (*n*=1154)	
Knew what hypoglycemia was at baseline before Part 1 SAQ (%)*	100.0		89.7	
Defined hypoglycemia based on (%)*				
Symptoms only	54.6		54.2	
Blood glucose measurement only	4.0		2.2	
Either†	8.0		9.4	
Both‡	8.0		20.0	
Hypoglycemic awareness (%)*				
How often do you have symptoms when you have a low blood sugar measurement?				
Always or usually	80.0		62.7	
Occasionally	16.0		23.5	
Never	0		9.4	
Missing	4.0		4.3	
Patients' response to hypoglycemia (%)*	**Retrospective (*n*=25)**	**Prospective (*n*=25)**	**Retrospective (*n*=1154)**	**Prospective (*n*=1153)**
Consulted their doctor/nurse	60.0	28.0	46.4	20.0
Required any form of medical assistance	60.0	28.0	46.5	20.4
Increased calorie intake	56.0	36.0	32.5	17.4
Avoided physical exercise	20.0	8.0	9.1	5.4
Reduced insulin dose	20.0	16.0	28.0	15.3
Skipped insulin injections	16.0	4.0	12.0	3.9
Increased blood glucose monitoring	24.0	12.0	25.1	13.4

†Either symptoms or blood glucose measurement, ‡Both symptoms and blood glucose measurements, *n*: Total number of patients participating, *Percentages based on the number of patients with evaluable data. T1DM: Type 1 diabetes mellitus; T2DM: Type 2 diabetes mellitus, SQA: Self-assessment questionnaire

events by DM patients, which could have possibly resulted in underreporting of the events in the retrospective period.

At baseline, glycemic control in terms of mean HbA1c in patients with T2DM in Bangladeshi cohort of IO-HAT study was poor similar to baseline HbA1c levels in patients with T2DM in DiabCare Bangladesh 2008 study and A$_1$CHIEVE study (8.8% vs. 8.6% vs. 10.0%, respectively).[23,24] However, we found that for patients with T1DM or T2DM, there was no association between the percentages of patients with any, severe, or nocturnal hypoglycemia and baseline HbA1c in the 4 weeks before and after the baseline period. Similar to the global HAT trial, the hypoglycemic rates had no significant association with HbA1C level in patients of both T1DM and T2DM.[2] The results showed that hypoglycemia is independent of HbA1c levels, and hypoglycemia was common at all HbA1C levels.[25] Patients should be given the confidence that tight glycemic control with the usage of insulin therapy will not increase the risk of hypoglycemia.

One of the limitations of this study is recall bias. Educating patients to regularly document the hypoglycemic events by themselves in a diary may be a possible remedy to lower recall bias.

DM in Bangladeshi cohort presented higher rates of hypoglycemia in spite of having a lower average duration of diabetes, duration of insulin use, and high HbA1c levels. While the status of health-care access in Bangladesh was not captured in the study, more DM had increased health-care costs in terms of increased hospital admissions, clinic appointments, and telephone contacts, suggesting that the impact of hypoglycemia on health care was extensive. A higher percentage of patients with T1DM or T2DM were absent from work or studies or arrived late to work/study, and left early from work or study. These results must be interpreted with caution as a low number of patients with T1DM were present in this cohort.

Overall, these results indicate that the incidence rates of hypoglycemia were high among patients with T1DM. However, the results may be skewed by the low number of patients with T1DM in this cohort. In patients with T2DM, significantly higher prospective reporting of hypoglycemia compared to the retrospective period indicated that patients had underreported hypoglycemia during the retrospective period. Though patients had a good knowledge of hypoglycemia at baseline, it is observed that the hypoglycemic rates are usually underestimated in Bangladesh on the basis of recall alone. The need of the hour is to educate DM patients in Bangladesh on hypoglycemia and encourage them to better document these events and do regular SMBG.

Acknowledgment

Conflicts of interest

There are no conflicts of interest.

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