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Assessment of the Magnitude, Severity and Associated Factors of Hypoglycemia in Diabetic Patients Attending National Diabetes Referral Clinic at Tikur Anbessa Hospital, Addis Ababa, Ethiopia

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Abstract

Background: Hypoglycemia poses a barrier to optimum diabetes management especially among patients taking insulin therapy. However little is known about the magnitude and effect of hypoglycemia among diabetic patients in Ethiopia.

Methods: A Cross-sectional study was conducted on diabetic patients who were above 14 years of age and attending National Diabetic referral clinic at Tikur Anbesa Specialized Hospital, between June and August 2016.

Results: The study involved 562 diabetic patients (194 T1DM and 368 T2DM). Previous episode of hypoglycemia was experienced by 61.2% (344) of the patients. Hypoglycemia was reported by 88% T1DM and 69% of insulin treated T2DM .There were 523 episodes of hypoglycemia reported by 186(33.1%) of the patients in the last month, out of which 40(5.9%) episodes were sever hypoglycemia reported by 26 (14%) of the patients. Female gender, higher BMI, low educational status and higher FBS were associated with higher reported incident of previous hypoglycemia (p<0.05). Although majority of the patients were on Insulin 381 (67.8%), FBS above 130mg/dl was recorded in 65% (363) of the patients. About 63.3 % patients reported that their hypoglycemia was precipitated by delayed meal. Out of the participant 152(44.2%) were unaware, 94(27.4%) had impaired awareness and only 98(28.4%) were fully aware of their hypoglycemic episodes.

Conclusion: Hypoglycemia was experienced by the majority of diabetic patients involved in this study. Notably, the rate recorded among insulin treated T2DM patients was significantly higher than those on OHA alone. The study also revealed higher rate of sever hypoglycemic incidents in our patients. Continuous health education on SMBG practice and management of hypoglycemia is needed among diabetic patients in Ethiopia.

Keywords: Diabetes mellitus; Hypoglycemia; Insulin; Risk factor; Severity and awareness

Abbreviations: OHA: Oral Hypoglycemic Agent; TASH: Tikur Anbessa Specialized Hospital; T1DM: Type1 Diabetes Mellitus; T2DM: Type 2 Diabetes Mellitus

Introduction

Background

Despite the great advancements that have been made in the treatment of diabetes in recent years, diabetes is one of the major causes of morbidity and mortality. It has a significant impact on the patients, quality of life, productivity and involves enormous health costs for virtually every society [1].The situation in the developing world, particularly in Africa, is even worse resulting from late diagnosis and poor access to diabetic care [2].

According to the International Diabetes Federation (IDF) 2015 estimate about 14.2 (9.5-29.4) million adults aged 20-79 have diabetes in the Africa Region and over two thirds (66.7%) of people with diabetes are also unaware that they have the disease [2].This report puts Ethiopia in the fourth position among top sub-Saharan African countries with largest number of people living with diabetes having more than 1.3 [0.8-3.5] million diabetic patients. According to this report the estimated prevalence of diabetes among adults population (20-79 years) of Ethiopia is 2-4 %(3.4% for comparative prevalence). A fundamental goal in the management of patients with diabetes is the maintenance of normal or near-normal blood glucose levels often through the use of oral anti-diabetic and insulin therapy [3]. However, intensification of treatment especially with insulin therapy can increase the incidence of hypoglycemia; the most common and unpredictable side effect of insulin treatment [4].

In the ADVANCE trial, which recruited T2DM patients with a history of major macrovascular or microvascular disease or at least one other cardiovascular risk factor, 2.1% of diabetic patients experienced severe hypoglycemia. Severe hypoglycemia was shown to be strongly related to an increased risk of first macrovascular event in this study [4].

In the ACCORD trial, which included diabetic patients with cardiovascular disease or at high cardiovascular risk, the symptomatic severe hypoglycemic events (a blood glucose level, <50 mg/dL) requiring any assistance from someone else occurred in 15.9% vs. 5.0% of subjects assigned to the intensive treatment arm compared to the standard glycemic control arms (annual incidence of these events: 3.14% vs. 1.03% in the respective arms) [5]. A retrospective epidemiological analysis of the ACCORD study also showed that symptomatic severe hypoglycemia is associated with higher annual mortality in diabetic patients in both the intensive and the standard therapy arms [6].

Hypoglycemia also poses a significant barrier to optimal diabetes management as fear of hypoglycemic events may cause exaggerated avoidance behavior and consequently sub-optimal insulin therapy and glycemic control. Although diabetes management needs comprehensive and quality care, the situation of diabetic care is below the standard in Ethiopia even in a setting with a relatively established health infrastructure in urban areas as shown in study done by Yeweyenhareg and Fikre on the assessment of the health care system for diabetes in Addis Ababa [7].

Study by Abyot and Fitsum [8] in Northwestern Ethiopia shows that from the total respondents of 150 patients, 107 (69.3%) reported that they have experienced hypoglycemia previously when they took insulin. Of these patients, 135 (90%) knew the home management of hypoglycemia like taking sugar, candy, honey and other methods. In recent years there is an increment in the prevalence and number of diabetic patients in Ethiopia according to estimates [2]. Simultaneously there is also increased use of different hypoglycemic drugs such as insulin and sulfonylureas by diabetic patients to achieve glycemic control. Hypoglycemia is a common side effect of diabetic therapy that may contributes to suboptimal glyemic control in diabetic patients. Hypoglycemia is a common problem amongst diabetic patients in Ethiopia [8]. However, similar to other developing countries, there is no nationwide population based study on prevalence, risk factors and economic cost of hypoglycemia in diabetic patients in Ethiopia.

In the present study we aimed for and assessed the Magnitude, Severity and Associated risk factors of hypoglycemia in 562 diabetic patients attending National Diabetic referral clinic at Tikur Anbessa Specialized Hospital in Addis Ababa, Ethiopia.

Methods and Patients

Study area and period

A Cross-sectional study was conducted among diabetic patients attending a National Diabetic referral clinic at Tikur Anbessa Specialized Hospital, which is the national teaching hospital located in the capital. The Hospital has a large endocrine referral clinic which is the major, if not the only specialized comprehensive public diabetic care center in the country. On Averages about 800 diabetic patients are seen per month and then appointed at intervals of three to four months for regular follow up which is mostly provided by Internal Medicine Residents with support from endocrine fellows and consultant endocrinologist. The study was conducted over a three months period between June and August, 2016. Study Design and sampling procedure: A Cross-sectional study was conducted among diabetic patients who have follow up at diabetic clinic during the study period whose age is >14 years and agreed to be enrolled in the study. Patients with mental health problems, hearing impairments and those

patients who were unable to provide the appropriate information were excluded.

The sample size was calculated assuming a 69.3% proportion (p) of hypoglycemia incidence in diabetic patients, a 4% marginal error (d) and a confidence interval (CI) of 95%. Based on this assumption sample size was calculated using single population proportion formula $n = z2p (1-p)/d2$. Based on this formula the calculated sample size was 511. Due to the fact that there is a non- response (with an acceptable level of 10%), 10% of the calculated sample size was added to the estimated sample size making the final sample size of 562.

A systematic random sampling technique was used to select patients. During the study period there were about 3200 diabetic patients who were registered and had regular follow up at Diabetic follow up clinic. Most of the patients are given follow-up appointments at intervals of three to four months. However, for some patients the frequency of their visits may vary depending on their blood glucose level and co-morbidities. The diabetes clinics provide their services three days per week but mainly on Mondays and Wednesdays. On average about 200 patients were seen per week whereas, about 800 patients were seen per month. Based on the decision to collect data over the course of three months, the sampling interval was determined by dividing the expected number of diabetic patients over three months (2400) by the sample size (562) which gives a sampling interval of about four. Sampling fraction was determined by selecting one number from 1-4 by lottery method. Thus, every 4th patient was selected from patients" registration logbook and interviewed. Participants were recruited and identified at Diabetes follow up clinics by trained nurses from registration logbook.

Procedure and Ethical consideration: Written consent was obtained from each participant for participating in the study. For respondent who were between 14-18 years of age the assent was obtained from the children involved in the research and also the consent was obtained from family or care givers. The study was conducted after it was reviewed and approved by the Institutional review board of College of Health Sciences, Addis Ababa University. Then the data were obtained using a well-structured questionnaire, medical card review and anthropometric measurement. Questionnaires were prepared with modification from those used in a previous study [9,10] and were prepared in the English and translated into commonly spoken local language - Amharic. The completed questionnaires were translated back into English to check its consistency before analysis. The data were collected by trained nurses.

The patients were asked about past hypoglycemic events since the diagnosis of diabetes and incident of hypoglycemia in the previous one month prior to study enrolment. The collected data included patients demographic characteristic, awareness of hypoglycemia, the number of non-severe and severe hypoglycemic events. The study also included common precipitating (risk) factors of hypoglycemia and documented diabetes related complications and other chronic medical illness. Medical records were reviewed to check about treatment profile and recent fasting blood sugar record of the participant.

Data analysis

The data were analyzed by Statistical Package for Social Science (SPSS) version 20. Descriptive statistics were used for most variables such as socio-demographic data. A Chi-square test was employed to determine the presence of the association between magnitudes of hypoglycemia (severity of hypoglycemia) with different variables.

Variables that showed significant association on bivariate analyses were fitted into a multi-variable logistic regression model. All statistical tests were two-sided and statistical significance was set at a p-value <0.05.

Operational definitions

Hypoglycemia: A low plasma glucose concentration (<70 mg/dl) and/or symptoms consistent with hypoglycemia (e.g. sweating, shaking, headache, palpitation). Relief of symptoms after the plasma glucose level is raised.

Awareness of hypoglycemia: classification system is based on a prospectively validated study by Pedersen-Bjergaard et al. [10]. Any participant who answered "sometimes" or "never" to the question, "Can you feel when your blood sugar is low?" was classified as being unaware of hypoglycemia, those who answered "usually" were classified as having impaired awareness of hypoglycemia and those who answered "always" were classified as aware of hypoglycemia

Classification of hypoglycemia

Severe hypoglycemia: was an event requiring assistance of another person to actively administer carbohydrates, glucagon, or take other corrective actions. Plasma glucose concentrations may not be available during an event, but neurological recovery following the return of plasma glucose to normal is considered sufficient evidence that the event was induced by a low plasma glucose concentration.

Documented symptomatic hypoglycemia: was an event during which typical symptoms of hypoglycemia were accompanied by a measured plasma glucose concentration of <70 mg/dL (<3.9 mmol/L).

Asymptomatic hypoglycemia: was an event not accompanied by typical symptoms of hypoglycemia but with a measured plasma glucose concentration <70 mg/dL (<3.9 mmol/L).

Probable symptomatic hypoglycemia: was an event during which symptoms typical of hypoglycemia are not accompanied by a plasma glucose determination but that was presumably caused by a plasma glucose concentration <70 mg/dL (<3.9 mmol/L).

Results

In the present study a total of 562 diabetic patients were involved of which 286 (50.9%) were females. Majority of the patients (87%) of them lives in the capital Addis Ababa and nearby towns, but the rest come from rural area for routine follow up at the study center. Of the participant 94.5 % are literate, 211(37.5%) of them were educated up to secondary educational level (grades 8-12) while only 187(33.3%) got tertiary education (above 12 grades). Smoking history was reported by 49(8.8%) of the patients, of this 1.6 % were current smokers and 7.1% were ex-smokers. Female gender and low educational status were associated with higher reported incident of previous hypoglycemia (p<0.05).

A total 368(65.5%) patients had type2 diabetes while type 1 diabetes accounted for 194(35.5%). The mean age of participant was 55.9 (SD, 10) years for type 2 diabetic patients and 29.7(SD, 9.5) years for patients with type 1 diabetes. The mean BMI in patients with type 2 and type 1 diabetes were 25.55(SD ± 4.2) and 21.76(SD=3.5) respectively. About one third, 121(32.9%) of patients with type 2

diabetes were overweight whereas only 59(16%) of them were obese. Majority [130(67%)] of patient with type 1 diabetes had normal BMI although some of them were underweight [30(15.4%)]. The study showed that higher BMI was associated with higher reported incident of previous hypoglycemia (p<0.05). Duration of diabetes illness is less than 5 years in 139(24.7%) of patients, between 10-15 years in 144(25.6%) and greater than 15 years in 139(24.7%) of the participants (Table 1).

As shown in Table 2, majority of diabetic patients were treated with Insulin 381(67.8%) either alone or with OHA to control their blood glucose level. From 294 patients taking only insulin treatments 100 of them were type 2 diabetics. About 173(30.8%) of the patients were on treatment with oral hypoglycemic agents only (59, 11 and 103 of the patients were on Metiformin alone, Sulfonylurea alone and combination of both respectively). Whereas only few patients with type 2 diabetes were on lifestyle modification alone. The mean dose of insulin required by T1DM and insulin treated T2DM was 54.3 IU (SD ± 22.7) and 52.6IU (SD ± 27.4) respectively. The mean fasting blood sugar at the time of study enrollment was 159(SD ± 74.2) mg/dl and 163.3(SD ± 65.5) mg/dl in type 1 and type 2 diabetic patients respectively. FBS of above >130 mg/dl was recorded in about 65% of the study participant [109(56%) of type 1 and 254(69%) of type 2 diabetic patients] (Figure 1).
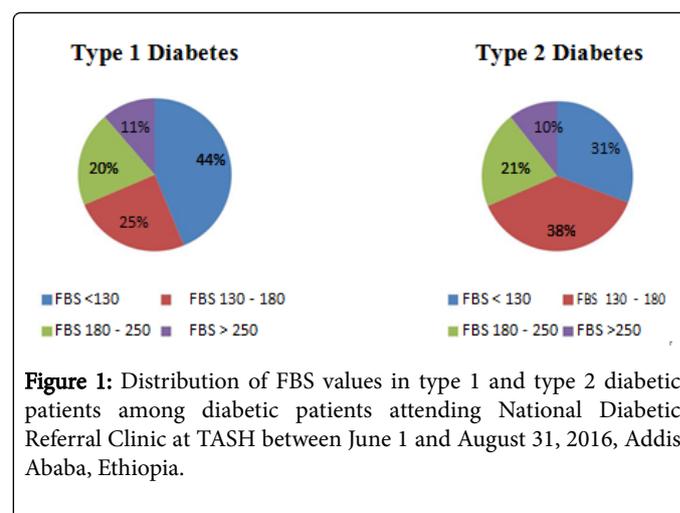

Figure 1: Distribution of FBS values in type 1 and type 2 diabetic patients among diabetic patients attending National Diabetic Referral Clinic at TASH between June 1 and August 31, 2016, Addis Ababa, Ethiopia.

The mean FBS in patients with duration of illness below or above 10 years was 162.7(SD ± 69.3) and 163.8(SD ± 68) respectively. The study showed that higher FBS level was associated with higher reported incident of previous hypoglycemia (p<0.05), but there was no significant difference in mean FBS based on duration diabetic (P=0.955).

Out of the 562 participants of the study those who had history of hypoglycemia since they were told to have diabetes were 344 (61.2%) (171 had type 1 diabetes and 173 had type 2 diabetes). Out of the 186(33%) patients who had hypoglycemia in the last month, 102 were type 1 and 84 were type 2 diabetic patients. A total of 523 episodes of hypoglycemia had occurred in the last month, off this 298 episodes occurred in type 1 diabetes patients and 225 episodes occur in type 2 diabetics.

Variables		Type 1 diabetes	Type 2 diabetes	Total frequency (%)
Number and Age	Number of patients, N (%)	194(34.5%)	368(65.5%)	562(100)
	Age, mean (SD)	29.7 (± 9.5)	55.9(± 10)	46.8(± 15.8)
Gender, N (%)	Female*	101(18)	286(50.9)	
	Male	93(16.5)	183(32.6)	276(49.1)
	FBS, mean (SD)*	159 (± 74.2)	163.3(± 68.6)	
	BMI, mean(SD)*	21.8(± 3.5)	25.5(± 4.2)	24.24(± 4.39)
Religion, N(%)	Orthodox	128(22.8)	261(46.4)	389(69.2)
	Muslim	45(8)	105(18.7)	
	Catholic	0	3(0.5)	3(0.5)
	Protestant	20(3.6)	60(10.7)	
	Other	1(0.2)	4(0.7)	5(0.9)
Marital status, N (%)	Single	103(18.3)	20(3.6)	123(21.9)
	Married	88(15.6)	366(65.1)	
	Divorced	0	20(3.6)	20(3.6)
	widowed	3(0.5)	53(9.4)	
Ethnic Group, N(%)	Oromo	51(9.1)	132(23.5)	
	Amhara	71(12.6)	182(32.4)	253(45)
	Tigre	18(3.2)	49(8.7)	
	Gurage	31(5.5)	38(6.8)	69(12.3)
	Educational status,N(%) †	23(4.1)	59(10.5)	
	Illiterate	1(0.2)	30(5.30	31(5.5)
	Read and write only	2(0.4)	20(3.6)	
	Primary education (1-8)	42((7.5)	71(12.6)	113(20.1)
	Secondary education (8-12)	88(15.7)	211(37.5)	
	Above grade 12	61((10.9)	126(22.4)	187(33.3)
Smoking history(N)	Current smoker	2(0.3)	7(1.3)	9(1.6)
	Ex-smoker	6(1.1)	40(7.1)	
	Non smoker	186(33.1)	327(58.2)	513(91.3)
Duration of diabetes £	<5 years	31(5.5)	108(19.2)	139(24.7)
	5-9 years	57(10.2)	140(25)	
	10-15 years	60(10.6)	84(15)	144(25.6)
	>15 years	46(8.2)	139(24.7)	

*Significant positive correlation with previous history hypoglycemic events (with (P<0.05); †Significant negative correlation with previous history hypoglycemic events (with (P<0.05); £Dose of insulin required to control hyperglycemia was positively correlate with duration of diabetes

Table 1: Sociodemographic characteristics of diabetic patients involved in hypoglycemia study, among diabetic patients attending National Diabetic Referral Clinic at TASH, between June 1 and August 31, 2016, Addis Ababa, Ethiopia.

Type treatment	Number of patients (%)
Diet modification & exercise	8 (1.4)
Oral glucose lowering	173 (30.8)
Drugs(OHA)	
Insulin and OHA	87 (15.5)
Insulin Therapy	294 (52.3)

Table 2: Treatment profile of diabetic patients attending National Diabetic referral Clinic at TASH, between June 1 and August 31, 2016, Addis Ababa, Ethiopia (OHA=Oral Hypoglycemic Agent).

Variables	Type 1 diabetes	Type 2 diabetes	Total patients
No. of Patients who had History of hypoglycemia ever previously since diagnosed diabetes	171(30.4%)	173(30.8%)	344 (61.2%)
No. of Patients who had hypoglycemia in the last month	102(18.1%)	84(15%)	186(33.1%)
Frequency of hypoglycemia in last month			
Once	16	17	33
Twice	27	24	51
3 times	26	22	48
4 times	15	11	26
5 or more times	18	10	28
Total episode of hypoglycemia that occur in the last month	298	225	523
Frequency hypoglycemia in last month that occur while sleeping			
Once	29	28	57
Twice	26	15	41
3 times	8	7	15
4 times	1	0	1
5 or more times	7	0	7
Total episode of hypoglycemia that occur in last month while sleeping	144	79	223
Patients who reported need for a third body assistance in last year to reverse hypoglycemia	58(10.3%)	33(5.9%)	91(16.2%)

Table 3: Episodes and frequency of hypoglycemic events among diabetic patients attending Diabetic Clinic at TASH, between June 1 and August 31, 2016, Addis Ababa, Ethiopia.

Out of the total episode of hypoglycemia that occurred in the last month, 223(42.6%) occurred while the patients were asleep (at night). off this nocturnal episodes of hypoglycemia 144 occurred in type 1 diabetic patients and 79 occurred in type 2 diabetic patients. The study also revealed that out of total episode of hypoglycemia in the last month 40(5.9%) episodes were severe hypoglycemic incidents (Table 3).

As shown in Figure 2, sever hypoglycemic event was occurred in 26(14%) of patients who had hypoglycemia in the last month. Out of patients who had non- hypoglycemia in the last month those who measured their blood glucose level during hypoglycemia incident (documented hypoglycemia) were 95 (51.1%), 52 (28%) of the patients had probable hypoglycemia (not supported by blood sugar measurement) and asymptomatic hypoglycemia occurred in 13(7%) of the patients.

As shown in Figure 3, hypertension and dyslipidemia was documented in 225 (40%) and 138(24.5%) of patients respectively. Documented retinopathy was found in 68 (12.1%) of the study participants while other complications and comorbidities including neuropathy, cardiac disease, nephropathy and foot ulcer occurred in 50(8.9%), 41(7.3%), 28(5%) and 5(.9%) of patients respectively. Screening for diabetic retinopathy was done for 441(78.1%) patients in the study. There was no significant correlation between diabetic related complications and previous incident of hypoglycemia. ("none" in the Figure 3 may not be the same as "no complications"; it is worth mentioning the diagnostic methods routinely employed(and the

limitations of their accuracy) to make the diagnosis of the chronic complications because in many cases the routine ways followed in our clinics hugely underestimate most of the complications and some co-morbidities e.g. no microalbumine test, in some patients tests such as lipid profile or renal function test might not have been done for a long period, at times years).
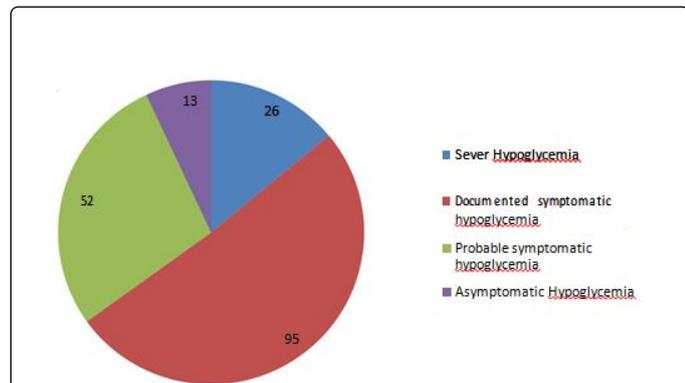

Figure 2: Classification of hypoglycemia among diabetic patients who reported hypoglycemia in the Last month, National Diabetic Referral Clinic at TASH, between June 1 and August 31, 2016, Addis Ababa, Ethiopia.
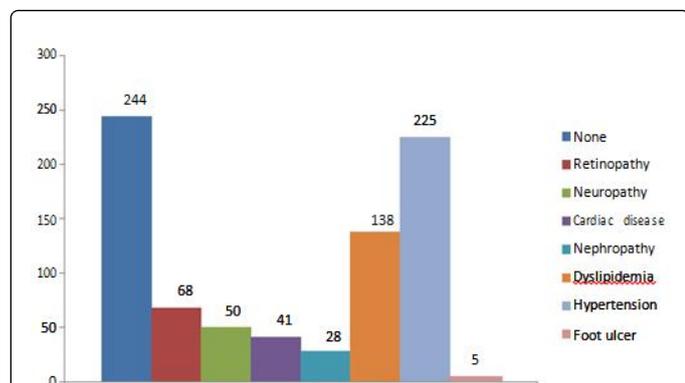

Figure 3: Number of patients with different diabetic related complications (other co-morbidities) among diabetic patients attending National Diabetic Referral Clinic at TASH, between June 1 and August 31, 2016, Addis Ababa, Ethiopia.

From the participants 63.3% (218 of the 344) patients who had Hypoglycemia reported that their hypoglycemia were precipitated by delayed meal, 29.4% reported that their hypoglycemia was associated with excess physical work or activity, 13.1% of them believe that their hypoglycemia experiences were caused by the treatments they were taking for diabetes (37 cases due to insulin and 8 cases due to glibenclamide) and 7.5% of patients had hypoglycemia shortly after meal (likely to be reactive hypoglycemia but diagnosis cannot be certain because some patients may have true hypo shortly after meal due to fast acting DM drugs such as regular insulin or if they do not do home Blood Glucose monitoring, they may have taken their treatments while their blood glucose is low enough to result in hypoglycemia shortly before the meal gets absorbed). Out of 101 participant who claimed Excess work (exercise) as preceding risk factor for their hypoglycemia event, only 27(26.7%) of them measures

their blood sugar level before(after) heavy work(exercise). Some patients have more than one precipitating factor during the different episode of hypoglycemia

From the total study participant 433(77%) patients reported that they had health education on hypoglycemia as well as 524(93.2%) of them knows how to treat hypoglycemia at home. Only 22.1% participants in this study (124 of patients) measured their blood sugar level before (and/or after) heavy work (exercise). The study also showed that only one quarter (25.3%) of patients who previously experienced hypoglycemia had habit of measuring their blood sugar before(and/or after) heavy work and exercise. Out of the 26 patients who reported sever hypoglycemic events in the past month, only 6 (23.1 %) of them measured their blood sugar before (and/or after) heavy work and exercise.

Of the 173 type 2 diabetic patients who had hypoglycemia, 129(74.6%) of them were taking insulin while those on oral hypoglycemic agent were 44 (25.4%). Majority of type 1 diabetic patients [171(88%)] had experienced hypoglycemia previously. From the total of 186 patient who had hypoglycemia in the last month, 102 were type 1 diabetic patients obviously on insulin treatment and the remaining 84 patients had type 2 diabetes out of whom 66(35.3%) were on insulin therapy and 18(10%) on oral glucose lowering agent (Figure 4).

Off the total 225 episodes of hypoglycemia that occurred in the last month among type 2 diabetic patients, 178 episodes occurred in those taking insulin and 47 episodes occurred in those taking oral glucose lowering agents. Out of the 121 patients who experienced hypoglycemia in the last month while sleeping (at night), 50 of them were type 2 diabetic patients. Off the 79 nocturnal hypoglycemias that occurred in the last month among type 2 diabetic patients, 64 episodes were reported by 40 patients who were taking insulin while 15 episodes were accounted for by 10 patients were on oral hypoglycemic drugs.
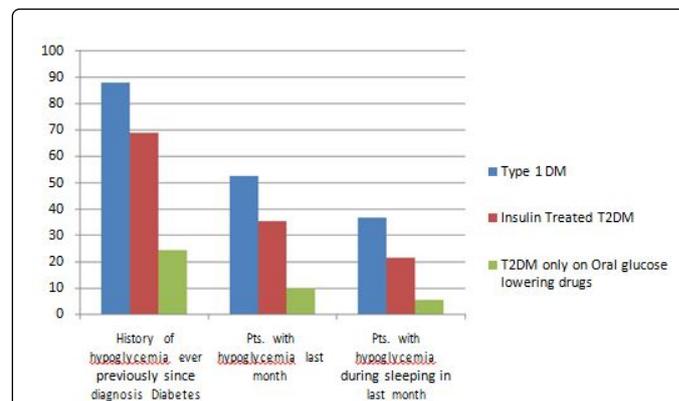

Figure 4: Proportion of hypoglycemia in sub-group analysis among diabetic patients attending Diabetic Clinic at TASH between June 1 and August 31, 2016, Addis Ababa, Ethiopia.

The study also showed that out of the total study participants who experienced hypoglycemia 152(44.2%) of them were unaware, 94(27.4%) had impaired awareness and only 98(28.4%) of them were fully aware of their hypoglycemic episodes. Among those with sever hypoglycemia 15(57.7%) were unaware, 5(19.2%) had impaired awareness while only 6(23.1%) were fully aware of their hypoglycemia.

Discussion

This study assessed the Magnitude, Severity and Associated risk factors of hypoglycemia in 562 diabetic patients. Majority (65.5%) of the study participants were patients with type 2 diabetes with mean age of 55.9 (SD ± 10) and were relatively younger when compared with type 2 diabetes patients involved in different previous studies [9,11], but was comparable with that of type 2 diabetes patients in the UKPDS (the United Kingdome Diabetes Prospective Study) 33 [12]. Nearly half of the patients with type 2 diabetes and two third of type 1 diabetes patients had normal BMI. Patients with type 2 diabetes in this study had lower BMI with only 16% of them being obese(BMI ≥ 30) when compared with body habits of patients involved different study done in western population with type 2 diabetes [11,12].

The present study also revealed that out of the participants who had experienced at least one episode of symptoms indicating hypoglycemia since they were diagnosed with diabetes, only 57.8% of them had documented hypoglycemia which was supported by a blood glucose measurement. The proportion of biochemically documented hypoglycemic events in this study was lower when compared with the result from previous prospective population-based study in Tayside, Scotland [13] in which 84% of the hypoglycemic events were documented with blood glucose measurement. These may be explained by the fact that only small proportion diabetic patients do practice self-monitoring blood glucose in Ethiopia for various reasons [14,15].

The total reported episodes of non-severe hypoglycemia in a month prior to the study were 298 in 102 T1DM patients and 225 in 84 T2DM patients. This corresponds to an event rate of 0.4 and 0.2 hypoglycemic episodes per respondent per week in Type 1 and Type 2 diabetic patients respectively. The event rate reported by type 1 diabetic patients in this study was lower when compared to the one reported in study by the C. G. O¨ stenson et.al [9] which involves 3827 respondents from seven European countries, in which the reported rates of non-severe hypoglycaemia were between 1.8 per respondent, per week in patients with type 1 diabetes. This could be as a result of low SMBG practice among our diabetic patients. However, the hypoglycemic event rate reported in T2DM patients in this study was comparable with the one reported by study in Tayside, Scotland. (0.2 vs. 0.3 per respondent, per week) [13].

The episodes of non-sever hypoglycemia were higher in patients with type 1 diabetes compared to type 2 diabetic patients treated either with insulin or oral glucose lowering drugs. However, the episodes of hypoglycemia is significantly higher in insulin treated T2DM (p<0.001) when compared with T2DM patients who were taking only oral glucose lowering drugs.

The rate of sever hypoglycemia reported in this study among the patients who had hypoglycemia in the last month prior to the study enrollment was 5.9%. The rate of severe hypoglycemia in this study was higher when compared to the rate in a prospective community-based study on 267 [13] insulin-treated diabetes patients where only 2% of the patients had sever hypoglycemia over a month period. The proportion of patients with severe hypoglycemic events in our study was significantly higher in patients with type 1 diabetes when compared to insulin treated type 2 diabetes patients. These finding was similar with the one reported by previous studies [3,4,13]. However, with increasing duration of treatment with insulin in people with type 2 diabetes, the frequency of severe hypoglycemia begins to approach that observed in type 1 diabetes [16]. Severe hypoglycemia was shown to be strongly related to an increased risk of the first macrovascular event as reported by the ADVANCE trial [4] and also associated with higher annual mortality in diabetic patients in both intensive vs. standard therapy arms of the ACCORD trial [6].

The study also revealed that FBS was above 130 mg/dl in about two third of the study participants (65%) which shows poor glycemic control among our patients. This is comparable with finding documented in the study done in south western part of Ethiopia [14] in which majority of the patients (82.9%) had FBS above the target level of 126 mg/dL. Similar finding were also reported in other previous study [15]. Our study showed that higher fasting blood sugar record (poor glycemic control) was significantly associated with the incident of previous hypoglycemic event. This finding is similar with one reported in previous study [11] in which longer duration of diabetes and a higher HbA1c were significantly associated with sever hypoglycemic incidents. This could also be due to fear of another hypoglycemia episode where the patients attempting to keep blood glucose rather high instead of experiencing another episode.

Majority of the respondent (63.3 %) reported that their hypoglycemia was precipitated by delayed meal and about 29.4% of the participant had their hypoglycemic symptoms preceded by heavy work (exercise). Hypoglycemic symptoms were attributed to the treatment given for control of the hyperglycemia in 13.1 % of the patients. Previous history of hypoglycemia was significantly higher among patients who did not measures their blood sugar level before (and/or after) Heavy work (exercise) (p=0.021).

Out of the total study participants 40% had hypertension, dyslipidemia was also found in 24.5% patients and only 12.1% of them had documented retinopathy. Previous study from Ethiopia on 523 diabetic patients in Addis Ababa [17] showed that 28% of the diabetic patients had hypertension whereas only 11% had diabetic retinopathy [18].

Conclusion and Recommendation

Our study shows that hypoglycemia was experienced by the majority of diabetic patients involved in the study. Notably, the rate of hypoglycemia was significantly higher among insulin treated type 2 diabetics compared to type 2 diabetic patient taking only oral glucose lowering agent. Higher rate of sever hypoglycemic incidents and impaired hypoglycemia awareness were reported by diabetic patients compared to the rate reported by previous studies.

Based on the findings of our study, we foreword the following recommendations:

- Encourage continuous health education to improve awareness and practice on prevention and management of hypoglycemia in health care facilities at different level of the health care system.
- Encourage Self-Monitoring of Blood Glucose (SMBG) among diabetic patients
- Improve the availability and affordability of point –of- care glucose test apparatus and test strips for self-monitoring
- Improve glycemic control in diabetic patients by ensuring access for more frequent blood sugar determination at nearby health facilities
- Improve the availability of some drugs (like glucagon) which is used to reverse severe hypoglycemic episodes as higher rate of sever hypoglycemia were recorded among our patients

- Finally, since majority of the patients related their hypoglycemic events to delayed meal this should be a target for intervention by governmental and non-governmental organizations.

Limitations

Since the study was Institution-based finding from this study may be interpreted with caution as it may not reflect real incidence of hypoglycemia in population of patients with diabetic mellitus at large. It may also be subject to bias like any other self-reported data.

Ethics Approval and Consent to Participate

The study was conducted after it was reviewed and approved by the Institutional review board of College of Health Sciences, Addis Ababa University. Written consent was obtained from each participant to participate in the study. For respondent who were between 14-18 years of age the assent was obtained from the children involved in the research and also the consent was obtained from family or care givers.

Consent for Publication

Consent for the publication of the data was obtained from each participant of the study using institution consent form. And also the consent for publication was obtained from family or care givers for participants aged between 14-18 years.

Availability of Data and Materials

The data sets used and/or analyzed during the current study is available from the corresponding author on reasonable request.

Competing Interests

The authors declare that they have no financial or personal relationship(s) what so ever with any party that might have inappropriately influenced them in any way in the preparation, conduct or write-up of this article.

Authors Contributions

All researchers (authors) were involved in the design, results analysis and development of this manuscript.

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