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ORIGINAL ARTICLE

# Correlates of fear of hypoglycemia among patients with type 1 and 2 diabetes mellitus in outpatient hospitals in Zambia

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## Abstract

**Background** Severe hypoglycemia is a burdensome complication of diabetes mellitus that can induce fear of hypoglycemia and contribute to suboptimal glycemic control. The challenge is to achieve and maintain adequate glycemic control while avoiding episodes of severe hypoglycemia. The purpose of the study was to determine how common fear of hypoglycemia was in Zambian out-patients with diabetes and also to explore correlates of fear of hypoglycemia.

**Methods** One hundred fifty-seven individuals with types 1 and 2 diabetes participated in the study. Fear of Hypoglycemia Scale, Diabetes Self-Care Inventory, Problem Areas in Diabetes, and the Major Depression Inventory were completed. Multiple linear regression models were computed to assess the association between fear of hypoglycemia and psychological factors.

**Results** About 19% [16.3% type 1 and 12.6% type 2] of individuals with diabetes based on item endorsement expressed fear of hypoglycemia especially among individuals with type 1 diabetes. After controlling for demographic variables, diabetes self-care ($\beta = 0.24$, $p < 0.05$), and diabetes specific distress ($\beta = 0.41$, $p < 0.001$) were associated with fear of hypoglycemia.

**Conclusion** Fear of hypoglycemia was common and was positively associated with diabetes specific emotional distress and diabetes self-care. Interventions to avert fear of hypoglycemia are needed while optimizing glycemic control through managing diabetes care and emotion distress in individuals with diabetes.

**Keywords** Fear of hypoglycemia · Hypoglycemia · Fear · HFS · Correlates

## Introduction

Diabetes mellitus along with hypertension are major risk factors for cardiovascular diseases. Treating these risk factors are cost effective and can help boost productivity [1, 2]. One other neglected complication in diabetes research in Sub Saharan Africa is hypoglycemia. The American Diabetes Association defines hypoglycemia as a condition characterized by abnormally low blood glucose levels usually less than 70 mg/dl [3]. However, because of individual differences, it is vital to consult a physician on appropriate glucose targets and what level is low for each individual. The cause of hypoglycemia can be either excess of diabetes medication, for example, if too much insulin does not match the amount of carbohydrates or drinks ingested or the levels of exercise was too much for the amount of carbohydrates consumed. Too much alcohol can also be a cause for hypoglycemia [4, 5]. The symptoms of hypoglycemia caused by very low blood glucose levels (neurogenic symptoms) include shaking, sweating, drowsiness, pupil dilation, hunger, nausea, anxiety, palpitations, and headache. Other symptoms (neuroglycopenic systems) include poor

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motor coordination, confusion, negative mood state, argumentativeness and irritability, seizures, coma, and even death if severe hypoglycemia remains untreated [6, 7]. Moreover, cognitive difficulties have been linked to early illness onset and illness duration, recurrent hypoglycemic episodes, and hypoglycemia especially in children with diabetes [8, 9]. A global study involving 24 countries found that hypoglycemia is common (2.5 per person/year) in individuals with type 1 diabetes mellitus (T1DM) or type 2 diabetes mellitus (T2DM) using insulin therapy and that it is one of the leading reasons for hospitalization for individuals with diabetes [10]. For instance, in a study in South Africa with 43 patients that were admitted at Baragwanath Hospital in Soweto, a total of 51 episodes of hypoglycemia in a 5-month period were recorded [11]. Hypoglycemia has a burden on healthcare utilization, costs, and quality of life [12]. While data shows hypolycemia is common, little is known how common fear of hypoglycemia is in Zambia. Unlike in developed countries, many SSA countries have weak diabetes health care, as such, investigating fear of hypoglycemia and its correlates remains important as it is an indicator of glycemic control and diabetes-related quality of life.

One of the challenges in the treatment of diabetes is to achieve optimal glycemic control while avoiding episodes of hyperglycemia or hypoglycemia [6]. One major downside of near normal glycemic controls is the elevated risk for hypoglycemia [13, 14]. Given the unpleasant aspects of hypoglycemia and the potentially life-threatening nature of severe hypoglycemia, many people with diabetes have significant fears of developing hypoglycemia [15]. Over time, FoH is triggered by hypoglycemia unawareness (HU). HU is defined at the onset of neuroglycopenia before the appearance of autonomic warning symptoms [16]. Enough evidence including data from systematic reviews shows that fear of hypoglycemia (FoH) is associated with being female [17–19], being old [17, 19], young age as reported by parents for children with type 1 diabetes [20], psychosocial factors such as anxiety, stress, depression, and impaired quality of life (QoL) [11, 19], whereas mixed results were found for the association of FoH with BMI [21]. FoH is also positively associated with duration of diabetes [17, 22], diabetes complications [18], and the individual's history of hypoglycemia especially severe episodes [12, 15].

FoH can adversely affect QoL, emotional wellbeing, diabetes management, and glycemic control in people with diabetes, yet few studies have been conducted on the subject in Africa, and these studies tend to be epidemiological in nature [11, 23]. For instance, a study with a sample of 43 South African patients, reported a total of 51 episodes of hypoglycemia in a period of 5 months [11]. Hypoglycemia has been observed to range between 25 and 55% in Sub-Saharan African diabetes patients per year [23]. Given that severe hypoglycemia is one of the leading reasons for hospitalization in African patients with diabetes, studies exploring FoH and factors associated with it are warranted. Identifying FoH and specific factors associated with FoH are important for developing parsimonious interventions. The aim of this study was to investigate how common FoH is and factors related with FoH in out-patients with type 1 diabetes and type 2 diabetes mellitus.

## Methods

### Design

This study employed a cross-sectional design. We assessed the association between the independent variables of interest (e.g., diabetes self-care, depression, and diabetes specific emotional distress) and the dependent variable, fear of hypoglycemia while controlling demographic variables.

### Study sample

The study sample comprised of outpatients with either type 1 diabetes mellitus (T1DM) or type 2 diabetes mellitus (T2DM) who were either on insulin or oral treatment from major hospitals in Lusaka (University Teaching Hospital), Ndola (Arthur Davison Children's Hospital, Kitwe (Kitwe Central Hospital), and Livingstone (Livingstone General Hospital). Convenience sampling was used to recruit patients in the study as long as they were at least 12 years old and were diagnosed at least 6 months before the study to allow for manifestation of psychological challenges. The exclusion criteria included anyone who was not yet on any diabetes medicine, diagnosed less than 6 months and were below 12 year of age. In total 157 patients signed the consent form and were recruited over a 1-year period.

### Measures

The measures were administered in English and in 2 local languages, namely Nyanja and Bemba. Back translations were done by two native speakers in each language who were fluent in the other language and English. The translators met to discuss the translation together with the first author to discuss the translation in each language and the differences between forward and back translation versions. The goal was to maximize both linguistic and psychological equivalence. All measures were chosen for use in this study based on their good psychometric properties.

**Demographic variables** Age, sex, education level, SES (as evaluated using proxy measures of properties and services owned by families of participants) and diabetes type. In addition, the body mass index of the participants was calculated using height and weight.

**Fear of hypoglycemia** The Hypoglycaemia Fear Survey (HFS) consists of 26 items. HFS comprises two scales assessing "worries

about hypoglycaemia" and "hypoglycaemia-related behaviors." The items are rated on a 5-point scale ranging from 1 (never) to 5 (very often). A Cronbach's alpha of 0.90 suggests high internal consistency [24]. In the current study alpha was 0.80 (Lambda2 = 0.81). A pilot study on 6 adolescents with T1DM confirmed item comprehension by the participants. Extreme scores indicate FoH (possible range 26–130) [11]. In order to examine the proportion of individuals with high frequency of worries about hypoglycemia, the point scales "1 = never and 2 = rarely" were considered "rarely do," the scale "3 = sometimes" remained sometimes while the scales "4 = often and 5 very often" were considered "often do" in the current study.

**Diabetes-specific emotional distress** The PAID is a 20-item self-report measure used to assess diabetes-specific emotional distress, including a range of feelings such as diabetes-related anger, fear, depression, worry, and guilt. Items can be responded to on a scale from 0 (not a problem) to 4 (serious problem). An overall score for the PAID can be calculated by adding all of the item scores and multiplying by 1.25, which gives a total score ranging from 0 to 100. Higher scores indicate more distress. Reported Cronbach's alphas for the PAID ranges from 0.84 to 0.96 [25–34]. In the current study the alpha was 0.88 (Lambda2 = 0.89).

**Diabetes self-care** The 13 item Self-Care Inventory (SCI) is a self-report measure used to assess patients' perceptions of their adherence to diabetes self-care recommendations over the previous 1 month. Individuals rate themselves on a 5-point Likert scale that reflects on how well they followed recommendations for self-care during the past month (i.e., 1 = "never do it" to 5 = "always do this as recommended, without fail"). Higher scores indicate more optimal diabetes self-care. Cronbach's alpha for the SCI was 0.84 (Lambda2 = 0.85) for T1DM and 0.85 (lambda2 = 0.86) for T2DM [35]

**Depression** The Major Depression Inventory (MDI) is a 12-item self-report questionnaire used to assess depression. Items of the MDI asked of the patient to rate how long in the past 2 weeks each of the depressive symptoms was present on a six-point scale ranging from 0 "not at all" to 5 "all time". It can be used as an instrument measuring severity of depression with a range from 0 - 60. The internal consistency of the MDI appeared to be good as indicated by Cronbach alphas ranging from 0.89 to 0.94 [36, 37]. In the current study, Cronbach alpha was 0.80 (Lambda2 = 0.81).

## Statistical analysis

Descriptive statistics including means (standard deviations), frequencies, and percentages were computed. We used the item endorsement criteria recommended by Hajos et al. to determine the proportion of individuals with elevated fear of hypoglycemia [38]. The Mann-Whitney *U* test was conducted to examine the mean rank differences between the two types of diabetes and individual items of the FoH scale. Independent *t* tests were conducted to examine mean difference between the two types of diabetes on the total score of the FoH Scale and on the two dimensions (behavior and worry) of the scale. Multiple linear regression models were conducted to assess the association between the total score of the FoH scale and the two dimensions of the scale as the criterion variables with other predictor variables, including diabetes self-care, diabetes specific-emotional distress, depressive symptoms, age, type of diabetes, sex, socioeconomic status (SES), and body mass index (BMI). Statistical significance was set at $p < 0.05$. BMI was computed in SPSS using the following formula: weight (kg)/[height (m)]$^2$.

## Results

### Demographic data

Of the 157 participants, 80 were females (51%). We did not find significant differences in gender composition of the patients with T1DM or T2DM. Mean age was 39 ± 17 years, ranging from 12 to 68 years. Of the total sample, 115 (73%) were adults and 42 (27%) adolescents. Table 1 shows the detailed demographic characteristics of the participants.

### Proportions of fear of hypoglycemia

About 19% of the sample endorsed 4 "often" and 5 "very often" worry on the scale indicating elevated FoH. The general pattern showed that individuals with T1DM (16.3%) had more FoH than individuals with T2DM (12.6%) (Table 2), although this difference was not statistically significant on the full scale or the two dimensions: behavior and worry (Table 2). At the item level, under the behavior dimension of the FoH, only one item was statistically significant: individuals with type 1 diabetes were significantly more likely to carry fast acting sugar with them ($U = 1938.50$, $p < 0.01$) (Table 3). On the worry dimension of the FHS, appearing stupid or drunk ($U = 2347.00$, $p < 0.05$), got bad evaluation at school/work because of something that happened when blood glucose was low ($U = 1722.50$, $p < 0.001$), and having an insulin reaction ($U = 2234.50$, $p < 0.05$) were reported more in T1DM individuals compared to T2DM individuals. Making a mistake/accident while at school or work ($U = 2336.00$, $p < 0.056$) bordered on significance (Table 2).

**Table 1** Demographic and clinical characteristics of 157 participants with type 1 and type 2 diabetes

| | |
|---|---|
| Sex, *n* (%) | |
| Females | 80 (51%) |
| Age, mean (SD) | 39±17 |
| Age range | 12-68 years |
| Location of patients | |
| Lusaka | 48 (31%) |
| Kitwe | 60 (38%) |
| Ndola | 35 (22%) |
| Livingstone | 14 (9%) |
| Developmental stage *n* (%) | |
| Adolescents | 42 (27%) |
| Adults | 115 (73%) |
| Educational levels *n* (%) | |
| Adolescents (42) | |
| 5-7th Grade (Primary school) | 14 (31%) |
| 8-12th Grade (Secondary school) | 16 (38%) |
| Missing | 14 (31%) |
| Adults (115) | |
| Primary education | 10 (9%) |
| Secondary education | 29 (25%) |
| Tertiary education | 22 (19%) |
| Missing | 54 (47%) |
| Marital status (Adults/115) *n* (%) | |
| Single | 6 (5%) |
| Married | 80 (70%) |
| Missing | 29 (25%) |
| Type of diabetes | |
| Type 1 | 93(59) |
| Type 2 | 58 (37) |
| Missing (either type 1or 2) | 6 (4) |
| BMI mean (*SD*) | 25 (5) kg/m$^2$ |
| Males | 25 (5) kg/m$^2$ |
| Females | 26 (5) kg/m$^2$ |
| Adolescents | 22 (4) kg/m$^2$ |
| Adults | 27 (5) kg/m$^2$ |

### Factors associated with fear of hypoglycemia

Multiple linear regression showed that after adjusting for background variables, there was a positive association between FoH and higher diabetes self-care scores ($\beta = 0.20$, $p < 0.05$). Higher levels of diabetes specific-emotional distress ($\beta = 0.40$, $p < 0.001$), and higher levels of depressive symptoms ($\beta = 0.10$, $p < 0.05$) were associated with higher FoH. Among the adjusted variables, younger age was associated with more FoH ($\beta = -0.26$, $p < 0.05$). In the second model involving the behavior dimension of the FoH, a higher diabetes self-care score was associated with more FoH ($\beta = 0.24$, $p < 0.01$). For the adjusted variables, younger age was the only one associated with increased FoH ($\beta = -0.36$, $p < 0.01$) while a higher socioeconomic status was associated with more FoH ($\beta = 0.21$, $p < 0.05$). In the third model involving the worry dimension, FoH was associated with higher diabetes-specific emotional distress ($\beta = 0.46$, $p < 0.001$) and depressive symptoms ($\beta = 0.21$, $p < 0.01$). Having T1DM (as opposed to having T2DM) was the only background variable that was associated with higher FoH-worry dimension (Table 4).

## Discussion

The aim of this study was to find out to how common FoH is in people with diabetes in Zambia, and also to explore correlates of FoH. About 19% [16.3% T1DM and 12.6% T2DM] of individuals with diabetes in Zambia reported elevated FoH. Our results are slightly lower, compared to those reported in an epidemiological study (25–55%) in Sub-Saharan African T1DM patients and 798 T2DM patients in Helsinki, Finland (52.5% all, 43% men, and 62% women) [23, 39]. The mean scores for Zambians living with diabetes were somewhat lower (57.38 ± 12.34) compared to a sample of insulin-dependent diabetes patients aged 18–80 years in the USA and India. It is important to realize the potential pitfalls of the comparisons (e.g., incomparable background characteristics of samples, differential appropriateness of the instrument across the USA and Zambia, sample size or other assessment bias issues). Still, across all countries, past experience of hypoglycemia, or unrecognizable condition can cause fear. It could be that participants in our study experienced less frequent severe hypoglycemic episodes, because of deliberate suboptimal diabetes care in order to avoid hypoglycemia because hypoglycemia can result from exogenous or endogenous insulin excess alone, hence some patients do a trade-off between good self-care or avoiding hypoglycemia; unfortunately, data on severe hypoglycemic events were lacking. Hypoglycemia has long been recognized to be a major limitation in achieving good control especially in T1DM, although with the increasing use of insulin to treat T2DM, the actual prevalence of hypoglycemia is likely to escalate [40]. Moreover, our SCI mean scores show suboptimal diabetes self-care in both types of diabetes. Our data showed individuals with T1DM seemed to FoH more compared to individuals with T2DM as expected. Specifically, individuals with type 1 carried more fast-acting sugar (behavior dimension), were more worried to appear stupid or drunk, making a mistake/accident at school/work, getting a bad evaluation at school/work because of something that happened when sugar was low and they worried more on having an insulin reaction.

**Table 2** Proportions of engaging in diabetes-related control measures to avoid hypoglycemia and frequent worries for hypoglycemia

| Item Description | Frequency (%) | | | Mean rank (*p*-values) | |
|---|---|---|---|---|---|
| | Never do | Sometimes | Often do | TIDM vs. T2DM | |
| **Behavior dimension** | | | | | |
| Eat large snack at bed time | 125(80) | 19(12) | 13(8) | 75.83 vs.77.56 | (>0.05) |
| Avoid being alone when sugar is likely to be low | 62(40) | 58(37) | 37(23) | 75.39 vs.78.25 | (>0.05) |
| …little sugar to be on the safe side | 94(60) | 44(28) | 19(12) | 78.64 vs.73.25 | (>0.05) |
| Keep my sugar high when I will be alone for a while | 109(69) | 17(11) | 31(20) | 74.35 vs.79.89 | (>0.05) |
| Eat something as soon as I feel sign of low blood sugar | 27(17) | 50(32) | 80(**51**) | 80.84 vs. 69.65 | (>0.05) |
| Reduce my medication when I think sugar is too low | 77(50) | 23(14) | 57(**36**) | 75.58 vs. 77.96 | (>0.05) |
| Keep my sugar higher when I plan to be in a long activity | 104(66) | 23(15) | 30(19) | 74.45 vs.79.96 | (>0.05) |
| **Carry fast acting sugar with me** | **88(56)** | **39(25)** | **30(10)** | **85.16 vs.62.86** | **(<0.01)** |
| Avoid a lot of exercising when I think my sugar is low | 63(40) | 42(27) | 52(**33**) | 80.04 vs.70.92 | (>0.05) |
| Check my sugar often when I plan to be in a long activity | 71(45) | 26(17) | 60(**38**) | 80.52 vs. 70.16 | (>0.05) |
| **Worry dimension** | | | | | |
| Not recognising/realizing I am having a reaction | 71(45) | 56(36) | 30(19) | 77.89 vs.74.35 | (>0.05) |
| Not having food, fruit or juice with me | 73(47) | 56(35) | 28(18) | 78.58 vs.73.22 | (>0.05) |
| Feeling dizzy or passing out in public | 91(58) | 44(28) | 22(14) | 73.33 vs. 81.50 | (>0.05) |
| Having a reaction while asleep | 84(52) | 50(32) | 25(16) | 73.36 vs. 81.45 | (>0.05) |
| Embarrassing myself/family in social situations | 122(78) | 25(16) | 10(6) | 79.40 vs.71.92 | (>0.05) |
| Having a reaction while alone | 92(59) | 55(35) | 10(6) | 75.08 vs.78.75 | (>0.05) |
| **Appearing stupid or drunk** | **141(90)** | **14(9)** | **2(1)** | 80.76 vs. 69.78 | **(<0.05)** |
| Losing control | 95(60) | 53(34) | 9(6) | 79.75 vs. 71.37 | (>0.05) |
| No one being around to help me during a reaction | 84(54) | 58(37) | 15(9) | 76.15 vs.77.05 | (>0.05) |
| **Making a mistake/accident at school/work** | **130(83)** | **19(12)** | **8(5)** | 80.88 vs. 69.59 | **(>0.05)**† |
| **Getting a bad evaluation at school/work because something…** | **123(78)** | **20(13)** | **14(9)** | 87.48 vs.59.19 | **(<0.001)** |
| Having seizures or convulsions | 130(83) | 22(14) | 5(3) | 80.41 vs.70.33 | (>0.05) |
| Difficulty thinking clearly when responsible for others. | 95(57) | 49(31) | 18(12) | 77.68 vs. 74.64 | (>0.05) |
| Developing long term complications from freq.low blood | 115(73) | 32(21) | 10(6) | 78.93 vs.72.67 | (>0.05) |
| Feeling lightheaded or faint | 91(58) | 48(30) | 18(12) | 76.88 vs.75.91 | (>0.05) |
| **Having an insulin reactions** | **112(71)** | **36(23)** | **9(6)** | 81.97 vs.67.87 | **(<0.05)** |

† Marginal (0.56), scale 1&2 = "never do", 3 = "sometimes", 4 &5 = "often do". Significant differences in bold.

**Table 3** Fear of hypoglycemia, PAID, DSC, and MDI mean (and SDs) for the two types of diabetes

| | All types | Type 1 diabetes | Type 2 diabetes | *p*-value |
|---|---|---|---|---|
| Fear of hypoglycaemia (total) | 57.38 (12.34) | 59.02 (12.71) | 55.17 (11.23) | > 0.05 |
| Behavior dimension | 25.01 (6.43) | 25.42 (6.53) | 24.11 (6.26) | > 0.05 |
| Worry dimension | 33.37 (8.63) | 33.60 (9.08) | 31.06 (7.35) | >0 .05 |
| Diabetes self-care | 44.18 (9.05) | 43.10 (8.93) | 45.06 (8.93) | >0 .05 |
| PAID | 40.28 (18.62) | 39.72 (19.09) | 42.33 (17.81) | > 0.05 |
| Depression (MDI) | 29.44 (9.18) | 28.56 (9.86) | 31.18 (8.16) | >0 .05 |

The study looked at the associations between FoH and psychological constructs in the first model, and in the second and third model, the study looked at the associations between the two dimensions of FoH (behavior and worry) and a number of psychological constructs. In the first model, FoH was associated with increased diabetes care. Significant evidence shows that improved glycemic control i.e, lowering of average glucose, is associated with increased occurrence of hypoglycemia [19, 41]. The relationship between hypoglycemia and diabetes self-care particularly glycemic control is that of "you gain one and lose one." People with diabetes need to navigate their ship between two seamonsters, one named Scylla, the other Charybdis. Scylla is sitting on a rock (hyperglycemia), the other monster Charybdis creates a whirlpool (hypoglycemia).

Increased diabetes-specific distress (PAID) was also associated with increased FoH. People living with diabetes are often confronted with stressors that can affect diabetes care and contribute to FoH. Surprisingly, depression was not associated with FoH at least in this model. Of the controlled background variables, being young was associated with FoH. Our study confirms previous findings suggesting that younger age is associated with FoH [17, 20] although elsewhere older people showed more fear [15, 19, 42].

The behavior dimension of the FoH was only associated with diabetes self-care. However, among background variables, higher socioeconomic status and younger age of patients was associated with FoH. The behavior dimension of FoH involves crucial self-care activities useful for glycemic control. Perhaps patients from high SES engage in social activities that distract them from self-care activities such as drinking alcohol which has been found to be a risk factor. Moreover, the best way to control hypoglycemia is through a diet similar to that used to control diabetes mellitus: a reduction in simple sugars, a large intake of complex carbohydrates, and frequent feedings. It could be that those from high SES have easy access to candy, sodas, and even fruit juices (which manufacturers often sweeten with lots of sugar) all high in sugar and should be avoided. Future research should explore this association further.

Not surprising, the worry dimension of the FoH was associated with diabetes-specific distress and depressive symptoms. Hypoglycemia adversely alters mood, and recurrent hypoglycemia elevates anxiety and depression [43]. Depressive symptoms and selective serotonin reuptake inhibitors are associated with progressively increased risks of hypoglycemia [44].

An interesting pattern of association emerged from our data. The behavior dimension of the FoH was associated with more

**Table 4** Predictors of fear for hypoglycemia

| | Model 1: FoH total scale | | Model 2: FoH Behavior dimension | | Model 3: Worry dimension | |
|---|---|---|---|---|---|---|
| Variables | *Beta* | *p-value* | *Beta* | *p-value* | *Beta* | *p-value* |
| Age | -.26 | 0.02* | -.36 | 0.00*** | -.10 | 0.33 |
| Being female | .02 | 0.79 | -.06 | 0.47 | .08 | 0.33 |
| Having type 2 diabetes | .10 | 0.30 | .06 | 0.53 | -.18 | 0.04* |
| Socioeconomic status | .06 | 0.47 | .20 | 0.02* | -.07 | 0.41 |
| Body mass index | .14 | 0.17 | .07 | 0.49 | .14 | 0.14 |
| Diabetes self-care | .20 | 0.02* | .24 | 0.01** | .12 | 0.16 |
| Diabetes-specific emotional distress | .41 | 0.001*** | .15 | 0.13 | .46 | 0.001*** |
| Depressive symptoms | .19 | 0.17 | .09 | 0.36 | .21 | 0.02* |
| | $R^2$ = .27, Adj $R2$ = .22 | | $R^2$ = .18, Adj $R2$ = .12 | | $R^2$ = .33, Adj $R2$ = .28 | |

*$p$ <0.05, **$p$ <0.01, ***$p$ < 0.001

constructs such as diabetes self-care activities and socioeconomic status whereas the worry dimension relates to more psychological constructs such as depression and diabetes specific distress. Young people were more likely to have fear of hypoglycemia based on the behavior dimensions of the scale while individuals with T2DM (all adults in this study) were likely to have FoH based on the worry dimension of the scale. At the item level, having T1DM compared to T2DM was associated with carrying fast acting sugar, appearing stupid or drunk, making a mistake or having an accident at school or work and getting bad evaluation at school because of something that happened when sugar was low. These results were not surprising given that T1DM is the one which is more prone to hypoglycemia and has more self-care demands than T2DM. Moreover, the developmental age of individuals with T1DM are the ones below 18 years of age (also the case in this study) which complicates the balance between diabetes self-care and avoiding hypoglycemia.

The strength of the study is that we were able to assess FoH in both T1DM and T2DM. Most studies examine the two types of diabetes separately making it difficult to make comparison. Limitations of the study are that we do not know the refusal rate; therefore, there might have been a selection-bias. The sample size was also small due to recruitment difficulties; as a consequence, probability sampling could not be used. Another limitation is that data on HbA1c, type of medication for T2DM patients (oral or insulin), and number of severe and frequency of hypoglycemia in the past year were lacking. However, despite these limitations, this study still remains important as it shed lights on psychosocial factors associated with FoH in a country with little information on FoH in diabetes patients. Therefore, this study will suggest directions for future studies on the mechanism influencing FoH in Zambia and other SSA countries. Future studies on fear of hypoglycemia should be complimented by interviews to individuals with diabetes and adults living with individuals with diabetes.

In conclusion, FoH was common in individuals with diabetes in Zambia. FoH is positively associated with diabetes specific emotional distress and diabetes self-care. Therefore, physicians need to assess fear of hypoglycemia based on its dimensions since they seem to be associated with demographic characteristics and psychosocial issues differently. Physician need to consider depression, self-care, diabetes-specific distress, younger age, higher SES, and T1DM when intervening on fear of hypoglycemia.

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**Authors' contributions** GH collected data, analyzed, and drafted the manuscript. AA verified analysis and reviewed the manuscript. FV and FP reviewed and approved the manuscript.

## Compliance with ethical standards

**Competing interests** The authors declare that they have no conflict of interest.

The study obtained consent from adults participants and assent from children after their guardians consented for their participation.

**Ethical approval and consent** The study was approved by the ethics committee of the School of Humanities and Social Sciences, University of Zambia on 29th April, 2011 (reference number IRB: 00006464, IORG: 005376). The study only used data from participants that consented to participate in the study. Assent was obtained from participants younger than 18 years old.

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