Original article

Attitudes and behaviors toward hypoglycemia among adults with type 2 diabetes at Hue University of Medicine and Pharmacy Hospital

Nguyen Thi To[1], Le Van An[2], Dao Thi Thuy Hien[1],
Nguyen Thi Hoai Phong[1], Duong Thi Ngoc Lan[2*]
[1]Hue University of Medicine and Pharmacy Hospital
[2]Hue University of Medicine and Pharmacy, Hue University

***Corresponding author:** Duong Thi Ngoc Lan; email: dtnlan@huemed-univ.edu.vn
Received: 03/09/2026; **Accepted**: 25/09/2026; **Published:** 15/11/2026
DOI:10.34071/jmp.2026.S-3.15

Abstract

Background: Hypoglycemia is a common complication of diabetes treatment and may influence not only clinical outcomes but also patients' worries, avoidance behaviors, and confidence in managing hypoglycemia. This study assessed hypoglycemia-related attitudes and behaviors using the Hypoglycemic Attitudes and Behavior Scale (HABS) and examined associated factors.

Materials and methods: An analytical cross-sectional study was conducted among 179 adults with type 2 diabetes receiving care at Hue University of Medicine and Pharmacy Hospital. Data were collected by structured interview and medical record review. HABS contains 14 items in three domains: Avoidance, Anxiety, and Confidence. Univariable and multivariable linear regression analyses were performed for the total HABS score and domain scores.

Results: The mean age was 64.02 ± 13.60 years, and 57.0% were women. Hypoglycemia during the previous 6 months was reported by 55.3%, severe hypoglycemia by 24.6%, and emergency care/hospitalization due to hypoglycemia by 14.5%. The mean total HABS score was 2.59 ± 0.37; domain scores were 2.97 ± 0.53 for Avoidance, 2.72 ± 0.62 for Anxiety, and 3.84 ± 0.45 for Confidence. The multivariable model explained 50.8% of the variance in total HABS score. Recent hypoglycemia (B = 0.216; $p < 0.001$) and severe hypoglycemia (B = 0.306; $p < 0.001$) were associated with higher total HABS scores, while previous hypoglycemia education was associated with a lower score (B = -0.226; $p < 0.001$). Severe hypoglycemia was adversely associated with all three HABS domains. Previous hypoglycemia education was associated with lower Anxiety and higher Confidence.

Conclusion: Recent and severe hypoglycemic experiences remained associated with more adverse hypoglycemia-related attitudes and behaviors after adjustment. Hypoglycemia education was associated with lower Anxiety and higher Confidence. These findings support incorporating behavioral assessment and hypoglycemia education and counseling into diabetes care, while the cross-sectional design precludes causal inference.

Keywords: *type 2 diabetes mellitus; hypoglycemia; Hypoglycemic Attitudes and Behavior Scale; patient education.*

1. INTRODUCTION

Diabetes mellitus is a major noncommunicable disease and continues to impose a substantial global burden of morbidity, mortality, and healthcare costs [1]. Hypoglycemia is a frequent adverse event during diabetes treatment, particularly among people receiving insulin or glucose-lowering agents with a high risk of hypoglycemia. The American Diabetes Association (ADA) classifies hypoglycemia as level 1 when glucose is < 70 mg/dL (3.9 mmol/L) and ≥ 54 mg/dL (3.0 mmol/L), level 2 when glucose is < 54 mg/dL (3.0 mmol/L), and level 3 when an event causes altered mental and/or physical status requiring assistance from another person [2].

Beyond acute clinical consequences, hypoglycemia may substantially affect psychological well-being and self-management. Previous hypoglycemic experiences, particularly severe or recurrent episodes, may increase worry, fear, avoidance behaviors, and perceived loss of safety [3]. Some patients intentionally maintain glucose above target, eat more than necessary, reduce treatment, or restrict activities to avoid hypoglycemia. Conversely, confidence in recognizing and managing hypoglycemia may support safer self-management [4-6].

The 14-item Hypoglycemic Attitudes and Behavior Scale (HABS), developed by Polonsky et al., assesses

three complementary domains: Anxiety, Avoidance, and Confidence [4]. Although hypoglycemia-related psychological and behavioral responses have been increasingly recognized, evidence from Vietnam remains limited. In particular, little is known about anxiety, avoidance behaviors, and confidence in managing hypoglycemia, as assessed by the HABS, and the factors associated with these dimensions among Vietnamese adults with type 2 diabetes. Therefore, this study aimed to (1) describe attitudes and behaviors toward hypoglycemia among adults with type 2 diabetes at Hue University of Medicine and Pharmacy Hospital and (2) identify factors associated with the total HABS score and its domains.

2. MATERIALS AND METHODS

2.1. Study design and participants

This analytical cross-sectional study recruited participants from May to September 2026 at the Department of General Internal Medicine–Endocrinology–Rheumatology and the Department of Cardiology, Hue University of Medicine and Pharmacy Hospital. Eligible participants were adults aged ≥18 years with type 2 diabetes mellitus who were receiving treatment or follow-up at either department. Participants were required to be able to communicate, understand and complete the questionnaire, and provide informed consent. Patients with cognitive or communication impairments that precluded questionnaire completion and those with severe acute conditions preventing participation in the interview were excluded.

Sample size: Sample size adequacy for multiple linear regression was assessed using Green's rule of thumb, $N \geq 50 + 8$ m [7]. Based on 15 candidate predictors identified a priori from previous evidence, the study objectives, and their clinical relevance to hypoglycemia-related attitudes and behaviors, this rule suggested a sample of approximately 170 participants. Because some categorical predictors required dummy coding in the regression analyses, this calculation was considered a pragmatic guide rather than a definitive parameter-based sample-size requirement. To account for incomplete responses, the target sample was increased by approximately 5%, resulting in a final sample of 179 participants.

2.2. Data collection and variables

Data were obtained through structured face-to-face interviews and review of medical records, prescriptions, and laboratory results. Variables included age, sex, education, occupation, residence, living arrangement, diabetes duration, treatment regimen, HbA1c, chronic complications, hypoglycemia during the previous 6 months, severe hypoglycemia, emergency care/hospitalization due to hypoglycemia, home glucose monitoring, glucose-monitoring frequency, previous hypoglycemia education and its sources, safety-sensitive occupation, physical activity, and irregular meals.

Hypoglycemia was defined according to the American Diabetes Association criteria. Severe hypoglycemia was defined as level 3 hypoglycemia, characterized by altered mental and/or physical status requiring assistance from another person for recovery, irrespective of glucose level [2]. Hypoglycemia during the previous 6 months and severe hypoglycemia were assessed by structured interview with the participant or caregiver and cross-checked against available self-monitoring glucose records and medical records when available. Emergency care or hospitalization due to hypoglycemia was defined as at least one hypoglycemic event requiring evaluation at an emergency department or hospital admission during the previous 6 months and was ascertained by interview and medical record review when available. These three variables represented related but clinically distinct aspects of hypoglycemia burden: occurrence, severity requiring assistance, and healthcare utilization, respectively. They were not mutually exclusive, as a single severe hypoglycemic event could contribute to more than one of these variables. Home glucose monitoring referred to capillary glucose measurement at home by the patient or caregiver. Glucose-monitoring frequency included measurements at home and/or healthcare facilities and was categorized as < 1/month, 1/month, or > 1/month. Hypoglycemia education was recorded when participants had received information or guidance on recognition, risk situations, prevention, and/or treatment of hypoglycemia. A safety-sensitive occupation was defined as work requiring sustained alertness, cognitive function, or motor ability, in which hypoglycemia could pose a risk to the participant or others, such as driving, operating machinery, or working at height. Physical activity was defined as meeting the recommended level of at least 150 minutes per week of moderate-to-vigorous aerobic activity, performed over at least 3 days per week, with no more than 2 consecutive days without activity [8]. Irregular meals were defined as skipping or delaying meals.

2.3. HABS measurement

HABS comprises 14 items rated from 1 (strongly disagree) to 5 (strongly agree). Avoidance includes items 1, 3, 10, and 13; Confidence includes items 4, 6, 8, 11, and 14; and Anxiety includes items 2, 5, 7, 9,

and 12 [4]. Each domain score is the mean of its items. Higher Avoidance and Anxiety scores indicate more avoidance and anxiety, whereas higher Confidence indicates greater confidence. For the total HABS score, Confidence items were reverse-scored (6 - original score) before averaging all 14 items; a higher total score therefore indicates more adverse hypoglycemia-related attitudes and behaviors. The original English HABS developed by Polonsky et al. [4] was translated into Vietnamese using a forward–backward translation and cultural adaptation process [9]. The forward-translated version was back-translated into English and compared with the original version to identify discrepancies. The Vietnamese version was subsequently reviewed by experts experienced in diabetes care for semantic equivalence, clarity, and cultural appropriateness. The final draft was pilot-tested in 30 adults with type 2 diabetes to assess comprehensibility and feasibility before its use in the main study. Internal consistency was evaluated in the main study sample (n = 179) using Cronbach's alpha. Cronbach's alpha was 0.861 for the total HABS, 0.702 for Anxiety, 0.763 for Avoidance, and 0.720 for Confidence.

2.4. Statistical analysis

Data were analyzed using SPSS version 20.0. Categorical variables are reported as n (%). Continuous variables are reported as mean ± standard deviation (SD) or median (Q1-Q3), as appropriate. HABS total and domain scores are additionally reported with medians and ranges. Univariable linear regression examined associations with total HABS score. Variables with $p < 0.20$ in univariable analyses and/or those considered clinically or theoretically relevant based on previous evidence and the study objectives were considered for multivariable analysis. Separate multivariable linear regression models were fitted for total HABS, Avoidance, Anxiety, and Confidence. Recent hypoglycemia, severe hypoglycemia, and emergency care/hospitalization due to hypoglycemia were included simultaneously in the multivariable models. Multicollinearity was assessed using variance inflation factors (VIF), and influential observations using Cook's distance. Statistical significance was set at $p < 0.05$.

2.5. Ethics

The study was conducted after approval by the Biomedical Research Ethics Committee of Hue University of Medicine and Pharmacy, Hue University (Approval No. H2026/255, dated 13th May 2026). Participation was voluntary, and all collected information was coded and kept confidential.

3. RESULTS

3.1. Sociodemographic characteristics of participants

Table 1. Sociodemographic characteristics of participants (n = 179)

Characteristics	n (%) or Mean ± SD
Age (years)	64.02 ± 13.60
Sex	
Male	77 (43.0)
Female	102 (57.0)
Education level	
No schooling	27 (15.1)
Primary school	54 (30.2)
Lower secondary school	52 (29.1)
Upper secondary school	25 (14.0)
Vocational/college/university	21 (11.7)
Occupation	
Agriculture/forestry/fishery	26 (14.5)
Worker	12 (6.7)
Civil servant/public employee	2 (1.1)

Homemaker	34 (19.0)
Trade/services	16 (8.9)
Retired	21 (11.7)
Other	68 (38.0)
Residence	
Rural	88 (49.2)
Urban	91 (50.8)
Living arrangement	
Living alone	16 (8.9)
Living with family	163 (91.1)

The mean age of participants was 64.02 ± 13.60 years, and 57.0% were women. Most participants had a lower secondary education or below, 91.1% lived with their families, and the proportions living in rural and urban areas were similar.

3.2. Clinical and hypoglycemia-related characteristics

Table 2. Clinical and hypoglycemia-related characteristics of participants (n = 179)

Characteristics	n (%) or Median (Q1–Q3)
Duration of diabetes (years)	5 (3 – 10)
Treatment regimen	
Oral glucose-lowering drugs only	40 (22.3)
Insulin only	79 (44.1)
Oral drugs + insulin	60 (33.5)
Hypoglycemia in the previous 6 months	
Yes	99 (55.3)
No	80 (44.7)
Severe hypoglycemia	
Yes	44 (24.6)
No	135 (75.4)
Emergency care/hospitalization due to hypoglycemia	
Yes	26 (14.5)
No	153 (85.5)
Home blood glucose monitoring	
Yes	69 (38.5)
No	110 (61.5)
Frequency of blood glucose measurement	
< 1 time/month	33 (18.4)
1 time/month	100 (55.9)
> 1 time/month	46 (25.7)
Received hypoglycemia education/counseling	
Yes	121 (67.6)
No	58 (32.4)
Source of hypoglycemia education	
Physician	85 (47.5)
Nurse	69 (38.5)

Educational materials/media	46 (25.7)
Self-directed information seeking	35 (19.6)
HbA1c (%)	8.75 (7.08 – 10.93)
Chronic diabetes complications	
Yes	118 (65.9)
No	61 (34.1)
Safety-sensitive occupation	
Yes	22 (12.3)
No	157 (87.7)
Physical activity	
Yes	79 (44.1)
No	100 (55.9)
Irregular meals	
Yes	57 (31.8)
No	122 (68.2)

The median duration of diabetes was 5 years (3 – 10), and the median HbA1c was 8.75% (7.08 – 10.93). Overall, 55.3% of participants had experienced hypoglycemia during the previous 6 months, 24.6% had experienced severe hypoglycemia, and 67.6% had received hypoglycemia education or counseling.

3.3. Hypoglycemic attitudes and behaviors

Table 3. HABS total and domain scores (n = 179)

HABS domains	Mean ± SD	Median	Min–Max
Avoidance	2.97 ± 0.53	3.00	2.00 – 4.25
Confidence	3.84 ± 0.45	3.80	2.60 – 5.00
Anxiety	2.72 ± 0.62	2.80	1.40 – 4.60
Total HABS	**2.59 ± 0.37**	**2.57**	**1.86 – 3.64**

The mean total HABS score was 2.59 ± 0.37. Among the three domains, Confidence had the highest mean score (3.84 ± 0.45), followed by Avoidance (2.97 ± 0.53) and Anxiety (2.72 ± 0.62).

3.4. Factors associated with total HABS score

Table 4. Univariable linear regression analysis of factors associated with total HABS score

Factors	B	95% CI	p
Age (years)	0.005	0.001 to 0.009	**0.027**
Sex			
Male	Ref.		
Female	0.057	−0.054 to 0.168	0.313
Education level			0.495*
Vocational/college/university	Ref.		
No schooling	0.028	−0.187 to 0.243	0.795
Primary school	0.100	−0.090 to 0.290	0.301
Lower secondary school	0.038	−0.153 to 0.229	0.693
Upper secondary school	−0.060	−0.278 to 0.159	0.591

Occupation			0.761*
Other	Ref.		
Agriculture/forestry/fishery	−0.037	−0.208 to 0.134	0.672
Worker	−0.083	−0.315 to 0.150	0.484
Civil servant/public employee	−0.380	−0.913 to 0.153	0.161
Homemaker	0.013	−0.143 to 0.169	0.874
Trade/services	−0.005	−0.212 to 0.201	0.960
Retired	0.059	−0.127 to 0.244	0.534
Residence			
Rural	Ref.		
Urban	0.066	−0.044 to 0.177	0.235
Living arrangement			
Living alone	Ref.		
Living with family	−0.036	−0.229 to 0.158	0.718
Duration of diabetes (years)	0.003	−0.005 to 0.011	0.448
Treatment regimen			**0.001***
Oral drugs + insulin	Ref.		
Oral drugs only	−0.220	−0.365 to −0.074	**0.003**
Insulin only	0.044	−0.078 to 0.166	0.478
Hypoglycemia in previous 6 months (Yes vs No)	0.415	0.322 to 0.507	**< 0.001**
Severe hypoglycemia (Yes vs No)	0.479	0.372 to 0.586	**< 0.001**
Emergency care/hospitalization due to hypoglycemia (Yes vs No)	0.427	0.284 to 0.571	**< 0.001**
Home blood glucose monitoring (Yes vs No)	−0.026	−0.139 to 0.088	0.657
Frequency of blood glucose measurement			0.929*
> 1 time/month	Ref.		
< 1 time/month	0.023	−0.146 to 0.192	0.787
1 time/month	0.025	−0.107 to 0.157	0.708
Hypoglycemia education (Yes vs No)	−0.152	−0.268 to −0.036	**0.010**
HbA1c (%)	−0.012	−0.031 to 0.007	0.221
Chronic complications (Yes vs No)	−0.031	−0.148 to 0.085	0.595
Safety-sensitive occupation (Yes vs No)	−0.071	−0.239 to 0.097	0.406
Physical activity (Yes vs No)	0.043	−0.068 to 0.154	0.448
Irregular meals (Yes vs No)	−0.021	−0.140 to 0.098	0.728

B, unstandardized regression coefficient; CI, confidence interval; Ref., reference category.

***** *Overall p-value for the categorical variable.*

Univariable analysis showed that age, treatment regimen, hypoglycemia in the previous 6 months, severe hypoglycemia, emergency care/hospitalization due to hypoglycemia, and hypoglycemia education were significantly associated with the total HABS score ($p < 0.05$).

Table 5. Multivariable linear regression analysis of factors associated with total HABS score

Factors	B	95% CI	p	VIF
Age (years)	0.000	−0.003 to 0.004	0.761	1.087
Treatment regimen				
Oral drugs + insulin	Ref.			
Oral drugs only	−0.139	−0.249 to −0.030	**0.013**	1.337
Insulin only	0.005	−0.086 to 0.097	0.906	1.334
Hypoglycemia in previous 6 months (Yes vs No)	0.216	0.121 to 0.311	**< 0.001**	1.434
Severe hypoglycemia (Yes vs No)	0.306	0.181 to 0.432	**< 0.001**	1.884
Emergency care/hospitalization due to hypoglycemia (Yes vs No)	0.135	−0.004 to 0.274	0.057	1.538
Hypoglycemia education (Yes vs No)	−0.226	−0.314 to −0.138	**< 0.001**	1.085

Model: $R^2 = 0.508$; adjusted $R^2 = 0.488$; $F(7,171) = 25.198$; $p < 0.001$.

B, unstandardized regression coefficient; CI, confidence interval; VIF, variance inflation factor; Ref., reference category. Treatment-regimen coefficients are comparisons with the reference group (oral drugs + insulin); an overall adjusted p-value for the categorical variable was not estimated.

The model explained 50.8% of the variance in total HABS score. Recent hypoglycemia, severe hypoglycemia, and previous hypoglycemia education were associated with total HABS score after adjustment. For treatment regimen, participants receiving oral drugs only had a lower total HABS score than those receiving combined oral drugs and insulin (B = −0.139; 95% CI: −0.249 to −0.030; p = 0.013). This coefficient represents a comparison with the reference category and should not be interpreted as an overall effect of treatment regimen. All VIF values were < 2.

3.5. Factors associated with HABS domains

Table 6. Multivariable linear regression analyses of factors associated with HABS domains

Factors	Avoidance B	95% CI	p	Anxiety B	95% CI	p	Confidence B	95% CI	p
Age (years)	0.003	−0.003 to 0.008	0.300	0.001	−0.005 to 0.006	0.835	0.002	−0.003 to 0.006	0.513
Treatment regimen									
Oral drugs + insulin	Ref.			Ref.			Ref.		
Oral drugs only	−0.192	−0.385 to 0.002	0.053	−0.286	−0.486 to −0.085	**0.005**	−0.049	−0.216 to 0.119	0.566
Insulin only	0.082	−0.081 to 0.244	0.321	−0.039	−0.207 to 0.129	0.648	0.011	−0.129 to 0.151	0.874
Hypoglycemia in previous 6 months (Yes vs No)	0.213	0.044 to 0.381	**0.014**	0.401	0.227 to 0.575	**< 0.001**	−0.033	−0.178 to 0.112	0.655
Severe hypoglycemia (Yes vs No)	0.250	0.028 to 0.473	**0.028**	0.353	0.123 to 0.584	**0.003**	−0.304	−0.496 to −0.112	**0.002**
Emergency care/ hospitalization due to hypoglycemia (Yes vs No)	0.089	−0.157 to 0.335	0.476	0.231	−0.024 to 0.485	0.075	−0.076	−0.288 to 0.136	0.478

Hypoglycemia education (Yes vs No)	−0.094	−0.250 to 0.061	0.234	−0.187	−0.348 to −0.026	**0.023**	0.371	0.237 to 0.505	**<0.001**

Model statistics: Avoidance: R^2 = 0.238; adjusted R^2 = 0.207; F = 7.644; p < 0.001. Anxiety: R^2 = 0.404; adjusted R^2 = 0.379; F = 16.546; p < 0.001. Confidence: R^2 = 0.215; adjusted R^2 = 0.183; F = 6.678; p < 0.001. VIF range = 1.085 – 1.884.

B, unstandardized regression coefficient; CI, confidence interval; Ref., reference category. Higher Confidence scores indicate greater confidence, whereas higher Avoidance and Anxiety scores indicate more adverse hypoglycemia-related attitudes and behaviors.

Severe hypoglycemia was adversely associated with all three HABS domains. Hypoglycemia in the previous 6 months was associated with higher Avoidance and Anxiety, whereas previous hypoglycemia education was associated with lower Anxiety and higher Confidence (p < 0.05).

4. DISCUSSION

This study provides a detailed description of hypoglycemia-related attitudes and behaviors among 179 adults with type 2 diabetes and examines factors associated with the HABS total and domain scores. The main findings were that Confidence was relatively high, while Anxiety and Avoidance remained present; recent and severe hypoglycemia were consistently associated with more adverse HABS profiles; and previous hypoglycemia education was associated with a lower total HABS score, lower Anxiety, and higher Confidence.

The study population was relatively old (mean age 64.02 years), and more than three quarters were treated with insulin alone or insulin combined with oral agents. More than half reported hypoglycemia in the previous 6 months, 24.6% reported severe hypoglycemia, and 14.5% had required emergency care or hospitalization. These proportions underscore the clinical relevance of hypoglycemia in this sample. Edridge et al. reported substantial hypoglycemia burden among people with type 2 diabetes, particularly insulin-treated patients, although direct comparison is limited by differences in populations, definitions, and recall periods [10]. The median HbA1c was 8.75%, illustrating that elevated average glycemia and hypoglycemic episodes can coexist. HbA1c alone does not capture glycemic variability or episodic hypoglycemia.

Confidence was comparatively high. For example, 65.4% agreed or strongly agreed that they could recognize and treat hypoglycemia before glucose became too low; 68.2% reported confidence in staying safe during exercise, and 68.1% in public. Gilbert et al. reported a baseline Confidence score of 3.70 ± 0.85 among participants with type 2 diabetes using insulin, somewhat lower than in the present study [11]. At the same time, anxiety-related concerns were also observed: 20.1% feared passing out in public, 18.4% reported worry severe enough to interfere with enjoyment, 18.5% feared injury to themselves or others, and 21.3% limited travel away from home. These findings support the concept that confidence and fear-related responses can coexist rather than simply representing opposite ends of one dimension.

The multivariable model for total HABS score explained 50.8% of the variance. Recent hypoglycemia was associated with a 0.216-point higher total score, and severe hypoglycemia with a 0.306-point higher score. These findings are consistent with the original HABS study, in which greater Anxiety and Avoidance were associated with more hypoglycemic experiences and poorer psychological outcomes [4], and with systematic reviews showing that severe hypoglycemia is associated with greater fear of hypoglycemia and poorer psychological well-being [2, 12]. A severe event may produce a sense of loss of control and threat to personal safety, which may subsequently increase vigilance, worry, and protective behaviors.

Severe hypoglycemia showed the most consistent adverse pattern across individual domains: it was associated with higher Avoidance (B = 0.250), higher Anxiety (B = 0.353), and lower Confidence (B = -0.304). Recent hypoglycemia was also associated with higher Avoidance and Anxiety. These domain-specific findings are important because a total score alone may obscure clinically distinct responses. A patient may be highly confident in recognizing symptoms while simultaneously adopting excessive avoidance strategies or experiencing substantial anxiety.

After adjustment, participants receiving oral drugs alone had a 0.139-point lower total HABS score and a 0.286-point lower Anxiety score than those receiving combined oral drugs and insulin. These coefficients represent comparisons with the reference treatment category rather than an overall effect of treatment regimen. The observed differences may reflect

variation in perceived hypoglycemia risk, treatment complexity, or disease severity. However, the study did not capture individual oral drug classes, insulin doses, or regimen complexity in sufficient detail; therefore, these associations should not be interpreted as evidence that all oral agents carry lower hypoglycemia risk or that treatment regimen directly causes the observed attitudes.

A clinically relevant finding was the association between previous hypoglycemia education/counseling and HABS outcomes. Participants who had received hypoglycemia education/counseling had a 0.226-point lower total HABS score, 0.187-point lower Anxiety, and 0.371-point higher Confidence after adjustment. Previous studies indicate that educational and self-management interventions can support hypoglycemia prevention and management [13, 14] and may reduce fear of hypoglycemia, although much of the intervention evidence comes from type 1 diabetes [15]. In the present study, however, the education variable only recorded whether participants had previously received information or guidance on hypoglycemia; the structure, content, intensity, timing, and quality of education were not assessed. Therefore, these findings should not be interpreted as evidence of the effect of a structured education program, and the cross-sectional design precludes causal inference.

Several variables, including sex, education level, occupation, residence, living arrangement, diabetes duration, HbA1c, chronic complications, home glucose monitoring, monitoring frequency, physical activity, and irregular meals, were not significantly associated with total HABS score in univariable analyses. Age was significant in univariable analysis but not after adjustment. In this study, HbA1c was not significantly associated with total HABS score.

These findings have practical implications. Assessment after recent or severe hypoglycemia should extend beyond recurrence risk to include worry, avoidance behaviors, and confidence in self-management. Education should address symptom recognition, glucose confirmation when feasible, appropriate treatment, prevention during exercise or travel, and excessive protective behaviors such as intentional hyperglycemia or unnecessary carbohydrate intake. The HABS domains may help clinicians identify different behavioral needs and guide patient-centered discussions.

Strengths and limitations

This study assessed both the total HABS score and all three domains and included detailed item-level and regression analyses. Nevertheless, the cross-sectional design precludes causal inference. Several variables, including hypoglycemia history and behaviors, were self-reported and may be affected by recall or reporting bias. Recent hypoglycemia, severe hypoglycemia, and emergency care or hospitalization due to hypoglycemia may also overlap clinically, because a single severe event could be recorded as recent hypoglycemia and could also result in emergency care or hospitalization. These variables were retained to represent different clinical dimensions of hypoglycemia burden, but their regression coefficients should be interpreted cautiously. Although all VIF values were <2 and did not indicate substantial statistical multicollinearity, this does not eliminate the possibility of clinically meaningful overlap between these events, which may have influenced the estimated associations. Glucose-monitoring frequency combined measurements performed at home and at healthcare facilities because these settings were not recorded separately, limiting the ability to distinguish self-monitoring from facility-based testing. The single-center setting limits generalizability. Detailed glucose-lowering drug classes, insulin doses, glucose variability, and additional psychosocial factors were not fully assessed. Multiple analyses of the total HABS score, domain scores, and individual items may have increased the risk of type I error; therefore, domain- and item-level findings should be interpreted cautiously. Finally, HABS has no established cutoff values for classifying low, moderate, or high levels; scores should therefore be interpreted as continuous measures.

5. CONCLUSION

Among 179 adults with type 2 diabetes, the mean total HABS score was 2.59 ± 0.37; Confidence was 3.84 ± 0.45, Avoidance 2.97 ± 0.53, and Anxiety 2.72 ± 0.62. Recent hypoglycemia, severe hypoglycemia, and previous hypoglycemia education were associated with total HABS score after adjustment. Compared with participants receiving combined oral drugs and insulin, those receiving oral drugs only had a lower total HABS score; this finding represents a comparison with the reference treatment category rather than an overall effect of treatment regimen. Severe hypoglycemia was adversely associated with all three HABS domains, while previous hypoglycemia education was associated with lower Anxiety and higher Confidence.

Practice implications

Patients with recent or severe hypoglycemia should be assessed for hypoglycemia-related anxiety, avoidance behaviors, and reduced confidence. Hypoglycemia education and counseling should emphasize recognition, prevention, and appropriate treatment, particularly for insulin-treated patients and those with previous hypoglycemic events. Multicenter and interventional studies are needed to evaluate these relationships further and determine whether targeted educational interventions improve HABS outcomes.

Conflict of interest

The authors declare no conflicts of interest.

REFERENCES

1. International Diabetes Federation. IDF Diabetes Atlas. 11th ed. Brussels: International Diabetes Federation; 2025.

2. American Diabetes Association Professional Practice Committee for Diabetes. 6. Glycemic goals, hypoglycemia, and hyperglycemic crises: Standards of Care in Diabetes—2026. Diabetes Care. 2026;49(Suppl 1):S132-S149. doi:10.2337/dc26-S006.

3. Hendrieckx C, Ivory N, Singh H, Frier BM, Speight J. Impact of severe hypoglycaemia on psychological outcomes in adults with Type 2 diabetes: a systematic review. Diabet Med. 2019;36(9):1082-1091. doi:10.1111/dme.14067.

4. Polonsky WH, Fisher L, Hessler D, Edelman SV. Identifying the worries and concerns about hypoglycemia in adults with type 2 diabetes. J Diabetes Complications. 2015;29(8):1171-1176. doi:10.1016/j.jdiacomp.2015.08.002.

5. Polonsky WH, Fisher L, Hessler D, Liu J, Fan L, McAuliffe-Fogarty AH. Worries and concerns about hypoglycemia in adults with type 1 diabetes: an examination of the reliability and validity of the Hypoglycemic Attitudes and Behavior Scale (HABS). J Diabetes Complications. 2020;34(7):107606. doi:10.1016/j.jdiacomp.2020.107606.

6. Polonsky WH, Guzman SJ, Fisher L. The hypoglycemic fear syndrome: understanding and addressing this common clinical problem in adults with diabetes. Clin Diabetes. 2023;41(4):502-509. doi:10.2337/cd22-0131.

7. Green SB. How many subjects does it take to do a regression analysis? Multivariate Behav Res. 1991;26(3):499-510. doi:10.1207/s15327906mbr2603_7.

8. American Diabetes Association Professional Practice Committee. 5. Facilitating positive health behaviors and well-being to improve health outcomes: Standards of Care in Diabetes—2025. Diabetes Care. 2025;48(Suppl 1):S86–S127. doi:10.2337/dc25-S005.

9. World Health Organization. Process of translation and adaptation of instruments. Geneva: World Health Organization; 2016.

10. Edridge CL, Dunkley AJ, Bodicoat DH, Rose TC, Gray LJ, Davies MJ, et al. Prevalence and incidence of hypoglycaemia in 532,542 people with type 2 diabetes on oral therapies and insulin: a systematic review and meta-analysis of population based studies. PLoS One. 2015;10(6):e0126427. doi:10.1371/journal.pone.0126427.

11. Gilbert TR, Noar A, Blalock O, Polonsky WH. Change in hemoglobin A1c and quality of life with real-time continuous glucose monitoring use by people with insulin-treated diabetes in the Landmark study. Diabetes Technol Ther. 2021;23(S1):S35-S39. doi:10.1089/dia.2020.0666.

12. Zhang Y, Li S, Zou Y, Wu X, Bi Y, Zhang L, et al. Fear of hypoglycemia in patients with type 1 and 2 diabetes: a systematic review. J Clin Nurs. 2021;30(1-2):72-82. doi:10.1111/jocn.15538.

13. Iqbal A, Heller S. The role of structured education in the management of hypoglycaemia. Diabetologia. 2018;61(4):751-760. doi:10.1007/s00125-017-4334-z.

14. Yorke E, Atiase Y. Impact of structured education on glucose control and hypoglycaemia in Type-2 diabetes: a systematic review of randomized controlled trials. Ghana Med J. 2018;52(1):41-60. doi:10.4314/gmj.v52i1.8.

15. Chatwin H, Broadley M, de Galan B, Bazelmans E, Speight J, Pouwer F, et al. Effectiveness of educational and behavioural interventions for reducing fear of hypoglycaemia among adults with type 1 diabetes: systematic review and meta-analyses. Diabet Med. 2023;40(5):e15071. doi:10.1111/dme.15071.