

Predictive factors of fear of hypoglycemia in type 2 diabetes patients; an analytical study on the role of hypoglycemic episodes and their interpretation



Hamid Reza Salimi¹ , Fatemeh Zarei¹, Movahdeh Hosseinali¹, Farnoosh Rashvand^{2,3*} 

¹Students' Research Committee, Qazvin University of Medical Sciences, Qazvin, Iran

²Social Determinants of Health Research Center, Research Institute for Prevention of Non-Communicable Diseases, Qazvin University of Medical Sciences, Qazvin, Iran

³Department of Nursing, School of Nursing and Midwifery, Qazvin University of Medical Science, Qazvin, Iran

Correspondence to:

Farnoosh Rashvand,
Email: f.rashvand@qums.ac.ir

Received: 6 Aug. 2024

Accepted: 28 Sep. 2024

ePublished: 23 Oct. 2024

Keywords: Hypoglycemia, Type 2 diabetes, Hypoglycemic episodes, Predictive factors

Abstract

Introduction: Fear of hypoglycemia (FoH) is a prevalent psychosocial issue among individuals with type 2 diabetes, often leading to maladaptive behaviors such as elevated blood glucose levels, reduced physical activity, and inappropriate insulin management.

Objectives: The current study seeks to identify predictors of this fear and examine its interpretative role in managing diabetes, emphasizing the necessity for targeted interventions that address both the psychological and physiological aspects of diabetes care.

Patients and Methods: This descriptive-analytical study involved 260 patients with type 2 diabetes receiving treatment at Velayat clinic and Bu Ali hospital in Qazvin city. Data was collected using a demographic questionnaire and the hypoglycemia fear survey II (HFS-II). The demographic questionnaire gathered information on participants' age, gender, marital status, educational background, occupation, duration of diabetes, treatment modality, co-existing medical conditions, and religious affiliation. To assess the FoH, the HFS-II was employed, focusing on a worry dimension. To explore the factors affecting the FoH univariate and multivariate linear regression was used.

Results: The analysis of predictors of FoH in patients with type 2 diabetes revealed several significant associations, including a positive correlation between the number of hypoglycemic episodes in the past six months and fear levels. Educational attainment influenced fear, with those having academic education reporting lower fear compared to those with guidance education. Economic status revealed that patients in poorer conditions experienced higher fear levels than those with moderate status. Insulin treatment was associated with greater fear compared to oral tablet treatment, while the presence of long-term diabetes complications and a history of hypoglycemia were linked to increased fear.

Conclusion: In conclusion, the analysis of predictors of FoH in patients with type 2 diabetes highlights the need for a comprehensive, patient-centered approach that considers demographic, clinical, and psychosocial factors. Healthcare providers should tailor interventions to individual patient characteristics, provide targeted education and support, and address both physiological and psychological aspects of diabetes management to effectively mitigate the FoH and improve the overall quality of life for patients with type 2 diabetes.



Citation: Salimi HR, Zarei F, Hosseinali M, Rashvand F. Predictive factors of fear of hypoglycemia in type 2 diabetes patients; an analytical study on the role of hypoglycemic episodes and their interpretation. J Prev Epidemiol. 2025;10(1):e38255. doi: 10.34172/jpe.2025.38255.

Introduction

Fear of hypoglycemia (FoH) is a prevalent psychosocial concern among individuals with diabetes, particularly those with type 2 diabetes (1). Fear of hypoglycemia is a significant psychological concern that manifests in various individuals with diabetes, including patients, their family members, caregivers, and spouses, albeit to differing extents. Research indicates that approximately 20% to 30% of patients undergoing insulin treatment report experiencing FoH, which subsequently exacerbates levels of anxiety associated

with diabetes management (2). The FOH is manifested as the fear of the negative impact of hypoglycemia on health and life, fear of an emergency, fear of losing self-control, and the onset of behavioral or cognitive disorders, which may result in behaviors that are generally socially unacceptable (3).

The FoH often results in maladaptive behaviors aimed at preventing hypoglycemic episodes. Common strategies employed by individuals with FoH include maintaining elevated blood glucose levels through the limitation of physical activity, reduction of insulin dosages, and excessive carbohydrate

Key point

The findings from this study on predictors of fear of hypoglycemia in patients with type 2 diabetes have significant implications for health policy, practice, research, and medical education. Policymakers should prioritize the development of targeted educational programs that address the specific needs of patients based on their educational background, economic status, and treatment type, particularly focusing on those using insulin, who exhibit higher fear levels. Healthcare providers must implement comprehensive care strategies that include psychological support and education about hypoglycemia management, especially for patients with a history of hypoglycemic episodes or long-term complications. Additionally, further research is required to explore effective interventions that can reduce fear and improve glycemic control, while medical education should emphasize the importance of understanding the psychosocial aspects of diabetes management to prepare future healthcare professionals to address these challenges effectively.

consumption. Such inconsistent behaviors can lead to an increased risk of both temporary and chronic hyperglycemia, as well as complications associated with microvascular and macrovascular damage. Furthermore, these behaviors introduce significant safety hazards for the affected individuals, potentially exacerbating their overall health risks and complicating diabetes management (4,5). There is evidence that FoH may be a significant barrier to diabetes management, quality of life, and future health outcomes (4). To manage hypoglycemia, various technologies like insulin pumps, along with educational and cognitive behavioral methods, have been employed. However, the effectiveness of each of these approaches in controlling the FoH varies (1).

The FoH causes a decline in the quality of life for diabetic patients and can disrupt their treatment adherence (6). Therefore, it is necessary to take measures to identify and treat this fear. In the meantime, identifying predictors of the FoH can be effective.

Several studies have examined the factors that influence FoH and predict its occurrence. However, these studies have used varying factors and reported different results in some cases. According to the findings, marital status, gender, the presence of microvascular complications, and a history of hypoglycemia have been identified as predictors of FoH (7,8). Among these factors, the history of hypoglycemia is considered the most significant predictor of FoH, according to studies (7-9). Previous research has investigated various factors, including demographic variables, as potential predictors of FoH. The primary objective of the research team in this study is to identify the predictors of FoH among individuals with diabetes. Addressing this inquiry through the investigation may provide a foundation for future studies aimed at developing interventions to mitigate FoH, thereby enhancing the quality of life for individuals with type 2 diabetes.

Objectives

This study aimed to identify and analyze the predictive

factors contributing to the FoH in patients with type 2 diabetes, focusing on the role of hypoglycemic episodes and their interpretation. By examining a sample of 260 patients, this study explores the relationship between the frequency and severity of hypoglycemic events and the psychological responses they elicit, as well as assesses how patients' perceptions of these episodes influence their fear levels. Ultimately, this research seeks to provide insights that can inform clinical practices and improve the management of diabetes-related fears, enhancing patient quality of life.

Patients and Methods**Study design and participants**

This descriptive-analytical study was conducted at the Velayat clinic and Bu Ali hospital in Qazvin city, and it involved a total of 260 patients diagnosed with type 2 diabetes who were undergoing treatment with either oral tablets or insulin; following the acquisition of written informed consent and the thorough verification of the participants' eligibility based on predefined entry criteria, accessible sampling was employed to recruit participants until the target sample size was achieved.

Inclusion and exclusion criteria

The inclusion criteria for study participation required individuals to be at least 25 years old. Participants needed to have a specialist-diagnosed case of type 2 diabetes. Additionally, they must have experienced hypoglycemia and be receiving treatment with oral medication or insulin. The exclusion criteria encompassed individuals who were unwilling to cooperate with the study. Those who chose to withdraw from the study at any point were also excluded from participation.

Sampling method and sample size

The sampling method employed in this study was random sampling. The sample size was estimated based on the study by Erol et al (10), which determined a correlation coefficient of $r = 0.2$. Utilizing a type I error level of $\alpha = 0.05$, corresponding to a confidence level of 0.95, and a type II error level of $\beta = 0.11$, indicating a test power of 89%, the sample size was calculated to be 260 individuals through the application of the appropriate formula and MedCalc software.

$$n = \frac{(z_{1-\frac{\alpha}{2}} + z_{1-\beta})^2}{w^2} + 3 = \frac{(1.96 + 1.23)^2}{0.04} + 3 \sim 260$$

$$w = \frac{1}{2} \ln\left(\frac{1+r}{1-r}\right) = 0.2$$

Data collection

Data were collected using a demographic questionnaire checklist and the hypoglycemia fear survey II (HFS-II) questionnaire. The demographic questionnaire included

age, gender, marital status, educational attainment, occupation, duration of diabetes diagnosis, treatment modality, co-existing medical conditions, and religious affiliation. To assess FoH, the HFS-II scale, developed by Cox et al, was utilized, specifically focusing on the worry scale, which consists of 18 items that evaluate the FoH experienced over the past six months. The scoring for this subscale ranges from 0 to 72, with responses for each question varying from 0 to 4 (11). The validity and reliability of the HFS-II scale have been established through numerous studies, including an evaluation conducted by Momeni et al, which reported a Cronbach's alpha coefficient of 0.96 for the tool (7). In this study, the severity of hypoglycemia was classified into three distinct groups, as there is currently no standardized questionnaire available for assessing hypoglycemia severity in Iran. This classification was based on the guidelines established by the American Hypoglycemia Association. The three categories include mild hypoglycemia, characterized by no or minor disruption to daily activities without the need for treatment of symptoms; moderate hypoglycemia, which involves disruption in certain activities but does not require treatment; and severe hypoglycemia, defined as situations necessitating assistance from others to manage symptoms (12).

Statistical analysis

The data collected in this study were analyzed using SPSS24 software, employing various descriptive indices, including mean, standard deviation, frequency, and percentage. To assess the correlation of hypoglycemia fear scores and demographic variables, one-way analysis of variance (ANOVA), independent t-tests, and Pearson's correlation coefficients were utilized. Additionally, both univariate and multivariate linear regression models were employed to explore the predictors of FoH. The normality of the quantitative data was assessed using the Kolmogorov-Smirnov test, and a significance level of less than 0.05 was established for all statistical tests conducted.

Results

The results showed that the demographic characteristics of the included patients reveal a gender distribution with a higher percentage of females compared to males. In terms of education, the majority of participants have completed guidance education, followed by those with a high school diploma and a smaller proportion holding academic qualifications. Regarding economic status, most participants reported a moderate economic condition, while a minority classified themselves as poor. The duration of diabetes among participants varied, with a significant portion having diabetes for five to ten years, followed by those with less than five years and those with ten to twenty years. A notable percentage of participants reported a family history of diabetes, and a large majority had a history of hypoglycemia. The medication used by patients

was predominantly tablets, with a smaller number using insulin or a mixed regimen. The severity of hypoglycemia was mostly mild, with some reporting moderate severity and a few experiencing no symptoms. Long-term diabetes complications were present in over half of the participants, with various types of complications reported, including renal issues, vision problems, neuropathy, diabetic foot, and cardiac complications. Glycemic control practices varied, with a significant number monitoring their levels twice a week, while others checked once a month, daily, or not at all. The mean age of participants was 56.68 ± 11.05 years, the mean HbA1c level 7.89 ± 2.18 % was, and the frequency of hypoglycemia episodes over six months was 3.82 ± 6.06 % (Table 1).

Table 1. Basic demographic characteristics of included patients

Variable	Frequency	Percent
Gender		
Male	93	35.8
Female	167	64.2
Education		
Guidance	183	70.4
High school	57	21.9
Academic	20	7.7
Economic status		
Poor	15	5.8
Moderate	177	68.1
Good	68	26.1
Duration of diabetes (y)		
<5	70	26.9
5-10	100	38.5
10-20	70	26.9
20-30	15	5.8
>30	5	1.9
Family history of diabetes		
Yes	167	64.2
No	93	35.8
History of hypoglycemia		
Yes	200	77
No	60	23
Medication		
Tablet	153	58.8
Insulin	77	29.6
Mixed	30	11.5
Hypoglycemia severity		
Without symptoms	44	16.9
Mild	156	60
Moderate	54	20.8
Severity	6	2.3
Long-term diabetes complication		
Yes	140	53.8
No	120	46.2
Type of long-term complication		
Renal	13	5
Vision	24	9.2
Neuropathy	14	5.4
Diabetic foot	18	6.9
Cardiac	24	9.2
Multiple complications	41	15.8
Other	6	2.4
Glycemic control		
Once a month	57	21.9
Twice a week	99	38.1
Daily	56	21.5
No	48	18.5
Variable	Mean	SD
Age (y)	56.68	11.05
HbA1c (%)	7.89	2.18
Six-month hypoglycemia frequency (N)	3.82	6.06

HbA1c, Hemoglobin A1c; SD, Standard deviation.

The results demonstrated that patients with type 2 diabetes who had a poor economic status exhibited a significantly higher FoH compared to those with moderate or high economic status. Individuals receiving insulin therapy had a greater FoH than those taking oral tablets or a combination of both. Patients with long-term diabetes complications and a history of hypoglycemia experienced a more pronounced FoH than those without these factors. The severity of hypoglycemia was directly proportional to the level of fear, with those experiencing severe hypoglycemia episodes reporting the highest fear levels. Additionally, the number of hypoglycemic episodes in the past six months was positively correlated with the FoH (Table 2).

The analysis of predictors of FoH in patients with type 2 diabetes revealed several significant associations. The number of hypoglycemic episodes experienced in the past six months was positively correlated with fear levels. Educational attainment showed varied effects, with academic education being associated with a lower fear compared to guidance education. Economic status indicated that patients with poorer economic conditions reported higher fear levels than those with moderate status. Treatment type also played a role, as insulin users experienced greater fear compared to those on tablet treatment. Additionally, the presence of long-term diabetes complications and a history of hypoglycemia were linked to increased fear levels. Glycemic control frequency further influenced fear, with daily monitoring associated with higher fear than less frequent checks. Finally, the severity of hypoglycemia episodes was directly related to fear, with moderate and severe episodes correlating with significantly higher fear levels compared to mild or asymptomatic episodes (Table 3).

Discussion

The investigation into the predictors of FoH among patients with type 2 diabetes identified several noteworthy associations. A significant positive correlation was found between the frequency of hypoglycemic episodes in the previous six months and the levels of fear reported by patients. Furthermore, educational attainment appeared to influence fear, with individuals possessing academic qualifications demonstrating lower levels of fear compared to those with only guidance education. Economic status also played a critical role, as patients facing poorer economic conditions exhibited heightened fear levels relative to their counterparts in moderate economic situations. Additionally, the type of treatment administered was significant, with insulin users experiencing greater fear than those on oral tablet therapy. Lastly, both the presence of long-term diabetes complications and a history of hypoglycemic events were associated with increased fear levels, indicating the complex interplay of clinical and socioeconomic factors in the psychological experience of diabetes management.

The findings indicated that the average score for FoH among patients with type 2 diabetes was 12.95 ± 12.06 , which is notably lower than the scores reported in recent studies conducted in Iran. For instance, Momeni et al reported an average fear score of 16.8 ± 16.33 in their research, suggesting a potential decrease in fear levels among the current study's participants. This discrepancy may reflect variations in patient demographics, treatment modalities, or the effectiveness of educational interventions aimed at managing hypoglycemia fear in different populations (7). In the study conducted by Yeke Fallah et al, the average score for FoH was reported as 32.88 ± 14.68 (8), while another investigation by Salimi

Table 2. Association between demographic characteristics and fear of hypoglycemia among patients with type 2 diabetes

Variable	Fear of hypoglycemia		P value	
	Mean \pm SD			
Demographic Characteristics	Economic status	Poor	46.80 \pm 15.14	0.013*
		Moderate	37.80 \pm 11.73	
		High	36.41 \pm 11.54	
	Type of treatment	Tablet	36.05 \pm 11.13	0.005*
		Insulin	41.48 \pm 12.07	
		Mixed	38.63 \pm 14.67	
	Long-term diabetes complication	Yes	41.15 \pm 12.77	<0.001**
		No	34.23 \pm 10.01	
	History of hypoglycemia	Yes	40.42 \pm 12.02	<0.001**
		No	29.73 \pm 7.82	
Severity of hypoglycemia	Without symptoms	33.84 \pm 12.15	0.014*	
	Mild	35.31 \pm 10.30		
	Moderate	47.31 \pm 10.58		
	Severe	54.33 \pm 9.28		
Number of hypoglycemia in the past 6 months		r = 0.232	0.001***	

*ANOVA, **Independent T-test, ***Pearson's correlation coefficients.

Table 3. Unadjusted and adjusted predictors of fear of hypoglycemia in patients with type 2 diabetes

Variable		β (unadjusted)	P value	β (Adjusted)	95% Confidence interval		P value
					Lower	Upper	
Number of hypoglycemia in the past 6 months		0.232	*<0.001	0.033	-0.205	0.078	0.375
Education	Guidance			Ref			
	High school	-0.038	0.545	-0.004	-2.023	1.806	0.911
	Academic	-0.139	0.027*	-0.023	-4.020	1.98	0.501
Economic status	Moderate			Ref			
	Poor	0.174	0.005*	0.061	-0.282	6.56	0.042*
	Fire	-0.051	0.413	-0.002	-1.72	1.83	0.949
Type of treatment	Tablet			Ref			
	Insulin	0.206	0.001*	0.001	-1.82	1.82	0.999
	Mixed	0.068	0.277	0.059	-0.318	4.57	0.048*
Long-term diabetes complication	Yes			Ref			
	No	-0.286	<0.001*	-0.092	-3.82	-0.57	0.008
History of hypoglycemia	Yes	0.374	<0.001*	0.0342	6.57	12.48	<0.001*
	No			Ref			
Glycemic control	Twice in week			Ref			
	Once a month	0.008	.0259	0.038	-0.965	3.17	0.294
	Daily	0.151	0.028*	0.072	0.039	4.10	0.046*
	No	0.103	0.133	0.033	-1.21	3.27	0.367
Severity of hypoglycemia	Mild			Ref			
	Without symptoms	-0.046	0.422	-0.35	-3.34	1.03	0.301
	Moderate	0.405	<0.001*	0.136	1.74	6.16	0.001*
	Severity	0.238	<0.001*	0.063	-0.314	10.88	0.046*

et al indicated a score of 15.70 ± 13.66 . These variations underscore the importance of utilizing hypoglycemia fear surveys in clinical practice to evaluate patients' fear levels during endocrinologist visits, which could significantly enhance the quality of diabetes care. Moreover, the timely and accurate identification of patients at risk of developing excessive fear is crucial and can be achieved through a comprehensive analysis of their medical history and treatment outcomes (13). The integration of hypoglycemia fear surveys into clinical practice during endocrinologist visits is essential for enhancing the quality of diabetes care, as these assessments provide valuable insights into patients' psychological well-being and help identify those at risk of excessive fear. Timely and accurate identification of patients susceptible to developing heightened fear can be achieved through a thorough analysis of their medical history and treatment outcomes, allowing healthcare providers to implement targeted interventions. Such proactive measures not only address the psychological aspects of diabetes management but also contribute to improved patient adherence to treatment protocols and overall health outcomes. By prioritizing the assessment of FoH, healthcare practitioners can foster a more comprehensive approach to diabetes care that encompasses both physiological and psychosocial dimensions (14).

While Yeke Fallah et al reported that the majority of their study participants were treated with oral tablets, Salimi et al found that most patients in their investigation received

insulin therapy. In contrast, Momeni et al included only patients treated with oral antidiabetic medications in their study (7,8,15). These variations in treatment modalities across different investigations may contribute to the discrepancies observed in FoH scores, as insulin therapy has been associated with higher fear levels compared to oral tablet treatment in the current study's findings. Understanding the relationship between treatment type and FoH is crucial for tailoring interventions and providing appropriate support to patients based on their specific treatment regimens.

When comparing the change in fear scores of hypoglycemia in studies where oral tablets were used, differences in fear scores may be attributed to variations in the groups receiving oral blood sugar control medications.

Based on the multivariable linear regression model, economic status, treatment method, history of fear, long-term complications, number of hypoglycemia events, monitoring blood sugar levels, and severity of hypoglycemia were identified as independent predictors of FoH. These factors have a significant impact on patients' FoH and can serve as important indicators in diabetes treatment management. Moreover, a thorough examination of these factors can aid in mitigating the complications associated with hypoglycemia and enhancing patients' quality of life (2).

The history of FoH can be considered a key factor in shaping patients' attitudes towards blood sugar management; Individuals who have had more negative

experiences with hypoglycemia typically exhibit greater fear of this condition (6). The severity of hypoglycemia directly impacts patients' fear levels. The more severe the symptoms and complications of hypoglycemia, the higher the likelihood of fear and anxiety in patients (10,12,14). Additionally, the frequency of hypoglycemic events a patient experiences can be a significant predictor of their fear towards the condition. Patients who have had more instances of hypoglycemia typically have greater concerns about its recurrence. Research demonstrates a notable correlation between the frequency of hypoglycemic events and the intensity of fear associated with this condition. Consequently, individuals who frequently experience such events are more likely to take additional precautions (10,12).

According to the findings of this study, the type of treatment is one of the factors that influences the FoH. This association was also noted in the study by Yekeh Fallah et al (8). However, the study by Salimi et al (9) did not find this correlation. This relationship is not evident in diabetic pregnant women. The level of fear in individuals treated with insulin was higher in this study compared to others. Several studies have highlighted that diabetic patients treated with insulin experience a higher incidence and severity of hypoglycemia (16,17).

Another significant factor identified in this study is blood sugar monitoring, consistent with the findings of Pang et al attitudes towards blood sugar control are among the factors that influence the FoH (18).

In this study, a significant relationship was discovered between long-term complications of diabetes and FoH. Patients with long-term complications exhibited poor treatment compliance and reported experiencing more hypoglycemic episodes. This association was observed in the studies conducted by Momeni et al and Yekeh Fallah et al (7, 8). However, while a linkage between diabetes complications and FoH was evident in univariate regression, no significant relationship was identified in these studies' multivariate assessments.

Among the various predictive factors of FoH, three are linked to the occurrence of hypoglycemia, including the frequency and severity of episodes. These factors determine the significance of hypoglycemia occurrences and how patients interpret and manage them. Study results indicate that the level of concern regarding hypoglycemia was associated with episodes of hypoglycemia in the past 12 months, particularly in the last six months. Individuals who experienced hypoglycemia in the last six months exhibited mental health issues, reduced social well-being, and elevated stress levels. They also had higher levels of diabetes-related distress and lower self-efficacy (1). Hendrieckx et al reported that hypoglycemia unawareness and perceived risk for future hypoglycemic reactions also influenced FOH (19). In their study, Martyn-Nemeth et al asserts that the heightened fear experienced by certain individuals stems from an over-interpretation of

hypoglycemic symptoms (1). One way to expound upon this phenomenon is by referring to Marvel et al's theory. This theory posits that fear is initially instilled through dependent learning and response conditions, acting as an unconditioned stimulus to evoke a conditioned response. As both mental and physiological conditioned responses evoke fear in the individual, avoidance behaviors serve to steer them away from the actual triggers and are reinforced through negative means, thereby intensifying the fear (20).

In the study by Sheikhi et al titled "the effect of eye movement desensitization and reprocessing on the fear of hypoglycemia in type 2 diabetic patients: a randomized clinical trial", researchers implemented desensitization therapy to help patients cope with their past hypoglycemic episodes. The results showed that after the treatment, participants experienced a notable reduction in stress levels when recalling their previous hypoglycemic experiences. This suggests that such therapeutic interventions could be beneficial in managing the psychological impact of hypoglycemia in diabetic patients, potentially leading to better overall diabetes management and improved quality of life (15).

The investigation into the predictors of FoH among patients with type 2 diabetes revealed several significant associations that underscore the complexity of managing this condition. A notable positive correlation was identified between the frequency of hypoglycemic episodes in the previous six months and the reported levels of fear, suggesting that increased exposure to hypoglycemia may heighten anxiety regarding future episodes. This finding aligns with existing literature indicating that recurrent hypoglycemic events can lead to a cycle of fear that adversely affects patients' quality of life and diabetes management.

Educational attainment emerged as another critical factor, with individuals possessing academic qualifications exhibiting lower levels of fear compared to those with only guidance education. This suggests that higher educational levels may equip patients with better knowledge and coping strategies to manage their diabetes, thereby reducing fear. Additionally, economic status played a significant role, as patients in poorer conditions reported heightened fear levels. This relationship may reflect the additional stressors faced by individuals in lower socioeconomic brackets, such as limited access to healthcare resources and educational materials, which can exacerbate feelings of anxiety related to diabetes management.

The type of treatment also influenced fear levels, with insulin users experiencing greater fear compared to those on oral tablet therapy. This finding highlights the psychological burden that may accompany insulin treatment, potentially due to the perceived complexity and risks associated with insulin administration. Furthermore, the presence of long-term diabetes complications and a history of hypoglycemic events were associated with increased fear levels, indicating that the cumulative effects

of diabetes-related health issues contribute to patients' anxiety.

Conclusion

The analysis of predictors of FoH in patients with type 2 diabetes highlights several critical associations that can inform clinical practice. Notably, the frequency of hypoglycemic episodes, educational attainment, economic status, treatment type, and the presence of long-term complications all significantly influenced fear levels. Patients with more frequent hypoglycemic episodes and those with lower educational and economic status reported higher fear, while insulin users experienced greater anxiety compared to those on oral medications. Additionally, a history of hypoglycemia and the severity of episodes were strongly correlated with increased fear. These findings underscore the necessity for tailored interventions that address these predictors to effectively manage fear and improve the overall quality of care for patients with type 2 diabetes.

Limitations of the study

The study on predictive factors of FoH in patients with type 2 diabetes has several limitations. Firstly, the sample size of 260 patients from specific clinics in Qazvin City may limit the generalizability of the findings to broader populations. The cross-sectional design restricts the ability to establish causal relationships, as it captures data at a single point in time. Additionally, reliance on self-reported measures, such as the hypoglycemia fear survey II (HFS-II), may introduce biases due to social desirability or recall inaccuracies. The study may also lack control for all potential confounding variables, such as psychological conditions and support systems, which could influence fear levels. Lastly, the focus on the worry dimension of fear may not encompass all aspects of hypoglycemia-related fears, limiting the comprehensiveness of the assessment.

Acknowledgments

The authors wish to express their sincere gratitude to the Research Department of Qazvin University of Medical Sciences for their support and guidance throughout this study. Additionally, they extend their appreciation to the staff of Velayat and Bu Ali Hospital in Qazvin for their assistance in facilitating the research process. Finally, the authors would like to thank the patients who participated in this study, as their willingness to share their experiences and insights was invaluable to the research.

Authors' contribution

Conceptualization: Hamid Reza Salimi.

Data curation: Movahedeh Hosseinali and Fatemeh Zarei.

Formal analysis: Fatemeh Zarei.

Investigation: Fatemeh Zarei and Farnoosh Rashvand.

Methodology: Fatemeh Zarei and Farnoosh Rashvand.

Project management: Farnoosh Rashvand.

Resources: All authors.

Supervision: Hamid Reza Salimi.

Validation: Hamid Reza Salimi.

Writing—original draft: All authors.

Writing—reviewing and editing: All authors.

Conflicts of interest

The authors declare no conflict of interest.

Ethical issues

The research conducted in this study adhered to the principles outlined in the Declaration of Helsinki and was approved by the Ethics Committee of Qazvin University of Medical Sciences with the (ethical code# IR.QUMS.REC.1398.087 (<https://ethics.research.ac.ir/EthicsProposalView.php?id=76542>)). All the checklists used in this study were anonymous and before any intervention, all participants provided written informed consent. The study was extracted from the Students' Research Committee at this university (Thesis#14003759). Additionally, ethical issues (including plagiarism, data fabrication, and double publication) were completely observed by the authors.

Funding/Support

This study was supported by a grant provided by the Research Department of Qazvin University of Medical Sciences (Grant #14003759).

References

1. Martyn-Nemeth P, Schwarz Farabi S, Mihailescu D, Nemeth J, Quinn L. Fear of hypoglycemia in adults with type 1 diabetes: impact of therapeutic advances and strategies for prevention - a review. *J Diabetes Complications*. 2016;30:167-77. doi: 10.1016/j.jdiacomp.2015.09.003.
2. American Diabetes Association. 2. Classification and Diagnosis of Diabetes: Standards of Medical Care in Diabetes-2021. *Diabetes Care*. 2021;44: S15-S33. doi: 10.2337/dc21-S002.
3. Rossi MC, Nicolucci A, Ozzello A, Gentile S, Agliarolo A, Chiambretti A, et al; HYPOS-1 Study Group of AMD. Impact of severe and symptomatic hypoglycemia on quality of life and fear of hypoglycemia in type 1 and type 2 diabetes. Results of the Hypos-1 observational study. *Nutr Metab Cardiovasc Dis*. 2019;29:736-743. doi: 10.1016/j.numecd.2019.04.009.
4. Amiel SA. The consequences of hypoglycemia. *Diabetology*. 2021;64:963-70. doi: 10.1007/s00125-020-05366-3.
5. Rashvand F, Salsali M, Ebadi A, Vaismoradi M, Jordan S, Griffiths P. Iranian nurses perspectives on assessment of safe care: an exploratory study. *J Nurs Manag*. 2016;24:417-26. doi: 10.1111/jonm.12338.
6. Glocker V, Bachmann S, Hess M, Szinnai G, Burckhardt MA. Fear of hypoglycemia and quality of life in young people with type 1 diabetes and their parents in the era of sensor glucose monitoring. *Front Endocrinol (Lausanne)*. 2022;13:958671. doi: 10.3389/fendo.2022.958671.
7. Momeni M, Ziaee A, Ghorbani A. Predictors of Hypoglycemia Fear in Patients with Type 2 Diabetes Under Treatment of Oral Anti Hyperglycemic Agents. *Iranian Journal of Endocrinology and Metabolism* 2016;18:28-36.
8. Yeke Fallah L, Talebi F, Ghorbani A, Mafi M. Factors affecting hypoglycemia fear in patients with type 2 diabetes. *J Qazvin Uni Med Sci*. 2019;23:104-115. doi: 10.32598/JQUMS.23.2.104.
9. Salimi HR, Jalili S, Griffiths MD, Almoradi Z. Fear of hypoglycemia and its predictive factors among diabetic pregnant women. *Prim Care Diabetes*. 2023;17:68-72. doi: 10.1016/j.pcd.2022.11.009.
10. Erol O, Enc N. Hypoglycemia Fear and Self-efficacy of Turkish Patients Receiving Insulin Therapy. *Asian Nurs Res (Korean Soc Nurs Sci)*. 2011;5:222-8. doi: 10.1016/j.anr.2011.12.001.
11. Cox DJ, Irvine A, Gonder-Frederick L, Nowacek G, Butterfield J. Fear of hypoglycemia: quantification, validation, and utilization. *Diabetes Care*. 1987;10:617-21. doi: 10.2337/diacare.10.5.617.

12. Irvine AA, Cox D, Gonder-Frederick L. Fear of hypoglycemia: relationship to physical and psychological symptoms in patients with insulin-dependent diabetes mellitus. *Health Psychol.* 1992;11:135-8. doi: 10.1037//0278-6133.11.2.135.
13. Salimi H, Griffiths MD, Alimoradi Z. Prevalence of anxiety and depression among pregnant women with diabetes and their predictors. *Diabetes Epidemiol Management.* 2024;14:100198. doi: 10.1016/j.deman.2024.100198.
14. Przekaz A, Bielka W, Molęda P. Fear of hypoglycemia-An underestimated problem. *Brain Behav.* 2022;12:e2633. doi: 10.1002/brb3.2633.
15. Sheikhi M, Moradi M, Shamsavary S, Alimoradi Z, Salimi HR. The effect of eye movement desensitization and reprocessing on the fear of hypoglycemia in type 2 diabetic patients: a randomized clinical trial. *BMC Psychol.* 2020;8:82. doi: 10.1186/s40359-020-00450-0.
16. Bahrami J, Tomlinson G, Murphy HR, Feig DS; CONCEPTT Collaborative Group. Impaired awareness of hypoglycaemia in women with type 1 diabetes in pregnancy: Hypoglycaemia fear, glycaemic and pregnancy outcomes. *Diabet Med.* 2022;39: e14789. doi: 10.1111/dme.14789.
17. Huang J, Peng W, Ding S, Xiong S, Liu Z. Fear of hypoglycemia and associated factors in hospitalized patients with type 2 diabetes: a cross-sectional study. *Sci Rep.* 2022;12:20338. doi: 10.1038/s41598-022-24822-1.
18. Pang J, Zhang L, Li X, Sun F, Qiu J, Zhao Y, et al. Identification of factors associated with fear of hypoglycemia using the capability, opportunity, motivation and behavior model in people with type 2 diabetes mellitus: a cross-sectional study. *Acta Diabetol.* 2023;60:1405-1415. doi: 10.1007/s00592-023-02132-w.
19. Hendrieckx C, Halliday JA, Bowden JP, Colman PG, Cohen N, Jenkins A, et al. Severe hypoglycaemia and its association with psychological well-being in Australian adults with type 1 diabetes attending specialist tertiary clinics. *Diabetes Res Clin Pract.* 2014;103:430-6. doi: 10.1016/j.diabres.2013.12.005.
20. Johansen JP, Cain CK, Ostroff LE, LeDoux JE. Molecular mechanisms of fear learning and memory. *Cell.* 2011;147:509-24. doi: 10.1016/j.cell.2011.10.009.