International Journal of Medical Toxicology & Legal Medicine Volume 27, No. 2, 2024
e-ISSN: 0974-4614
p-ISSN: 0972-0448

Fear of Hypoglycemia among Diabetics in the Middle East: A Systematic Review and Meta-analysis

Hazim M. Bajri[1], Sultan Alessa[2*], Adel Alshehri[3*]

[1,2,3]Makkah Health Cluster, Ministry Of Health, Saudi Arabia
*Corresponding Author

Received: 17.08.2024 Revised: 15.09.2024 Accepted: 14.10.2024

ABSTRACT

Background: The Middle East and North Africa face high diabetes rates, contributing significantly to global diabetes burdens. Addressing diabetes management, including awareness, early diagnosis, and complication prevention, is a critical health priority due to its expanding burden. The psychosocial aspect of diabetes, particularly fear of hypoglycemia (FOH), affects patient outcomes by discouraging physical activity, reducing quality of life, and impacting treatment adherence and glycemic control. Evidence on FOH and its effects on diabetes management in the Middle East is limited, prompting a systematic literature review to synthesize available data.

Methods: A systematic search on PubMed, Web of Science (WOS), Scopus, and Cochrane Library was conducted from inception till May 5, 2024. Relevant studies were obtained and evaluated for inclusion, and their data were extracted. Our primary outcome was fear of hypoglycemia (FOH) as measured by the hypoglycemia fear survey (HFS). The R language was used to pool the means of HFS scores, and the narrative approach was used to synthesize evidence for other outcomes.

Results: Fourteen studies, comprising 4,869 participants, were included in the analysis. The overall pooled mean HFS among diabetic patients in the Middle East was 24.13 (95% CI: 13.92 to 34.34), indicating a moderate level of FOH. Younger age, longer duration of diabetes, treatment modality, and history of hypoglycemia were found to influence FOH levels. Patients with higher FOH levels reported lower treatment satisfaction, impaired emotional well-being, social interactions, and overall life satisfaction.

Conclusion: Diabetes patients in the Middle East have moderate levels of FOH. However, FOH negatively affected patients' quality of life in multiple aspects and treatment outcomes. Future well-designed research is warranted.

Keywords: Diabetes mellitus, Hypoglycemia, fear survey, glycemic control, Middle East

1. INTRODUCTION

Diabetes mellitus is a common endocrine disorder characterized by high blood glucose levels, either due to inadequate (type 1 diabetes mellitus, T1DM) or ineffective insulin hormone levels (type 2 diabetes mellitus, T2DM). Diabetes mellitus has different forms, but T1DM and T2DM are the most common subtypes [1].

The global burden of diabetes is dramatically increasing. In the year 2021, patients living with diabetes globally were estimated to be 529 million across all ages, with the regions of the Middle East and North Africa having the highest age-standardized rates [2], [3]. Deaths due to diabetes account for 5.9% of total deaths in the United States of America for the year 2019 [4]. With a prevalence rate of 14.6%, about 46 million people are living with diabetes in the Middle East region [5].Due to the alarming expanding burden of diabetes, its proper management is among the highest health priorities. This includes increasing the public awareness of diabetes risk factors, early diagnosis, and preventing diabetic complications [6].

Because of the chronic nature of diabetes, patient education and psychosocial aspects are significant factors for many diabetes outcomes [7], [8]. Fear of hypoglycemia is a common psychosocial consequence among people with diabetes that may negatively affect diabetes management outcomes [9], [10]. Fear of hypoglycemia (FOH) was reported to discourage patients from engaging in physical activity, decreased quality of life, reduced treatment adherence, and poor glycemic control [11], [12], [13].

The current literature lacks evidence on the fear of hypoglycemia and its impact on diabetes management among people with diabetes in the Middle East region. We aim to synthesize data from the available literature by conducting a systematic literature review.

2. METHODOLOGY

2.1 Literature search

We conducted a systematic review by adhering to the guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Statement 2020 [14]. PubMed, Web of Science (WOS), Scopus, and Cochrane Library were systematically queried using a search strategy that included the following keywords and their Mesh terms ("diabetes mellitus," "fear of hypoglycemia," and "prevalence"). The database search was conducted on May 5, 2024.

2.2 Screening and eligibility criteria

Retrieved articles were uploaded to Rayyan.ai, where duplicates were detected and deleted. Two review authors independently screened the remaining articles through title and abstract; the first author resolved conflicts. Full text of included articles from the first screening phase were obtained and carefully evaluated for inclusion criteria.

We utilized the following criteria to evaluate the relevance of articles to our review: primary research articles, investigating diabetic patients from the Middle East region, assessing for fear of hypoglycemia and its impact on diabetes management outcome or patients' quality of life, and in English. No restrictions were made regarding the age of patients or type of diabetes.

Studies were excluded if they were secondary research articles (systematic reviews, meta-analyses, editorials), not in English, included populations from countries outside the Middle East, or did not report fear of hypoglycemia.

2.3 Data extraction

Using a preformatted Excel sheet, we extracted the following data items from the included studies: first author's name, year of publication, study design, country, sample size, diabetes disease type, age, sex, the tool used to measure fear of hypoglycemia, the tool used to measure quality of life, and the main findings of the studies. We double-checked the extracted data to ensure accuracy.

2.4 Data synthesis

The means of HFS scores reported by the included studies were pooled using the R language (version 4.4.0) to provide an estimate of HFS mean scores across populations [15]. Random-effects models were utilized due to the anticipated heterogeneity among studies. Subgroup analysis was conducted to explore potential differences in hypoglycemia fear across different types of diabetes.

A narrative synthesis approach was employed for associations with FOH, impact on quality of life, and diabetes treatment outcome. This involved qualitatively summarizing the findings from individual studies and identifying patterns, discrepancies, and critical themes across the included studies.

2.5 Quality assessment

The Newcastle-Ottawa Scale (NOS) was used to assess the quality of the included studies. The NOS evaluates studies across three key domains: selection, comparability, and outcome assessment. Within each domain, specific criteria are considered to gauge the risk of bias and the overall quality of the study. Two review authors independently evaluated the studies' quality using the NOS tool, with any conflicts resolved by a third reviewer [16].

3. RESULTS

3.1 Literature search and screening

Four databases were searched and retrieved a total of 3,711 articles. After removing 850 duplicates, 2,861 articles entered the title and abstract screening phase. Full-text screening was done for 178 articles to end up with 14 studies fulfilling the inclusion criteria. The PRISMA flow diagram outlines the screening and selection process (**Figure 1**).

3.2 Studies characteristics

Fourteen studies were included in the analysis, comprising 4,869 participants. Among these participants, 1,931 were males. The mean age across the studies ranged from 9.2 to 57 years, indicating a wide age distribution within the sampled populations.

Seven of the fourteen studies included in the analysis were cross-sectional studies conducted in Iran. In addition, five studies were conducted in Saudi Arabia, consisting of four cross-sectional studies and one observational prospective study. Furthermore, two cross-sectional studies were conducted in Lebanon and Jordan, respectively [17-30](**table 1**) .

3.3 Quality assessment

Out of 14 included studies, 13 were found to be of good quality, and only one had a fair methodological quality. Details on quality assessment are presented in (Table 2).

3.4 measurements of Fear of hypoglycemia

The hypoglycemia fear survey (HFS) was used in 13 studies, and one study utilized the Hypoglycemia Awareness Behavior Scale (HABS) as a measure of fear of hypoglycemia among participants [31-32].

The Hypoglycemia Fear Survey (HFS) is a commonly used self-report questionnaire designed to assess the fear and worry associated with hypoglycemia among individuals with diabetes. Developed by Cox et al. in 1987, the HFS has been validated and utilized in various research and clinical settings to measure the impact of hypoglycemia on psychological well-being and diabetes management [31].

The HFS consists of two primary subscales: the worry subscale and the behavior subscale. The worry subscale evaluates the frequency and intensity of worries related to experiencing hypoglycemia. It assesses concerns about the potential consequences of low blood sugar levels, such as loss of consciousness, seizures, or impaired cognitive function. The behavior subscale measures the frequency of specific behaviors adopted to avoid or cope with hypoglycemia. It includes checking blood glucose levels, adjusting insulin doses, or consuming extra food to prevent low blood sugar episodes.

Respondents rate each item on a Likert scale, indicating the degree to which they agree or disagree with statements reflecting hypoglycemia-related worries and behaviors. Higher scores on the HFS indicate greater fear and worry about hypoglycemia and more frequent engagement in hypoglycemia-related behaviors.

The HFS has demonstrated reliability and validity in assessing fear of hypoglycemia across different age groups and diabetes populations. It provides valuable insights into the psychological impact of hypoglycemia and informs interventions aimed at addressing fear-related barriers to optimal diabetes management [33-35].

3.5 Hypoglycemia fear measurements

The overall pooled mean HFS among diabetic patients in the Middle East was 24.13 (95% CI: 13.92 to 34.34), indicating a moderate level of FOH. However, substantial heterogeneity (I^2 = 100%) was observed across studies, suggesting variability in HFS estimates. Subgroup analyses revealed differences in mean HFS among different types of diabetes, with T1DM patients exhibiting a mean HFS score of 18.44 (95% CI: -9.55 to 46.43), T2DM patients 19.61 (95% CI: 14.73 to 24.49), and mixed types 40.5 (95% CI: 7.33 to 73.67). Wide confidence intervals indicate uncertainty in the estimates. The test for subgroup difference yielded a non-significant p-value of 0.47, indicating no significant difference in mean HFS between diabetic subgroups in the Middle Eastern population. (Figures 2 and figure 3)

3.5.1 Age and fear of hypoglycemia

Four studies reported significant associations between age and FOH. [17]found that the older age group (16-18 years) had significantly higher scores on the Hypoglycemia Fear Survey (HFS), suggesting that adolescents in this age range may experience greater fear of hypoglycemia. [25]reported that younger patients had higher FOH scores compared to the elderly, implying that younger individuals may be more prone to fear hypoglycemia than older ones. [26]observed that patients aged 31-35 years were more likely to have a fear of hypoglycemia compared to other age groups, indicating that fear of hypoglycemia may peak in this specific age range. [27]found that younger age was associated with increased FOH, further supporting the notion that younger individuals tend to experience greater fear of hypoglycemia.

Overall, we found that younger age groups generally experienced higher levels of fear of hypoglycemia compared to older age groups. However, the specific age range with the highest fear levels may vary across studies.

3.5.2 Duration of diabetes and fear of hypoglycemia

Three studies reported significant associations between the duration of diabetes and FOH. [17] found that individuals with a longer duration of diabetes (>7 years) exhibited significantly higher scores on all subscales of FOH.[25]also observed a similar trend, indicating that as the duration of diabetes increases, the behavioral and overall scores of FOH increase.[26] noted that the duration of diabetes, ranging from 6 to 10 years, was linked to increased scores of fear of hypoglycemia.Overall, these findings suggest a consistent relationship between the duration of diabetes and the FOH, with longer durations generally correlating with higher levels of FOH.

3.5.3 Treatment method and fear of hypoglycemia

Six studies reported significant associations between the treatment modality of diabetes and FOH. [18]found that frequent flash glucose monitoring (FGM) scanning was significantly associated with improved fear of hypoglycemia (FOH). [19]observed that initiating second-line therapy was linked to a significant increase in

scores on the HFS. This indicates that changes or additions to treatment regimens may contribute to a heightened fear of hypoglycemia.
[20]reported that the prescription of oral hypoglycemic medications was associated with lower fear of hypoglycemia. [22]noted higher worry survey scores (HFS-II) among patients treated with injectable medication only compared to those treated with oral antidiabetic drugs (OADs). [25]observed the existence of fear of hypoglycemia among patients taking hypoglycemic agents. [27]found that fear of hypoglycemia scores were highest among individuals using a combination of diet and insulin compared to those using diet alone.
Overall, these studies highlight the complex relationship between treatment methods for diabetes and fear of hypoglycemia, with different treatments potentially influencing fear levels in varying ways. This indicates that regardless of the specific treatment method, fear of hypoglycemia remains a concern for individuals with diabetes.

3.5.4 History of hypoglycemia and FOH

Three studies reported significant associations between experiencing hypoglycemia and FOH. **[24]**found that individuals who experienced more severe hypoglycemia had higher scores on the Hypoglycemia Fear Survey (HFS) compared to those who experienced milder hypoglycemia. [26]observed that individuals who reported hospital admissions for hypoglycemic episodes in the previous six months were more likely to have a fear of hypoglycemia compared to those who did not report such admissions. [27]identified a positive history of hypoglycemia as the strongest predictor of fear of hypoglycemia among diabetic pregnant women. They found that individuals with a history of hypoglycemia had significantly higher scores on the fear of hypoglycemia scale compared to those without such a history.
Overall, these studies consistently suggest that a history of hypoglycemia, especially severe episodes requiring hospitalization, is strongly associated with increased fear of hypoglycemia. This indicates that past experiences of hypoglycemia play a significant role in shaping individuals' perceptions and fears regarding future episodes of low blood sugar.

3.5.5 Treatment outcome and FOH

In the study by [20], they observed an association between FOH and increased levels of HbA1c. Similarly, [25] also found that patients with higher levels of HbA1c and fasting blood glucose tended to score higher on measures of fear of hypoglycemia.
Overall, these studies indicate a relationship between treatment outcomes and fear of hypoglycemia. Individuals with higher HbA1c levels and poorer blood sugar control may experience a greater fear of hypoglycemia, highlighting the importance of addressing both treatment adherence and fear management in diabetes care.

3.5.6 Impact of FOH on quality of life

FOH has been consistently linked to various negative impacts on the quality of life (QoL) of individuals with diabetes. According to [23], there is a negative correlation between FOH and treatment satisfaction. This suggests that individuals who fear hypoglycemia may be less satisfied with their diabetes management strategies, potentially leading to decreased adherence to treatment plans[24] highlighted that fear of hypoglycemia could lead to counterproductive behaviors and impair health-related quality of life. These behaviors may include avoidance of activities that could potentially lower blood sugar levels, leading to reduced engagement in daily life activities and overall well-being. [25]suggest that fear of hypoglycemia directly negatively affects quality of life and that individuals experiencing fear of hypoglycemia may struggle with emotional well-being, social interactions, and overall life satisfaction.
Moreover, [28] indicate that fear of hypoglycemia can be a predictor of abnormal depression among pregnant women with diabetes. This highlights the psychological toll that fear of hypoglycemia can have on vulnerable populations, potentially exacerbating existing mental health conditions. [29]establish a direct and significant relationship between fear of hypoglycemia and poor sleep quality among type 2 diabetic patients. This suggests that the fear of experiencing low blood sugar levels during sleep can disrupt sleep patterns and contribute to sleep disturbances, further impacting overall well-being and functioning.
Overall, these studies collectively emphasize the multifaceted negative impact of fear of hypoglycemia on the quality of life of individuals with diabetes, highlighting the importance of addressing and managing this fear in diabetes care and management strategies.

4. DISCUSSION

In our study, we provide a mean estimate of fear of hypoglycemia among diabetes patients by synthesizing evidence from 14 studies conducted on Middle Eastern populations. We also explored the possible associations of FOH across various domains and its impact on the quality of patients' lives.
Our analysis revealed a moderate level of FOH among diabetic patients in the Middle East, as indicated by a pooled mean HFS score of 24.13. However, substantial heterogeneity across studies suggests variability in FOH

estimates, emphasizing the need for sizeable future research studies accommodating variations across population characteristics. A HFS score of 28 or more indicates fear of hypoglycemia. However, an accurate prevalence rate was not estimable because the included studies lacked prevalence data. [26]was the only study that reported FOH prevalence by 83.4% of the total population.

Young age and long duration of diabetes as demographic factors were associated with FOH. This association may appear contradictory; however, this can be explained by the complex interplay of psychological, physiological, and behavioral characteristics, and heterogeneity across populations of the included studies. Future studies may benefit from examining longitudinal trajectories of FOH to elucidate how fear evolves and how it intersects with various developmental, clinical, and psychosocial factors.

The complex relationship between treatment modalities and fear of hypoglycemia (FOH) underscores the need for individualized approaches that consider both clinical efficacy and psychological well-being. Our findings reveal that specific treatments, such as flash glucose monitoring (FGM) and oral hypoglycemic medications, were associated with reduced FOH, suggesting that these interventions may offer benefits beyond glycemic control by alleviating fear-related distress.

On the other hand, the initiation of second-line therapy and the use of injectable medications were linked to heightened fear levels. This highlights the importance of monitoring and addressing psychological factors alongside treatment adjustments to mitigate potential negative impacts on FOH. The bidirectional relationship between fear and glycemic control further emphasizes the need for integrated interventions targeting clinical outcomes and psychological well-being.

Individuals with poorer treatment outcomes, as indicated by higher HbA1c levels, were more likely to experience greater FOH. This suggests that fear-related distress may hinder adherence to treatment plans, leading to glycemic variability and an increased risk of hypoglycemic events. Therefore, interventions to improve treatment adherence and glycemic control should also address fear-related barriers to optimize diabetes management and overall well-being.

FOH emerged as a significant predictor of diminished QoL among individuals with diabetes. Our findings align with previous research demonstrating negative correlations between FOH and treatment satisfaction, impaired health-related QoL, emotional distress, depression, and sleep disturbances [36-37].Several limitations should be considered when interpreting our findings. The heterogeneity across studies may limit the generalizability of our results, necessitating well-designed future research. Additionally, the reliance on self-report measures may introduce bias, highlighting the need for objective assessments of FOH and QoL. Future research should address these limitations by employing standardized methodologies and incorporating diverse patient populations to enhance the robustness and generalizability of findings.

Our study underscores the importance of integrating FOH assessment, patients' demographics, and management strategies into routine diabetes care in the Middle East. Healthcare providers should prioritize patient-centered approaches that acknowledge the diverse impacts of FOH on people with diabetes and tailor interventions accordingly. Future research should focus on longitudinal studies to elucidate the dynamic interplay between FOH, glycemic control, and QoL over time, informing the development of targeted interventions to improve overall diabetes outcomes and well-being.

CONCLUSION

In conclusion, our study found that Middle Eastern diabetic patients have moderate levels of fear of hypoglycemia with an overall pooled mean HFS score of 24.13.Younger age, longer duration of diabetes, treatment modality, and history of hypoglycemia were found to influence FOH levels. Patients with higher FOH levels reported lower treatment satisfaction, impaired emotional well-being, social interactions, and overall life satisfaction. These findings highlight the importance of addressing and managing FOH as an integral component of diabetes care and management strategies in the Middle East. Future well-designed research is warranted to validate our conclusions.

Declarations and statements

Funding

The authors of this review received no funding from any persons or entities.

Ethical approval

Ethical approval was not required for this study; The authors of this article did not conduct any investigations involving human volunteers or animals.

Conflict of interest

The authors declare no conflict of interests.

Figure legends
Figure 1: The PRISMA flow diagram outlines the screening and selection process
Figure 2: Differences in mean HFS among different types of diabetes
Figure 3: Summary of study selection design.

REFERENCES

1. Z. Punthakee, R. Goldenberg, and P. Katz, "Definition, Classification and Diagnosis of Diabetes, Prediabetes, and Metabolic Syndrome," Can J Diabetes, vol. 42, pp. S10–S15, Apr. 2018, doi: 10.1016/j.jcjd.2017.10.003.
2. K. L. Ong et al., "Global, regional, and national burden of diabetes from 1990 to 2021, with projections of prevalence to 2050: a systematic analysis for the Global Burden of Disease Study 2021," The Lancet, vol. 402, no. 10397, pp. 203–234, Jul. 2023, doi: 10.1016/S0140-6736(23)01301-6.
3. N. A. ElSayedet al., "2. Classification and Diagnosis of Diabetes: Standards of Care in Diabetes—2023," Diabetes Care, vol. 46, no. Supplement_1, pp. S19–S40, Jan. 2023, doi: 10.2337/dc23-S002.
4. E. Cousin et al., "Burden of diabetes and hyperglycaemia in adults in the Americas, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019," Lancet Diabetes Endocrinol, vol. 10, no. 9, pp. 655–667, Sep. 2022, doi: 10.1016/S2213-8587(22)00186-3.
5. K. H. Kalan Farmanfarma, A. Ansari-Moghaddam, I. Zareban, and H. A. Adineh, "Prevalence of type 2 diabetes in Middle–East: Systematic review& meta-analysis," Prim Care Diabetes, vol. 14, no. 4, pp. 297–304, Aug. 2020, doi: 10.1016/j.pcd.2020.01.003.
6. "14. Children and Adolescents: Standards of Medical Care in Diabetes—2022," Diabetes Care, vol. 45, no. Supplement_1, pp. S208–S231, Jan. 2022, doi: 10.2337/dc22-S014.
7. S. E. Hampson et al., "Effects of educational and psychosocial interventions for adolescents with diabetes mellitus: a systematic review," Health Technol Assess (Rockv), vol. 5, no. 10, 2001, doi: 10.3310/hta5100.
8. S. Kahana, D. Drotar, and T. Frazier, "Meta-Analysis of Psychological Interventions to Promote Adherence to Treatment in Pediatric Chronic Health Conditions," J PediatrPsychol, vol. 33, no. 6, pp. 590–611, Jul. 2008, doi: 10.1093/jpepsy/jsm128.
9. A. Przezak, W. Bielka, and P. Molęda, "Fear of hypoglycemia—An underestimated problem," Brain Behav, vol. 12, no. 7, Jul. 2022, doi: 10.1002/brb3.2633.
10. O. Andreopoulouet al., "Evaluation of the possible impact of the fear of hypoglycemia on diabetes management in children and adolescents with type 1 diabetes mellitus and their parents: a cross-sectional study," Hormones, Apr. 2024, doi: 10.1007/s42000-024-00560-z.
11. A. Haugstvedt, T. Wentzel-Larsen, M. Aarflot, B. Rokne, and M. Graue, "Assessing fear of hypoglycemia in a population-based study among parents of children with type 1 diabetes – psychometric properties of the hypoglycemia fear survey – parent version," BMC EndocrDisord, vol. 15, no. 1, p. 2, Dec. 2015, doi: 10.1186/1472-6823-15-2.
12. Z. Zeng et al., "Health-related quality of life in Chinese individuals with type 2 diabetes mellitus: a multicenter cross-sectional study," Health Qual Life Outcomes, vol. 21, no. 1, p. 100, Aug. 2023, doi: 10.1186/s12955-023-02183-1.
13. D. Yildirim, C. ÇirişYildiz, E. Ergin, and İ. Özbay, "Hypoglycaemia fear, treatment adherence, and the quality of life in patients with type 2 diabetes and its determinants," Int J NursPract, vol. 30, no. 2, Apr. 2024, doi: 10.1111/ijn.13248.
14. M. J. Page et al., "The PRISMA 2020 statement: an updated guideline for reporting systematic reviews," BMJ, p. n71, Mar. 2021, doi: 10.1136/bmj.n71.
15. Sara Balduzzi and GertaRücker and Guido Schwarzer, "How to perform a meta-analysis with {R}: a practical tutorial," Evid Based Ment Health, vol. 22, pp. 153–160, 2019.
16. C. K.-L. Lo, D. Mertz, and M. Loeb, "Newcastle-Ottawa Scale: comparing reviewers' to authors' assessments," BMC Med Res Methodol, vol. 14, no. 1, p. 45, Dec. 2014, doi: 10.1186/1471-2288-14-45.
17. A. A. Al Hayek, A. A. Robert, R. B. Braham, B. A. Issa, and F. S. Al Sabaan, "Predictive Risk Factors for Fear of Hypoglycemia and Anxiety-Related Emotional Disorders among Adolescents with Type 1 Diabetes," Medical Principles and Practice, vol. 24, no. 3, pp. 222–230, 2015, doi: 10.1159/000375306.
18. A. A. Al Hayek, A. A. Robert, and M. A. Al Dawish, "Evaluation of FreeStyleLibre Flash Glucose Monitoring System on Glycemic Control, Health-Related Quality of Life, and Fear of Hypoglycemia in Patients with Type 1 Diabetes," Clin Med Insights Endocrinol Diabetes, vol. 10, p. 117955141774695, Jan. 2017, doi: 10.1177/1179551417746957.
19. K. Al Rubeaanet al., "Metabolic control and incidence of hypoglycaemia, hospitalisation and complications among Saudi patients with type 2 diabetes initiating second-line therapy: an analysis of the Saudi Arabia data from the DISCOVER Observational Study programme," BMJ Open, vol. 13, no. 8, p. e063586, Aug. 2023, doi: 10.1136/bmjopen-2022-063586.

20. A. M. Alosaimi, N. H. Alsulaimani, and W. A. Alotaibi, "Potential mechanisms for poor glycaemic control in patients with type two diabetes and fear of hypoglycaemia," J Diabetes MetabDisord, vol. 21, no. 2, pp. 1689–1697, Sep. 2022, doi: 10.1007/s40200-022-01123-y.
21. F. Amiri, M. Vafa, and L. Gonder-Frederick, "Glycemic Control, Self-Efficacy and Fear of Hypoglycemia Among Iranian Children with Type 1 Diabetes," Can J Diabetes, vol. 39, no. 4, pp. 302–307, Aug. 2015, doi: 10.1016/j.jcjd.2014.12.011.
22. P. Atallahet al., "Diabetes Management, Quality of Life and Treatment Satisfaction in Adult Population in Jordan and Lebanon, Observations from the SIMPLIFY Study," J Diabetes Mellitus, vol. 10, no. 02, pp. 73–87, 2020, doi: 10.4236/jdm.2020.102007.
23. H. Hakimi, P. A. Abadi, and M. Momeni, "Association Between Fear of Hypoglycemia and Treatment Satisfaction Among Patients With Diabetes Mellitus," Journal of Client-centered Nursing Care, vol. 10, no. 1, pp. 35–44, Jan. 2024, doi: 10.32598/JCCNC.10.1.452.1.
24. A. G. F. H. S. R. Maryam Momeni, "The relationship of health-related quality of life to fear of hypoglycemia among Iranian patients with type 2 diabetes treated with oral antihyperglycemic agents," Rom J Diabetes NutrMetab Dis, vol. 30, no. 1, pp. 73–83, 2023.
25. A. A. I. A. Shallya Omar, "Hypoglycaemia Fear among Diabetics ," Jordan Journal of Pharmaceutical Sciences, vol. 9, no. 2, 2016.
26. E. Salawati, "Mental Wellbeing and Quality of Life Among Patients With Diabetes Suffering FromHypoglycaemia in Saudi Arabia," Cureus, Aug. 2021, doi: 10.7759/cureus.17586.
27. H. R. Salimi, S. Jalili, M. D. Griffiths, and Z. Alimoradi, "Fear of hypoglycemia and its predictive factors among diabetic pregnant women," Prim Care Diabetes, vol. 17, no. 1, pp. 68–72, Feb. 2023, doi: 10.1016/j.pcd.2022.11.009.
28. H. R. Salimi, M. D. Griffiths, and Z. Alimoradi, "Prevalence of anxiety and depression among pregnant women with diabetes and their predictors," Diabetes Epidemiology and Management, vol. 14, p. 100198, Apr. 2024, doi: 10.1016/j.deman.2024.100198.
29. L. YekeFallah, P. Namdar, A. Jalalpour, F. Talebi, and M. H. Mafi, "The relationship between fear of hypoglycemia and sleep quality among type 2 diabetic patients," Clinical Diabetology, vol. 10, no. 1, pp. 149–154, Feb. 2021, doi: 10.5603/DK.2020.0057.
30. L. Yekefallah, M. Moradi, M. Javadi, A. Alizade, and M. H. Mafi, "Relationship between Fear of Hypoglycemia and Spiritual Well-Being in People with Type 2 Diabetes: A Single Center, Cross-Sectional Study from Iran," Clinical Diabetology, vol. 12, no. 2, pp. 87–94, Apr. 2023, doi: 10.5603/DK.a2023.0003.
31. D. J. Cox, A. Irvine, L. Gonder-Frederick, G. Nowacek, and J. Butterfield, "Fear of Hypoglycemia: Quantification, Validation, and Utilization," Diabetes Care, vol. 10, no. 5, pp. 617–621, Sep. 1987, doi: 10.2337/diacare.10.5.617.
32. W. H. Polonsky, L. Fisher, D. Hessler, J. Liu, L. Fan, and A. H. McAuliffe-Fogarty, "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, vol. 34, no. 7, p. 107606, Jul. 2020, doi: 10.1016/j.jdiacomp.2020.107606.
33. L. A. Gonder-Frederick et al., "Psychometric Properties of the Hypoglycemia Fear Survey-II for Adults With Type 1 Diabetes," Diabetes Care, vol. 34, no. 4, pp. 801–806, Apr. 2011, doi: 10.2337/dc10-1343.
34. E. Kostopoulouet al., "Translation and Validation Study of the Hypoglycemia Fear Survey in a Greek Population of Children and Adolescents with Type 1 Diabetes Mellitus and their Parents," Children, vol. 10, no. 9, p. 1458, Aug. 2023, doi: 10.3390/children10091458.
35. R. H. Maclean et al., "Hypoglycemia Subtypes in Type 1 Diabetes: An Exploration of the Hypoglycemia Fear Survey-II," Diabetes Care, vol. 45, no. 3, pp. 538–546, Mar. 2022, doi: 10.2337/dc21-1120.
36. S. R. Johnson, M. N. Cooper, E. A. Davis, and T. W. Jones, "Hypoglycaemia, fear of hypoglycaemia and quality of life in children with Type 1 diabetes and their parents," Diabetic Medicine, vol. 30, no. 9, pp. 1126–1131, Sep. 2013, doi: 10.1111/dme.12247.
37. V. Glocker, S. Bachmann, M. Hess, G. Szinnai, and M.-A. Burckhardt, "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), vol. 13, Jul. 2022, doi: 10.3389/fendo.2022.958671.

Table 1: Characteristics of included studies

Study ID	Country	Study design	Disease type	Participants, n	Age	Sex		FOH measure	Psychosocial and QoL measure
						Male	Female		
Al Hayek 2015	Saudi Arabia	cross-sectional study	T1DM	187	15.27 ± 1.61	92	95	HFS-C	SCARED

Salawati 2021	Saudi Arabia	cross-sectional study	T1DM, T1DM	603	NA	264	339	HFS	WHO, PAID-5
Yekefallah 2023	Iran	cross-sectional study	T2DM	380	56.89 ± 11.42	136	244	HFS	SWB
Al Hayek 2017	Saudi Arabia	cross-sectional study	T1DM	47	13-16: 18, 17-19: 29	20	27	HFS-C	PedsQL 3.0 DM
Alosaimi 2022	Saudi Arabia	cross-sectional study	T2DM	363	56.9 ± 13.8	163	200	HABS	NA
Amiri 2014	Iran	cross-sectional study	T1DM	61	9.2 ± 2.0	35	26	HFS-C	NA
Al Rubeaan 2023	Saudi Arabia	observational, longitudinal, prospective	T2DM	519	52.4±11	284	235	HFS-II	SF-36v2
Salimi 2024	Iran	cross-sectional study	T1DM, T1DM	350	31 ± 4.54	0	350	HFS-II	GSEQ, HADS
Salimi 2022	Iran	cross-sectional study	T1DM, T1DM, GDM	250	31.02 ± 4.72	0	250	HFS-II	GSEQ, HADS
Momeni 2022	Iran	cross-sectional study	T2DM	357	54.09 ± 11.5	155	202	HFS-II	NA
Hakimi 2024	Iran	cross-sectional study	T2DM	390	53.49±11.49	166	224	HFS-II	EQ-5D-3L
Atallah 2020	Lebanon, Jordan	cross-sectional study	T2DM	694	57.0 ± 11.0	388	356	HFS-II	ADDQoL
Omar 2016	Jordan	cross-sectional study	T1DM, T1DM	268	49.81±14.09	127	141	HFS	HRQoL
Yekefallah 2020	Iran	cross-sectional study	T2DM	400	55.75 ± 10.31	101	299	HFS-W	PSQI

Abbreviations:
HFS-C; Hypoglycemia Fear Survey – child version.
SCARED; Screen for Child Anxiety-Related Emotional Disorders.
PedsQL 3.0 DM;QoL in children and adolescents affected by diabetes.
SF-36v2; Short Form Health Survey version 2 Questionnaire.
HABS; Hypoglycemic Attitudes and Behavior Scale.
ADDQoL; Audit of Diabetes-Dependent Quality of Life.
EQ-5D-3L; The European Quality of Life scale.
WHO, PAID-5; The World Health Organization (WHO)-5 measure of mental wellbeing.
SWB; Spiritual Well-beingQuestionnaire.
FH-15; 15-item Fear of Hypoglycaemia scale.
GSEQ; The General Self-Efficacy Questionnaire.
HADS; The Hospital Anxiety and Depression Scale.

PSQI; The Pittsburgh Sleep Quality Index.
HRQoL; Health-Related Quality of Life questionnaire.
NA; not available.

Table 2: Results of quality assessment by Newcastle-Ottawa Scale for the included studies

Cross-sectional studies	Clearly stated aim	Selection				Comparability	Outcome		Total score	Overall quality
		Representativeness of the sample	Sample size	Non-respondents	Ascertainment of the exposure (risk factor)	Confounding factors are controlled	Assessment of outcome	Statistical test		
Al Hayek 2015	**	*	**	*	**	*	*	**	12	Good
Salawati 2021	*	**	**	*	**	*	*	*	11	Good
Yekefallah 2023	**	*	**	*	**	**	*	**	13	Good
Al Hayek 2017	**	*	**	*	**	*	*	**	13	Good
Alosaimi 2022	**	**	*	*	*	*	*	**	11	Good
Amiri 2014	*	**	**	*	**	*	*	*	11	Good
Salimi 2024	**	*	**	**	**	**	*	**	14	Good
Salimi 2022	**	**	**	**	**	*	*	**	14	Good
Momeni 2022	**	*	**	**	**	*	*	*	12	Good
Hakimi 2024	**	**	*	**	**	**	*	**	14	Good
Atallah 2020	**	*	**	*	**	*	*	**	12	Good
Omar 2016	*	**	**	**	**	*	*	**	13	Good
Yekefallah 2020	**	**	*	**	**	**	*	**	14	Good

Cohort studies	Selection				Comparability	Outcome			Total score	Overall quality
	Representativeness of the exposed cohort	Selection of the non-exposed cohort	Ascertainment of exposure	Demonstration that outcome of interest was not present at start of study	Comparability of cohorts on the basis of the design or analysis	Assessment of the outcome	Was follow-up long enough for outcomes to occur?	Adequacy of follow-up of cohorts		
Al Rubeaan 2023	*	*	*	*	-	*	-	*	6	Fair