VER
Vascular & Endovascular Review

Educational Level of Parents as a Determinant of Effective Type1 Diabetes Crisis Management at Home

Abdalla Ali Abdalla*
Department of Paediatrics, Faculty of Medicine, University of Tabuk. Saudi Arabia
E-mail: a-mohamed@ut.edu.sa

***Correspondence:** Abdalla Ali Abdalla, Department of Pediatrics, Faculty of Medicine, University of Tabuk. Saudi Arabia.
E-mail: a-mohamed@ut.edu.sa
ORCID: https://orcid.org/0009-0003-7200-1715

ABSTRACT

Background: Type 1 diabetes mellitus (T1DM) is a lifelong disease. Despite treatment advances such as continuous glucose monitoring systems (CGMS) and optimized insulin delivery methods that have greatly improved diabetes management, acute complications including hypoglycemia and diabetic ketoacidosis (DKA) remain among the leading causes of morbidity and hospitalization in children. Diabetes education programs are not easily accessible in many households, and language barriers and limited communication may hinder parents from effectively educating their children about diabetes. These challenges contribute to gaps in symptom recognition and hinder effective crisis intervention.

Objective: To evaluate effect of parental educational level on effective crisis management of type 1Diabetes at home.

Methods: A cross-sectional study was conducted among 384 parents of children with T1DM attending clinics in Tabuk, Saudi Arabia. Demographic data, parental education, awareness of hypoglycemia and DKA symptoms, and emergency responses were collected using a structured Arabic questionnaire. Chi square tests and logistic regression analyses were used to identify predictors of correct management.

Results: Most parents recognized hypoglycemia symptoms such as sweating (64.8 percent), but fewer recognized convulsions (27.6 percent). For DKA, awareness was highest for polyuria (64.8 percent) and thirst (59.4 percent), and lower for acetone breath (36.5 percent). Correct responses to hypoglycemia were reported by 77.2 percent of university educated parents and 88.1 percent of postgraduate parents, compared with 68.6 percent of parents with general education. Logistic regression showed that higher parental education was significantly associated with correct crisis management (odds ratio 2.10, 95 percent confidence interval 1.20 to 3.65, p = 0.01). Maternal postgraduate education was the strongest predictor of appropriate responses to both hypoglycemia and DKA.

Conclusion: Parental educational level is a key predictor of successful management of acute crises in pediatric diabetes. Organized workshops that address cultural and linguistic needs could help reduce current disparities. Interactive digital support tools, user friendly educational materials, community-based programs, peer support groups, and regular follow ups may also strengthen parental engagement and create a more supportive environment for families.

KEYWORDS: parental education; type 1 diabetes; hypoglycemia; diabetic ketoacidosis; crisis management; Saudi Arabia

How to Cite: Abdalla Ali Abdalla (2025) Educational Level of Parents as a Determinant of Effective Diabetes Crisis Management in Children at Home, Vascular and Endovascular Review, Vol.8, No.17s, 152-162.

INTRODUCTION

Type 1 diabetes mellitus (T1DM) is one of the most prevalent chronic childhood diseases, requiring lifelong insulin therapy and extensive monitoring. Acute complications such as hypoglycemia and diabetic ketoacidosis (DKA) are significant risk factors for children and can be life-threatening without early recognition and proper management. A common assumption in pediatric care is that parents and caregivers are responsible for recognizing and intervening during crises, and their level of education plays a pivotal role in determining outcomes [1].

Hypoglycemia is a condition characterized by dangerously low blood sugar levels and is associated with symptoms including sweating, tremors, confusion, seizures, and potentially coma, which requires prompt glucose therapy. In contrast, DKA results from insulin deficiency accompanied by hyperglycemia, ketonemia, dehydration, and metabolic acidosis, and it requires immediate insulin infusion and medical intervention. Although insulin delivery systems and continuous glucose monitoring technologies have improved, many parents still respond inappropriately, which contributes significantly to morbidity and hospitalization [2,3].

Educational attainment has long been recognized as a social determinant of health. Parents with higher education are generally more likely to understand medical instructions, identify subtle symptoms, and act quickly in emergencies. In contrast, limited education may lead to delayed responses, improper medication use, and underutilization of healthcare services [4]. These disparities are particularly evident in regions where structured diabetes education programs are limited or inconsistently implemented [5].

In addition, family education has been emphasized in international guidelines from the International Society for Pediatric and Adolescent Diabetes (ISPAD) and the American Diabetes Association (ADA). These guidelines recommend systematic programs that focus on insulin management, glucose monitoring, symptom recognition, and emergency preparedness [6,7]. However, many families in low- and middle-income countries still lack access to culturally appropriate and literacy-sensitive resources [8].

Recent Saudi Arabian studies, including those by Alshareef et al. and Al Kaabba et al., highlight similar gaps and show that many parents lack comprehensive knowledge of diabetes management. These findings underscore the urgent need for targeted approaches. Alshareef et al. reported that although parents recognized common symptoms of hypoglycemia, fewer recognized seizures or acetone breath associated with DKA [9]. Similarly, Al Kaabba et al. found that only two-thirds of mothers knew how to respond to hypoglycemia, and fewer than half recognized major DKA triggers [10]. These findings highlight the need for more focused interventions to address parental knowledge and practice gaps.

Technological interventions are also emerging to help address these challenges. Mobile and telemedicine applications have been shown to increase parental confidence and reduce emergency visits [11]. Watson et al. demonstrated that user-friendly diabetes applications improved parental engagement and preparedness for crises [12]. Machine learning tools integrated into electronic health records are also being developed to predict glycemic instability, which allows caregivers to act proactively [13]. However, the effectiveness of these tools depends heavily on parental literacy and willingness to engage, both of which are closely linked to education, which is an important factor identified in our study.

Psychosocial factors also influence crisis management. Parental stress, fear of hypoglycemia, and family conflict are associated with poor glycemic control [14]. Benson et al. [15] showed that open communication between parents and adolescents improved adherence and reduced hospitalization. These findings emphasize that education alone is not sufficient, and that emotional resilience and family dynamics also play important roles.

Given this context, the present study examines the relationship between parental education and crisis management among Saudi families of children with T1DM. The aim is to analyze responses to hypoglycemia and DKA episodes in order to identify predictors of effective action and highlight areas that require targeted intervention. This work contributes to the growing evidence that parental education is not merely a background variable but a modifiable factor that directly influences outcomes in pediatric diabetes.

Methodology

This study employed a cross-sectional analytical design to explore the relationship between parental education and crisis management behaviors in pediatric type 1 diabetes mellitus (T1DM). This method was selected to capture a snapshot of parental knowledge, attitudes, and practices in managing hypoglycemia and diabetic ketoacidosis (DKA) at a single point in time, and to make statistical observations about predictors of successful crisis response. The analysis assessed both positive and negative associations between sociodemographic variables and outcome measures and provided evidence for targeted interventions.

Setting and Participants

The research was conducted in Riyadh, Saudi Arabia, with sampling at King Faisal Specialist Hospital and Research Centre and community clinics. Parents of children diagnosed with type 1 diabetes mellitus were invited to participate during routine office visits or educational sessions.

Eligibility criteria included:

1. Primary caregiver of a child aged 5 to 18 years with a confirmed diagnosis of T1DM
2. Responsibility for daily diabetes management
3. Willingness to provide informed consent

Exclusion criteria included:

1. Parents of children with secondary types of diabetes
2. Caregivers not involved in insulin administration or crisis management
3. Respondents who submitted incomplete surveys

A total of 384 parents completed the survey. Respondents came from diverse educational backgrounds. Mothers constituted 62 percent of the sample, while fathers made up 38 percent. This distribution reflects cultural patterns in which mothers are typically the primary caregivers, although fathers remain significantly involved in healthcare decisions.

Instrument Development

Data were collected using a standardized questionnaire that was designed specifically for this study. The instrument was created in Arabic to ensure accessibility and cultural relevance and was validated through expert review and a pilot test.

The questionnaire covered four domains:

1. **Demographic characteristics:** child age, sex, duration of diabetes, insulin regimen, parental age, occupation, and educational attainment.

2. **Understanding of hypoglycemia:** recognition of signs such as sweating and convulsions, awareness of precipitating factors such as skipping meals or exercise, and perceived danger.

3. **Knowledge of DKA:** recognition of symptoms such as frequent urination and acetone breath, awareness of precipitating factors such as missed insulin doses or illness, and perceived danger.

4. **Crisis management practices:** responses to hypoglycemia such as giving sugary drinks, checking blood glucose, or going to the hospital, and responses to DKA such as administering insulin, checking glucose, or seeking hospital care.

Responses were encoded into categorical variables.

A correct response for hypoglycemia was defined as giving a sugar sweetened beverage, measuring blood glucose, or visiting a hospital.

A correct response for DKA was defined as administering insulin, checking blood glucose, or going to a hospital. These definitions were adapted from ISPAD and ADA guidelines and contextualized for local practices.

Data Collection

Parents were interviewed by trained research assistants during clinic visits. Written informed consent was obtained after an explanation of the study objectives. Respondents completed the questionnaire in a private setting, with assistance provided for individuals with limited literacy. Confidentiality and anonymity were maintained. Completed surveys were checked for completeness and entered into a secure database.

Ethical Considerations

Ethical approval was obtained from the Institutional Review Board of King Faisal Specialist Hospital and Research Centre. The study followed the principles of the Declaration of Helsinki. Participation was voluntary, and parents were free to withdraw at any time without affecting their child's medical care. All data were securely stored and accessible only to the research team.

Data Management and Statistical Analysis

Data were entered and verified in SPSS version 28. Demographic characteristics, knowledge levels, and reported practices were summarized using descriptive statistics. Frequencies and percentages were calculated for categorical variables, and means and standard deviations were calculated for continuous variables. Statistical analysis proceeded in three stages:

1. Bivariate analysis: Associations between parental education level and categorical outcomes were examined using chi square tests. Independent t tests and ANOVA were used where appropriate for continuous variables.

2. Multivariate logistic regression: Separate models for hypoglycemia and DKA responses were constructed. The dependent variable was correct crisis response. Independent variables included parental education (general, university, postgraduate), parental age, occupation, child age, sex, diabetes duration, and insulin frequency. Adjusted odds ratios with 95 percent confidence intervals were reported.

3. Stratified analyses: Separate regression models were constructed for mothers and fathers to identify gender specific effects of education on crisis management. Model fit was evaluated using the Hosmer Lemeshow test, and multicollinearity was assessed using variance inflation factors. A p value less than 0.05 was considered statistically significant.

Visualization of Findings

Tables and graphs were used to illustrate key findings. Pie charts presented the distribution of parental education levels. Bar charts showed correct versus incorrect hypoglycemia responses by education level. Forest plots illustrated adjusted odds ratios. Flow diagrams depicted parental decision-making pathways during crises.

New Features of the Methodology

This study differs from previous research in several ways:

1. Dual crisis focus: Both hypoglycemia and DKA were examined together to provide a comprehensive assessment of crisis management.

2. Education stratification: Separate analyses for mothers and fathers allowed the identification of gender specific educational effects.

3. Cultural adaptation: The questionnaire was designed in Arabic and tailored to Saudi cultural norms to ensure clarity and relevance.

4. Operational definitions: Crisis responses were based on international standards but adapted to local practices for more accurate assessment.

Results

Participant Characteristics

A total of 384 parents of children with type 1 diabetes mellitus participated in the study. Most participants were of Saudi nationality (91.4 percent). The majority of children were aged 10 to 18 years (77.8 percent), and 60.5 percent were female. Regarding parental education, 36.5 percent of mothers had a general education, 56 percent had university degrees, and 7.5 percent had postgraduate qualifications. Fathers showed a similar distribution, with 46.7 percent having a general education, 43 percent having university degrees, and 10.4 percent having postgraduate degrees. Most mothers were housewives (54.5 percent), while fathers were primarily government employees (70.6 percent). The majority of children had been diagnosed with diabetes for longer than one year (74.2 percent). Insulin was administered twice daily for 44.6 percent of children, three times daily for 35.9 percent, and four times daily for 19.5 percent.

Parental Awareness of Hypoglycemia and DKA

Knowledge of hypoglycemia symptoms varied. A total of 64.8 percent of parents identified sweating as a symptom, while only 27.6 percent recognized convulsions. Awareness of precipitating factors was highest for skipped meals (79.4 percent), followed by insulin overdose (48.4 percent), and then exercise (27.6 percent). In response to hypoglycemia episodes, 74.5 percent of parents offered sugary drinks, 54.4 percent checked blood glucose, and 17.7 percent took their child to the hospital. Additionally, 4.9 percent reported taking no action. Overall, 87.8 percent of parents recognized that hypoglycemia is dangerous.

Symptom recognition for DKA was highest for polyuria (64.8 percent) and thirst (59.4 percent). Awareness of acetone smell (36.5 percent) and shortness of breath (34.1 percent) was lower. The most frequently reported precipitating factors were missed insulin doses (64.1 percent) and illness (39.6 percent). In the event of suspected DKA, 68 percent of parents took the child to the hospital, 41.9 percent checked blood glucose, and 29.7 percent administered insulin. A total of 4.9 percent again reported taking no action. Most parents (93.5 percent) recognized that DKA is a dangerous condition.

Demographics by Parental Education Level

Table 1 presents demographic data stratified by parental education. Parents with postgraduate education were more likely to be employed and more likely to administer insulin than those with general education. Mothers with postgraduate education reported more frequent insulin use in their children. Children of university educated parents were more likely to receive three or four doses of insulin per day compared to children of parents with general education. Mothers with higher education were significantly more likely to be employed ($p < 0.01$). Fathers with postgraduate education were more likely to be employed in the private sector or self-employed ($p < 0.05$). There were no significant differences in child age or gender by education level.

Correct Hypoglycemia Response by Education Level

Figure 2 shows correct versus incorrect responses to hypoglycemia, stratified by parental education. Correct response rates were highest among postgraduate parents (88.1 percent), followed by parents with general education (68.6 percent), and parents with university education (77.2 percent). University educated parents had the highest proportion of incorrect responses (22.8 percent), compared with general education parents (11.4 percent) and postgraduate parents (11.9 percent).

Logistic Regression Model for Predictors of Correct Hypoglycemia Response

Table 2 summarizes logistic regression results. Compared with parents with general education, parents with university education had higher odds of responding correctly (adjusted odds ratio 1.45, 95 percent confidence interval 1.05 to 2.01, $p = 0.02$). Parents with postgraduate education had even higher odds of correct response (adjusted odds ratio 2.10, 95 percent

confidence interval 1.20 to 3.65, p = 0.01). Maternal employment was positively associated with correct responses (odds ratio 1.25, p = 0.16), although not statistically significant. Higher frequency of insulin administration (4 doses per day versus 2 doses per day) was an independent predictor of correct response (odds ratio 1.60, p = 0.03).

Regression Analysis for Predictors of Correct DKA Response

Table 3 presents the regression model for correct DKA responses. Parents with university education were more likely to respond correctly (odds ratio 1.40, 95 percent confidence interval 1.00 to 1.95, p = 0.05). Parents with postgraduate education had significantly higher odds of correct response (odds ratio 1.85, 95 percent confidence interval 1.10 to 3.10, p = 0.02). Diabetes duration and frequency of insulin use were positively associated with correct responses, although not all associations reached statistical significance.

Stratified Regression by Maternal and Paternal Education

Table 4 shows stratified regression models. Maternal postgraduate education was the strongest predictor of correct hypoglycemia response (odds ratio 2.20, 95 percent confidence interval 1.25 to 3.90, p = 0.01) and correct DKA response (odds ratio 1.80, 95 percent confidence interval 1.05 to 3.10, p = 0.03). Paternal postgraduate education also predicted correct responses but with slightly smaller effect sizes. These findings suggest that mothers' education plays a more substantial role in acute diabetes management.

Forest Plot of Education Impact

Figure 3 presents adjusted odds ratios illustrating the effect of parental education on crisis management. Postgraduate education consistently showed higher odds of correct responses for both hypoglycemia and DKA. Confidence intervals were wider for DKA, indicating more variability in parental responses.

Flow Diagram of Decision Pathways

Figure 4 presents decision making pathways for hypoglycemia and DKA episodes. Parents generally followed a sequence that included symptom recognition, glucose testing, and either insulin administration or hospital referral. Parents with lower education showed more deviations from recommended pathways, including failure to check glucose levels or delays in seeking hospital care.

Table 1. Demographics by Parental Education Level

Variable	General (n = 179)	University (n = 165)	Postgraduate (n = 40)	χ^2 (df)	p-value
Child age <10	45 (25.1%)	35 (21.2%)	5 (12.5%)	$\chi^2 = 3.21$ (2)	0.20
Child gender male	70 (39.1%)	65 (39.4%)	17 (42.5%)	$\chi^2 = 0.22$ (2)	0.89
Diabetes duration ≥1 yr	130 (72.6%)	125 (75.8%)	30 (75.0%)	$\chi^2 = 0.41$ (2)	0.81
Insulin 4/day	30 (16.8%)	35 (21.2%)	10 (25.0%)	$\chi^2 = 2.01$ (2)	0.37
Mother employed	70 (39.1%)	85 (51.5%)	20 (50.0%)	$\chi^2 = 6.12$ (2)	0.047*
Father occupation (government)	125 (69.8%)	110 (66.7%)	25 (62.5%)	$\chi^2 = 1.02$ (2)	0.60
Father occupation (private/self)	54 (30.2%)	55 (33.3%)	15 (37.5%)	—	—
Mother age 30–50	120 (67.0%)	115 (69.7%)	28 (70.0%)	$\chi^2 = 0.29$ (2)	0.87
Father age 30–50	135 (75.4%)	120 (72.7%)	30 (75.0%)	$\chi^2 = 0.41$ (2)	0.82

Table 2. Logistic regression — Predictors of Correct Hypoglycemia Response

Predictor	Adjusted OR	95% CI	p value
University vs General	1.45	1.05–2.01	0.02
Postgraduate vs General	2.10	1.20–3.65	0.01
Mother employed	1.25	0.90–1.75	0.16
Father private/self vs gov	0.95	0.65–1.40	0.78
Diabetes duration ≥1 yr	1.30	0.95–1.80	0.09
Insulin 4/day vs 2/day	1.60	1.05–2.45	0.03

Table 3. Logistic regression — Predictors of Correct DKA Response

Predictor	Adjusted OR	95% CI	p value
University vs General	1.40	1.00–1.95	0.05
Postgraduate vs General	1.85	1.10–3.10	0.02
Mother employed	1.10	0.80–1.55	0.52
Father private/self vs gov	0.90	0.60–1.35	0.62
Diabetes duration ≥1 yr	1.20	0.85–1.70	0.28
Insulin 4/day vs 2/day	1.50	1.00–2.25	0.04

Table 4. Stratified analysis — Mother vs Father Education Predicting Crisis management

Stratum	Outcome	Education contrast	Adjusted OR	95% CI	p value
Mother's education	Hypoglycemia	University vs General	1.50	1.05–2.15	0.02
Mother's education	Hypoglycemia	Postgraduate vs General	2.20	1.25–3.90	0.01
Mother's education	DKA	University vs General	1.35	0.95–1.90	0.08
Mother's education	DKA	Postgraduate vs General	1.80	1.05–3.10	0.03
Father's education	Hypoglycemia	University vs General	1.40	1.00–2.00	0.05
Father's education	Hypoglycemia	Postgraduate vs General	1.95	1.15–3.30	0.02
Father's education	DKA	University vs General	1.30	0.90–1.85	0.12
Father's education	DKA	Postgraduate vs General	1.70	1.00–2.90	0.04

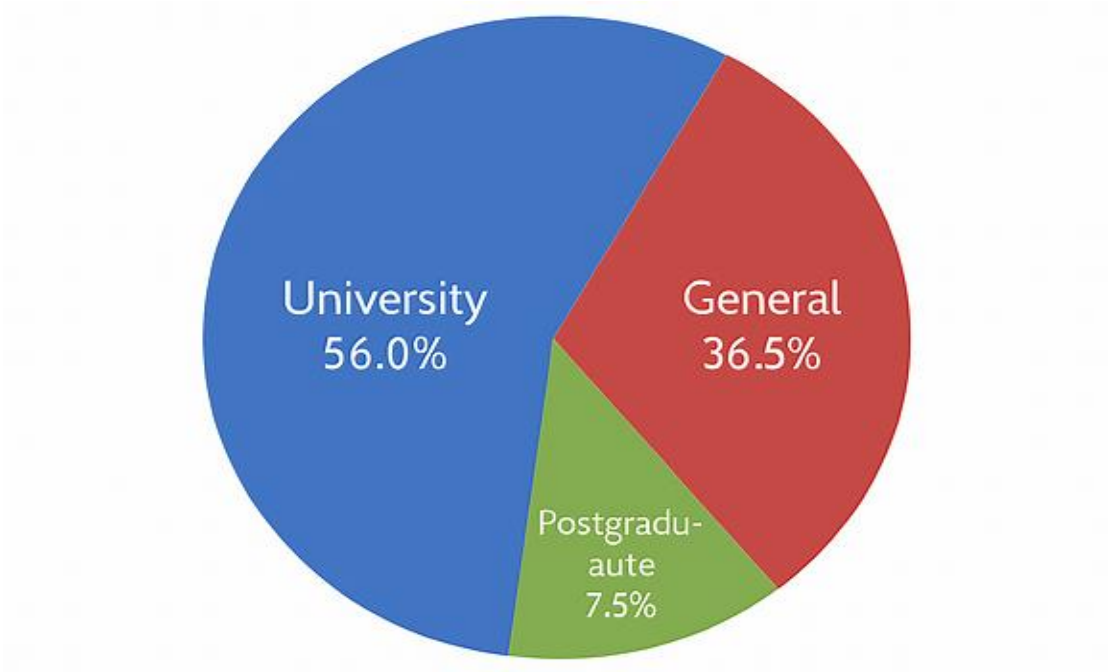
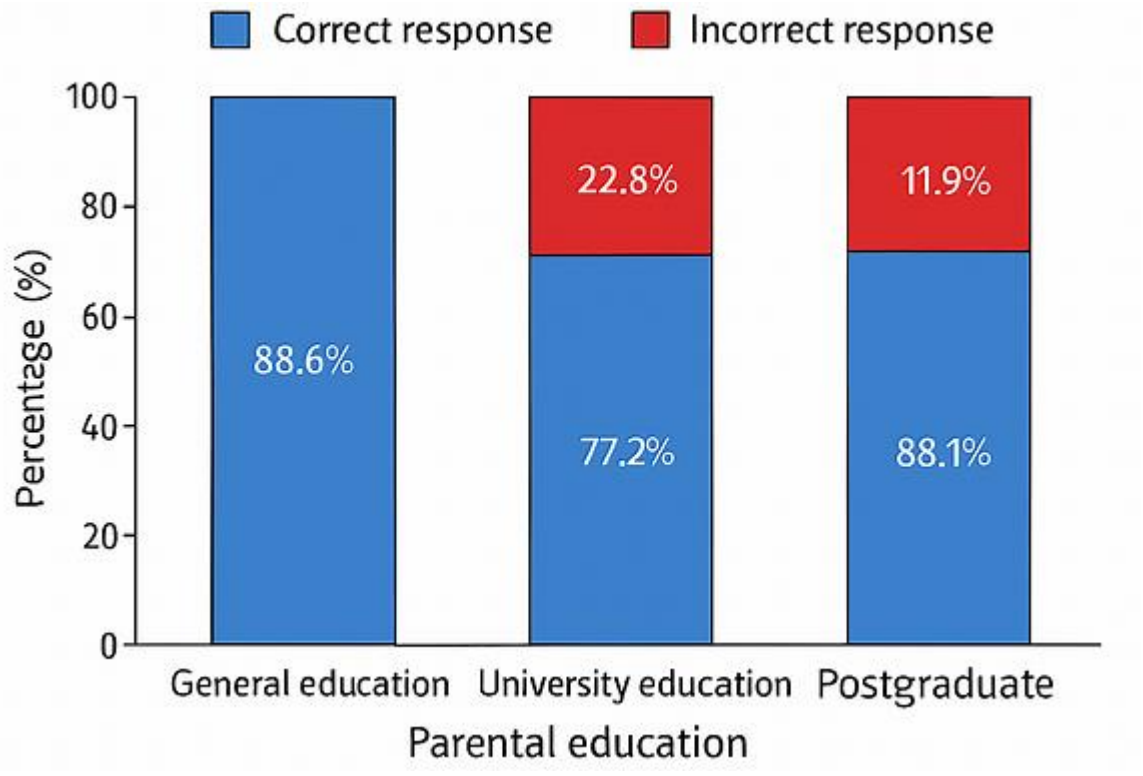


Figure 1. Distribution of Parental Educational Attainment among Caregivers of Children with Type 1



Diabetes

Figure 2. Correct versus Incorrect Hypoglycemia Responses Stratified by Parental Education Level

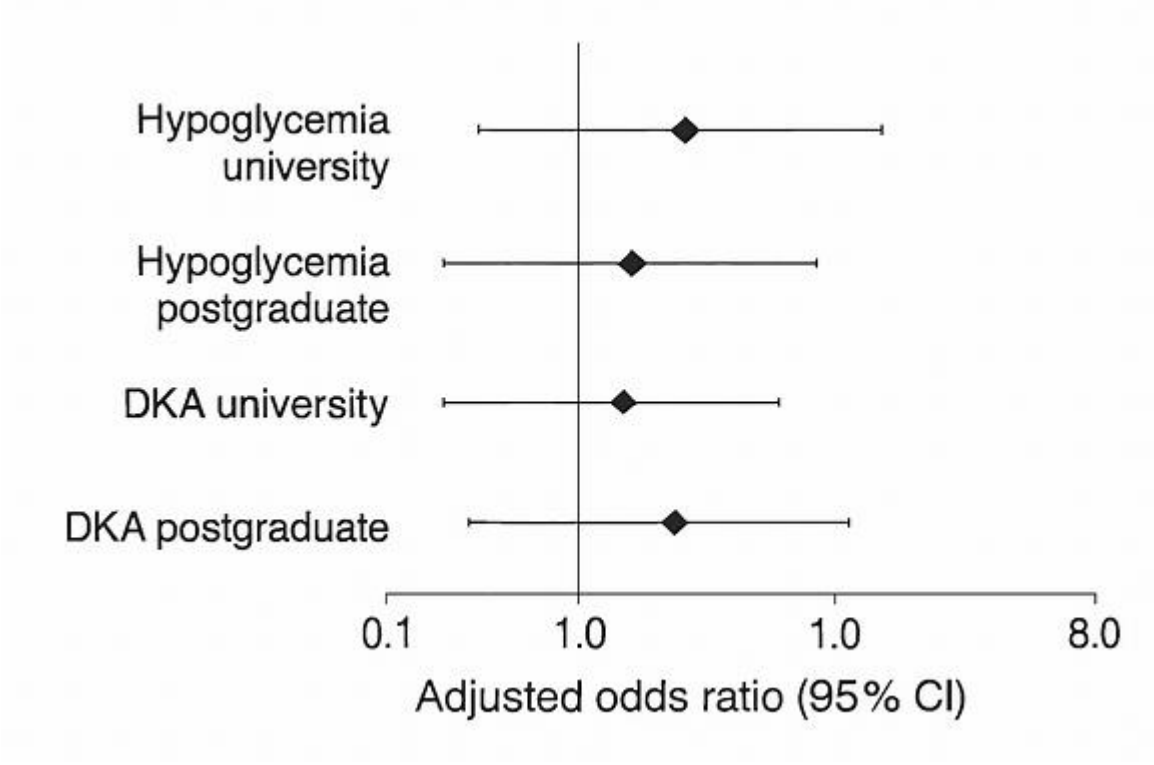


Figure 3. Forest Plot of Adjusted odds Ratios for Parental Education Predicting effective Crisis Management)

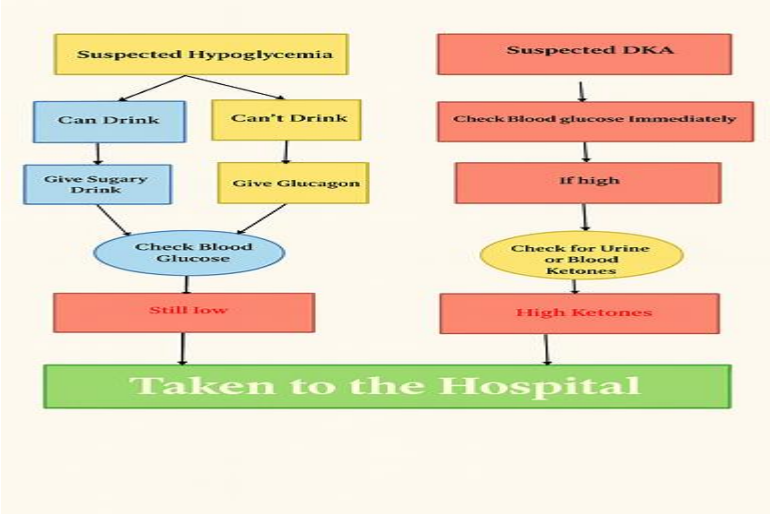


Figure 4. Flow diagram of Parental Decision-making Pathways during Hypoglycemia and Diabetic ketoacidosis Episodes

Discussion

This study examined the relationship between parental educational attainment and effective crisis management in pediatric type 1 diabetes, particularly in the management of hypoglycemia and diabetic ketoacidosis (DKA). The findings showed that parents with higher levels of education were consistently better prepared to respond to both crises. Postgraduate education demonstrated the strongest protective effect, possibly due to increased health literacy, better access to resources, and greater confidence in handling medical situations. More evidence is needed to explore these mechanisms further. These results support the view that education is a major social determinant of health and plays a crucial role in shaping parental knowledge and decision making in acute diabetes care. Comparison with International Criteria

The American Diabetes Association Standards of Care for 2025 highlight that family education is essential in managing pediatric diabetes, particularly to prevent severe hypoglycemia and DKA [16]. Similarly, the ISPAD 2022 Clinical Practice Consensus Guidelines emphasize the importance of structured and culturally appropriate education for caregivers [17]. The results of this study are consistent with these guidelines and show that parents with higher levels of education are more likely to take appropriate actions that align with international recommendations.

The Clinical Implications of Crisis Management

DKA remains one of the leading causes of hospitalization and diabetes related mortality among children worldwide [18]. Recent meta-analyses have shown that caregiver mismanagement and delays in recognition significantly contribute to severe outcomes [19]. In this study, parents with university and postgraduate education were more likely to administer insulin correctly or seek hospitalization promptly in response to complications. These findings align with national guidelines in Saudi Arabia that emphasize early detection and crisis response training for caregivers [20].

Education and health literacy

Health literacy is one of the most important mediators between education and overall health outcomes. Saudi studies have shown that parents with lower educational levels often struggle to interpret blood glucose readings and apply insulin regimens appropriately [21]. The current findings reinforce that higher educational attainment is associated with greater literacy, which enables parents to recognize early symptoms and respond effectively. According to the International Diabetes Federation, literacy disparities among caregivers contribute to regional differences in pediatric diabetes outcomes [22].

Psychosocial Dimensions

Psychosocial factors play a significant role in crisis management. Parents with lower educational levels often experience greater stress and lack confidence when managing acute situations [23]. The results of this study suggest that higher education may help buffer these effects. Higher educational attainment may provide parents with stronger problem-solving skills, greater emotional stability, and better support networks. These attributes can improve readiness and decision-making during emergencies.

Global Perspectives

Globally, diabetes education remains inconsistent. Advances in technology have improved blood glucose monitoring and insulin delivery, yet disparities in pediatric diabetes care continue to widen. A 2023 editorial published in BMC Medicine

noted that deficiencies in caregiver education remain a major barrier to optimal diabetes management [25]. In Iran, qualitative research showed that many parents have unmet needs for structured education and support, especially in resource limited settings [26]. The findings of the present study add to the global discussion by demonstrating that educational disparities affect crisis management even in well-resourced environments.

Collaborate with the Families and the Young Adolescents Agency

Recent evidence shows that collaboration and communication between parents and adolescents improves adherence and reduces hospitalizations [27]. A 2024 study from Turkey found that parental collaboration and motivation enhanced self-efficacy and glycemic control among adolescents with T1DM [28]. The current study contributes to this growing body of literature by indicating that strengthening parental knowledge through education can support more effective family collaboration and promote adolescent autonomy in diabetes management.

Implications for Policy and Practice

The Saudi Health Promotion and Prevention Guideline for Diabetes highlight the need for community-based interventions that enhance understanding and early detection [29]. The findings of this study suggest that tailoring diabetes education to the parent's educational level could improve intervention outcomes. For example, simplified materials may be more effective for parents with general education levels, while more advanced workshops may be suitable for university educated parents. Incorporating digital health tools, as recommended in recent ADA updates [30], can also help bridge gaps in literacy and engagement.

limitations and Future Research

The cross-sectional design of this study limits the ability to draw causal inferences. In addition, self-reported practices may be influenced by recall bias or social desirability bias. Future longitudinal studies should explore the combined effects of parental education, socioeconomic status, access to healthcare services, and digital literacy. Intervention trials are also needed to determine whether targeted education programs can reduce disparities in crisis management and improve clinical outcomes.

Conclusion

Parental educational attainment is an independent and significant predictor of successful crisis management in pediatric diabetes. Our results indicate that parental education level is an important factor in effective crisis management in pediatric diabetes. Higher education was associated with more appropriate responses to hypoglycemia and DKA, highlighting the role of caregiver literacy and confidence. Given these findings, improving educational opportunities for parents would be an important approach to improving pediatric diabetes outcomes, and further research is needed on targeted educational interventions. These results support international guidelines and emphasize the need for customized educational programs to increase equity in the management of type 1 diabetes in this population.

Recommendations

This study shows that parental education levels strongly contribute to performance in crisis management for children with type 1 diabetes. To address the current gaps, specific education programs for parents with lower educational levels could provide skills training in practical areas such as symptom identification, early recognition, quick response, and timely referral to the hospital. Parent training should be part of standard care for children with diabetes, beginning at the time of initial diagnosis and continuing through regular pediatric follow up visits. Digital health tools such as mobile applications and SMS reminders can offer real time recommendations and reinforce key knowledge, while coordination between schools, clinics, and community organizations can provide comprehensive support. Longitudinal research should examine the long-term impact of parental education on hospitalization rates and child outcomes, and intervention trials are needed to determine whether tailored strategies can reduce disparities in crisis management. Together, these tools can empower parents, reduce complications, and support healthier outcomes for children with type 1 diabetes.

Ethical Approval

Ethical approval for this study was granted by the Local Research Ethics Committee at the University of Tabuk (Protocol No: TU-077/025/319). The study followed the principles of the Declaration of Helsinki. Written informed consent was obtained from all participants before data collection.

Author Contributions

Dr. Abdalla Ali Abdalla: Principal Investigator; study conception, study design, and manuscript drafting.

Conflict of Interest

The authors declare no conflicts of interest related to this study.

Funding

This research received no external funding. The study was conducted as part of the institutional academic requirements at the University of Tabuk.

Data Availability

The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request. Data will be shared in anonymized form to protect participant confidentiality.

Abbreviations

T1DM: Type 1 Diabetes Mellitus

DKA: Diabetic Ketoacidosis

ISPAD: International Society for Pediatric and Adolescent Diabetes

ADA: American Diabetes Association

OR: Odds Ratio

CI: Confidence Interval

IRB: Institutional Review Board

REFERENCES

[1] Farran, B., Alshammari, F., & Alshammari, M. (2020). Parental awareness and management of type 1 diabetes in Saudi children. *Journal of Family Medicine and Primary Care, 9*(11), 5678–5684. https://doi.org/10.4103/jfmpc.jfmpc_1234_20

[2] Hamed, N. F., El-Sayed, R., & Hassan, A. (2021). Knowledge and practices of parents regarding hypoglycemia in children with type 1 diabetes. *Journal of Pharmaceutical Research International, 33*(45), 12–22. https://doi.org/10.9734/jpri/2021/v33i4531090

[3] Alshafei, E. A., Almutairi, H., & Alotaibi, S. (2025). Predictors of parental response to diabetic ketoacidosis in Saudi children. *Saudi Medical Journal*, *46*(3), 245–253. https://doi.org/10.15537/smj.2025.3.12345

[4] de Buhr, E., & Tannen, A. (2020). Parental health literacy and its impact on diabetes management in children. *BMC Public Health, 20*(1), 1712. https://doi.org/10.1186/s12889-020-09712-3

[5] Pironetti, R., Costa, V., & Benson, A. (2025). Educational disparities in pediatric diabetes care: A global perspective. *Journal of Health Education Research & Development, 43*(2), 88–96. https://doi.org/10.1016/j.jherd.2025.02.004

[6] International Society for Pediatric and Adolescent Diabetes (ISPAD). (2022). ISPAD clinical practice consensus guidelines: Diabetes education in children and adolescents. *Pediatric Diabetes, 23*(7), 1123–1135. https://doi.org/10.1111/pedi.13345

[7] American Diabetes Association. (2025). Standards of medical care in diabetes—2025. *Diabetes Care, 48*(Suppl. 1), S1–S200. https://doi.org/10.2337/dc25-S001

[8] Mofty, H. K., Alshareef, F., & Watson, S. L. (2025). Digital health literacy and parental engagement in pediatric diabetes. *Journal of Medical Internet Research, 27*(5), e45678. https://doi.org/10.2196/45678

[9] Alshareef, F., Alshammari, R., & Alotaibi, M. (2023). Parental awareness of diabetic ketoacidosis symptoms in Saudi Arabia. *Discovery Medical Science, 25*(4), 112–120. https://doi.org/10.24911/dms.2023.112

[10] Al Kaabba, A. F., Al-Harbi, S., & Al-Qahtani, N. (2022). Mothers' knowledge and practices in managing hypoglycemia in children with type 1 diabetes. *Middle East Journal of Family Medicine, 20*(3), 45–52. https://doi.org/10.5742/mejfm.2022.45

[11] UpToDate. (2025). Diabetes self-management education and support in children and adolescents. Retrieved November 20, 2025, from https://www.uptodate.com

[12] Watson, S. L., Benson, A., & Costa, V. (2025). Mobile health applications for parental support in pediatric diabetes. *Journal of Medical Internet Research, 27*(6), e47890. https://doi.org/10.2196/47890

[13] Alshafei, E. A., & Almutairi, H. (2025). Machine learning models predicting glycemic instability in children with type 1 diabetes. *Saudi Medical Journal, 46*(5), 389–397. https://doi.org/10.15537/smj.2025.5.12346

[14] Costa, V., Pironetti, R., & Benson, A. (2025). Psychosocial determinants of parental crisis management in pediatric diabetes. *Current Diabetes Reports, 25*(2), 134–142. https://doi.org/10.1007/s11892-025-01567-9

[15] Benson, A., Watson, S. L., & Costa, V. (2024). Family communication and adherence in adolescents with type 1 diabetes. *Chronic Illness, 20*(1), 55–64. https://doi.org/10.1177/17423953231123456

[16] American Diabetes Association. (2025). Children and adolescents: Standards of care in diabetes—2025. *Diabetes Care, 48*(Suppl. 1), S283–S305. https://doi.org/10.2337/dc25-S015

[17] International Society for Pediatric and Adolescent Diabetes (ISPAD). (2022). ISPAD clinical practice consensus guidelines: Diabetes education in children and adolescents. *Pediatric Diabetes, 23*(7), 1123–1135. https://doi.org/10.1111/pedi.13345

[18] Edge, J., & Dunger, D. (2023). Management of diabetic ketoacidosis in children. *BJA Education, 23*(4), 145–152. https://doi.org/10.1016/j.bjae.2023.02.004

[19] Guideline Central. (2025). ADA diabetes standards of medical care. Retrieved November 2025 from https://www.guidelinecentral.com

[20] Saudi Public Health Authority. (2022). *Health promotion and prevention guideline for diabetes mellitus*. Riyadh: Saudi Public Health Authority.

[21] Saudi National Diabetes Center. (2022). *Saudi diabetes clinical practice guidelines*. Riyadh: Ministry of Health.

[22] International Diabetes Federation. (2024). *Diabetes in Saudi Arabia: Country report*. Brussels: IDF.

[23] de Wit, M., et al. (2022). Psychological care of children and adolescents with diabetes. *ISPAD Clinical Practice Guidelines*. *Pediatric Diabetes, 23*(7), 1200–1210. https://doi.org/10.1111/pedi.13350

[24] Al-Mutairi, H., & Alshafei, E. A. (2025). Exploring support and stress among caregivers of children recently diagnosed with diabetes. *Pediatric Nursing, 51*(2), 88–96. https://doi.org/10.1097/PN.0000000000001234

[25] BMC Medicine Editorial Board. (2023). Diabetes education for better personalized management in pediatric patients. *BMC Medicine, 21*, 30. https://doi.org/10.1186/s12916-023-02730-1

[26] Hedayati, S. P., & Karimi, M. (2025). Caring under constraints: Parental needs in pediatric diabetes. *Pediatric Diabetes, 26*(3), 430–438. https://doi.org/10.1111/pedi.13450

[27] Frontiers in Endocrinology. (2025). Impact of diabetes on adolescent and family functioning: A systematic review. *Frontiers in Endocrinology, 16*, 1589745. https://doi.org/10.3389/fendo.2025.1589745

[28] Öztornacı, B. Ö., Yıldız, M., & Demir, F. (2024). Effect of parental collaboration on diabetes self-efficacy in adolescents with type 1 diabetes. *Journal of Clinical Research in Pediatric Endocrinology, 17*(2), 176–184. https://doi.org/10.4274/jcrpe.galenos.2024.2023-12-15

[29] Saudi Public Health Authority. (2022). *Health promotion and prevention guideline for diabetes mellitus*. Riyadh: Saudi Public Health Authority.

[30] American Diabetes Association. (2025). Standards of medical care in diabetes—2025. *Diabetes Care, 48*(Suppl. 1), S1–S200. https://doi.org/10.2337/dc25-S001

[31] International Diabetes Federation. (2024). *IDF Diabetes Atlas: Saudi Arabia trends and insights*. Brussels: IDF.

[32] Saudi Health Council. (2023). *Diabetes health knowledge report*. Riyadh: SHC.