ORIGINAL ARTICLE

Enhancing Mothers' Knowledge of Non-Pharmacological Pain Management in Children with Type 1 Diabetes Mellitus (T1DM): An Educational Intervention

Athmar A. Shaheed, MSc;
Khatam M. AL-Mousawi, MSc

Department of Pediatric Nursing, University of Baghdad, Baghdad, Iraq

Correspondence:
Athmar A. Shaheed,
Department of Pediatric Nursing, University of Baghdad, Baghdad, Iraq
Email: Athmar.Ali2204m@conursing.uobaghdad.edu.iq
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Abstract

Background: Mothers play a crucial role in managing pain in children with Type 1 Diabetes Mellitus (T1DM). Non-pharmacological methods are essential in pain management, but mothers' knowledge in this area is often limited. This study aimed to determine the effect of an educational intervention on mothers' knowledge regarding non-pharmacological methods of pain management in children with T1DM in Merjan Medical City - Al Hillah in Iraq.

Methods: A non-probability sample of 110 mothers was initially selected. However, 10 mothers were included in a pilot study, leaving 100 mothers for the main study. These 100 mothers were randomly assigned to either the intervention group (50 mothers) or the control group (50 mothers). The intervention group received a 6-session educational intervention, each lasting 50 minutes, focusing on T1DM management and non-pharmacological pain management strategies. A self-developed questionnaire assessed mothers' knowledge at three distinct time points: before the intervention, immediately after, and three months post-intervention.

Results: No significant differences were found between the groups before the intervention. However, the intervention group showed significant improvement in the knowledge of T1DM scores ($P<0.001$) and non-pharmacological pain management strategies scores ($P<0.001$) immediately and three months after the intervention, with a mean increase of 7.1 and 7.34 points, respectively. No significant change was observed in the control group.

Conclusion: The study demonstrates the effectiveness of an educational intervention in improving the mothers' knowledge of non-pharmacological pain management strategies for children with T1DM. The findings highlight the need for healthcare providers to prioritize education and support for mothers, empowering them to manage their children's pain effectively. Future studies should build on the findings of this study by exploring the long-term effects of educational interventions on mothers' knowledge and skills as well as the impact on health outcomes for children with T1DM.

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Introduction

Type 1 diabetes mellitus (T1DM) is a chronic autoimmune disease that leads to the destruction of pancreatic β cells, resulting in complete insulin deficiency.[1] Recent epidemiological studies have revealed significant changes in the incidence and prevalence of T1DM worldwide.[2, 3] Despite the increasing incidence of type 2 diabetes mellitus (T2DM) among the youth, T1DM remains the most common type of diabetes in children, accounting for approximately two-thirds of newly diagnosed cases in the United States under the age of 19. Globally, T1DM accounts for 85% or more of all diabetes cases in youth under the age of 20.[4, 5] Also, the incidence of T1DM has been increasing, with a 3-5% annual rise, particularly among younger children.[1, 6] The EURODIAB study found that the 0-4 age group had the largest increase in the annual incidence of T1DM.[1]

Iraq's healthcare system has been severely impacted by ongoing wars and conflicts, leading to disruptions in health[7] that affect the management of T1DM in children.[8] Consistent with the global trend, diabetes prevalence is also increasing in Iraq, where it has risen from 5% in 1978 to 19.7% in 2012, with a staggering 48.8% of the population exhibiting dysglycemia.[8] Almahfoodh et al. reported that, in Basra City, the incidence of type 1 diabetes mellitus (T1DM) among individuals 40 years old and younger was 87 per 100,000 in 2016. Between 2012 and 2016, a total of 818 new cases of T1DM were identified, resulting in an average annual incidence rate of 7.4 per 100,000 among this age group.[7] On the other hand, according to a study conducted by Hayder Zalzala et al., the prevalence of type 1 diabetes mellitus (T1DM) among primary school children in Baghdad, Iraq, was 159 per 100,000. The study, which was conducted on 141 schools, revealed that out of a total of 69,115 primary school students, 110 were diagnosed with T1DM.[9]

The cornerstone of managing T1DM in children is administering insulin therapy, which requires adherence to insulin injections and monitoring blood glucose levels to achieve optimal outcomes.[10] However, the fear and pain associated with insulin injections can lead to non-adherence, skipped doses, and negatively impact diabetes self-management.[11, 12] Research has shown that children with high levels of insulin injection-related fear tend to have higher HbA1c levels and are more likely to experience long-term complications.[13, 14] Addressing fear and pain associated with insulin injections is a key component of pediatric diabetes management, as it can significantly impact a child's adherence to insulin therapy, glycemic control, and overall risk of long-term complications.[12, 13] Overall, T1DM, especially among children, is a complex condition that requires a multifaceted approach to management, including education, support, and empowerment of individuals with the condition, as well as ongoing research to better understand its causes and improve treatment outcomes.[15]

In the management of pain in children with T1DM, a comprehensive approach is necessary, incorporating both pharmacological and non-pharmacological strategies.[16] While pharmacological interventions are essential, non-pharmacological methods play a critical role in enhancing pain management, especially in pediatric care. These methods are widely recognized as valuable adjunctive strategies that can be utilized independently or in combination with medication to provide comprehensive pain management. Various non-pharmacological techniques have been employed to reduce pain in children during painful medical procedures, with the notable exception of subcutaneous insulin injections.[12]

Research has recently focused on mothers' management of their children's pain, as it is recognized that a significant portion of pediatric pain care takes place in this setting. Despite being primarily responsible for their children's pain care, mothers have been found to have limited knowledge of the use of non-pharmacological methods to manage their children's pain.[3] Given the importance of mothers' knowledge of non-pharmacological methods in the management of pain in children with T1DM, this study aimed to determine the effect of an educational intervention based on planned effect of an educational intervention on mothers' knowledge regarding non-pharmacological methods of pain management in children with type 1 diabetes mellitus referred to diabetes and endocrinology Center at Merjan Medical City - Al Hillah in Iraq in 2023. The educational intervention of this study focused on providing mothers with knowledge and skills related to cognitive-behavioral therapy, physical therapy, emotional support, provision of a supportive environment, and assistance with daily life activities. These strategies were selected for their relevance in managing pain associated with T1DM, encompassing a holistic approach to care going beyond immediate pain relief during medical procedures.

Methods

Research Design and Participants

This study was conducted at the Diabetes and Endocrinology Center at Merjan Medical City in Hillah, Iraq, using a quasi-experimental design. The study was conducted from December 7, 2023, to April 2, 2024. Participants were randomly assigned to either a study group or a control group to assess the impact of the program on mothers' knowledge of non-pharmacological pain management strategies. The sample size for this study was determined by

referencing a similar study[17] and considering several key factors. These factors included a test power of 80%, a confidence coefficient of 95%, an accuracy of 0.05, and an anticipated sample loss of 10%. Based on these parameters, it was calculated that 50 participants would be required for each group.

The initial sample included 110 mothers, from whom 10 were selected for a pilot study to test the research instruments and procedures. The remaining 100 mothers were randomly assigned to either the intervention group (50 mothers) or the control group (50 mothers). Participants were selected using a non-probability (convenience) sampling method. Inclusion criteria were being able to read and write, having a child diagnosed with T1DM within the past year, and not having received prior education on non-pharmacological pain management. Mothers who refused to participate or could not attend at least three training sessions were excluded.

The questionnaire in this study was authorized by the College of Nursing Ethical Committee of Research. The Iraqi Ministry of Planning and the Ministry of Health granted agreement for data gathering, and participation in the study was voluntary. A written consent form was provided, allowing the subjects to withdraw from the study at any moment, with or without a valid reason. Before giving their consent to participate in the study, participants were made aware of their role in the research and the importance of keeping their data confidential.

Measurement

The questionnaire consisted of three sections. The first section gathered demographic data, including age, education level, occupation, family size, residency, and prior knowledge of the topic. The second section assessed the mothers' knowledge of T1DM with 24 items. The third section evaluated the mothers' knowledge of non-pharmacological pain management strategies, comprising 29 items across five dimensions: cognitive behavioral therapy (6 items), physical therapy (5 items), emotional support (6 items), provision of a supportive environment (6 items), and assistance in daily life activities (6 items). Participants selected one correct answer from four options, with each correct answer scoring 1 and each incorrect answer scoring 0.

To assess the content validity of the questionnaire, we employed both the Content Validity Index (CVI) and the Content Validity Ratio (CVR). Sixteen experts in pediatric nursing and pain management were asked to rate the relevance of each item (1=non-relevant, 2=requires revision, 3=relevant but it requires revision, 4=relevant) to assess CVI, and the necessity of each item (1=essential, 2=useful but not essential, 3=not essential) to assess CVR. Acceptable values for CVI and CVR were considered to be >0.70 and 0.49, respectively.[18] External reliability was evaluated using a test-retest method. A subset of 20 participants completed the questionnaire on two separate occasions, with a two-week interval between administrations. The stability of the responses was measured using the Intraclass Correlation Coefficient (ICC), which quantifies the consistency of responses over time. Additionally, the internal consistency was assessed by a Cronbach's Alpha coefficient. Acceptable values were considered to be >0.70.[19]

Educational Intervention

The intervention group received a 6-session educational intervention, comprising a lecture, group discussion, demonstration, and practice of non-pharmacological pain management strategies, as well as information about T1DM, with question-and-answer sessions, each lasting 50 minutes. These educational sessions, hosted at the Diabetes Centre Hall, featured instructive videos, graphics, and PowerPoint presentations. The content was carefully compiled and implemented based on the second part and five dimensions of the third part of the designed questionnaire, covering cognitive behavioral therapy, physical therapy, emotional support, provision of a supportive environment, and assistance in daily life activities. The educational intervention provided to mothers was designed to address both the physical and emotional aspects of managing insulin injections for children with T1DM. The key components of the intervention were:

1. Pain Management Techniques:

- Physical Techniques: Mothers were taught various physical strategies to reduce pain during insulin injections, such as proper injection techniques, use of distraction methods (e.g., focusing the child's attention elsewhere during the injection), and application of cold or vibration to the injection site prior to administering the injection.

- Cognitive-Behavioral Strategies: These included teaching mothers how to guide their children through breathing exercises and relaxation techniques to manage anxiety and pain associated with injections.

2- Emotional Support:

- Communication Skills: Mothers were trained on how to talk to their children about the importance of insulin injections and how to address their concerns and fears effectively.

- Creating a Supportive Environment: The intervention emphasized the importance of a nurturing and supportive home environment that can alleviate stress and anxiety related to diabetes management.

As part of the educational intervention, a Telegram

channel was established to provide ongoing support and information to the participating mothers. The channel served several purposes: 1- Reinforcement of Session Content: Weekly reminders and additional resources were shared to reinforce the information provided during the educational sessions. 2- Peer Support: The channel facilitated communication among mothers, allowing them to share experiences and support each other. 3- Direct Access to Educators: Mothers could ask questions and receive answers from the educators, ensuring that they had continuous access to expert advice. The effectiveness of the Telegram channel was evaluated using the following metrics: 1- Engagement Rate: The frequency and type of interactions within the channel (e.g., posts viewed, questions asked, and discussions initiated) were tracked and analyzed. High engagement indicated that mothers were actively utilizing the resource. 2- Feedback Surveys: At the end of the intervention, mothers were asked to complete a survey evaluating the usefulness of the Telegram channel in helping them apply the knowledge gained from the sessions. The survey included questions about how often they used the channel, how helpful they found the information, and whether it improved their ability to manage their child's pain. 3- Knowledge Retention: A follow-up assessment of the mothers' knowledge was conducted three months after the intervention. The results were compared to those immediately after the intervention to determine if ongoing engagement through the Telegram channel contributed to better knowledge retention.

Data Analysis

In the two evaluation phases, histograms and Kolmogorov-Smirnov tests were employed to assess the normality of the data distribution and skewness. As all dependent variables were normally distributed, independent t-tests, Repeated Measures ANOVA (RMA), and chi-square tests were used. Data analysis was performed using SPSS 26 software (IBM Corp, Armonk, NY, USA). A P value of ≤0.05 was considered statistically significant.

Results

The mean age of the participants in the intervention group was 40.2±10.14 years, while the control group had a mean age of 39.7±7.44 years (P=0.16). A chi-square test showed that there was no significant difference between the two groups in terms of age group (P=0.280), education level (P=0.462), occupation (*P*=0.170), family size (P=0.324), and residency (P=0.574) (Table 1).

The knowledge questionnaire demonstrated strong psychometric properties. The CVI for the individual items ranged from 0.80 to 1.00, with an overall scale-level CVI of 0.91. CVR for the items ranged from 0.78 to 0.92, with an average CVR of 0.81. The ICC and Cronbach's alpha values obtained were 0.82 and 0.86, indicating good reliability.

As shown in Table 2, the study findings revealed no notable differences between the two groups before the intervention regarding their knowledge of T1DM (P=0.576) and non-pharmacological pain management strategies (P=0.535). However, a significant improvement in scores was observed in the intervention group compared to the control group, both immediately and three months after the intervention. Conversely, no significant change was detected in the control group. The study revealed a significant increase in the mean scores of knowledge of T1DM and non-pharmacological pain management strategies in the intervention group, with a rise of 7.1 and 7.34 points, respectively, three months after the intervention compared to the baseline. In contrast, no notable change was observed in the control group.

Discussion

The present study aimed to investigate the effect of an educational intervention on mothers' knowledge regarding non-pharmacological methods of pain

Table 1: Frequency distribution of the intervention and control groups according to sociodemographic characteristics

Variable		Intervention group		Control group		P value
		No	%	N	%	
Age	25 – 35	14	28	16	32	0.28
	36 – 45	20	40	22	44	
	45<	16	32	12	24	
Education	Primary school	10	20	10	20	0.462
	Secondary school	18	36	18	36	
	Diploma	2	4	6	12	
	Academic Degree	20	40	16	32	
Occupation	Employed	26	52	28	56	0.170
	Housewife	24	48	22	44	
Number of family member	1 – 3	4	8	3	6	0.324
	4 – 6	34	68	36	72	
	7 or more	12	24	11	22	
Residency	Rural	8	0.16	10	0.20	0.574
	Urban	42	0.84	40	0.80	

Table 2: Comparison of the mean scores of knowledge of T1DM and knowledge of non-pharmacological pain management strategies in the intervention and control groups

Variable	Group	Before intervention M±SD	Immediately after intervention M±SD	Three months after intervention M±SD	P value test RMA	P value (Time*Group interaction)	Effect size (Cohen's d)
Knowledge of T1DM	Intervention	9.74±5.34	17.56±3.53	16.84±3.70	<0.001	<0.001	d=1.05
	Control	10.32±5.0	11.78±5.74	11.18±5.34	0.180	<0.001	d=0.12
	P value	0.576	<0.001	<0.001			
Knowledge of non-pharmacological pain management strategies	Intervention	11.18±5.85	20.26±5.69	18.52±5.81	<0.001	<0.001	d=1.22
	Control	10.48±5.37	12.1±6.74	11.58±6.46	0.131	<0.001	d=0.13
	P value	0.535	<0.001	<0.001			

management in children with T1DM at the Diabetes and Endocrinology Center at Merjan Medical City in Al Hillah, Iraq. This pioneering study breaks new ground as the inaugural investigation in the field of education for Iraqi mothers, specifically focusing on the impact of an educational intervention on mothers' knowledge regarding non-pharmacological methods of pain management in children with Type 1 Diabetes Mellitus (T1DM). This novelty is significant as it addresses a critical gap in the existing literature and provides a foundation for future research.

The pre-intervention assessment revealed that a significant number of mothers had low scores on the knowledge questionnaire, particularly in areas related to cognitive-behavioral therapy and physical pain management techniques. This indicated a lack of understanding of these strategies before participating in the educational intervention. This outcome is consistent with the results of a study conducted by Abd El-Gawad[20] and AL-Abedi and Abdul.[21] These results emphasize the need for healthcare providers to prioritize education and support for mothers, recognizing their critical role in managing their children's condition and promoting better health outcomes. By providing mothers with the necessary knowledge and skills, educational interventions can play a critical role in improving health outcomes for children with T1DM.[22]

The results of this study demonstrated a significant improvement in the knowledge of T1DM and non-pharmacological pain management strategies among mothers in the intervention group, both immediately and three months after the intervention, compared to the control group. This improvement is reflected in the significant increase in the mean scores of knowledge of T1DM and non-pharmacological pain management strategies, with a rise of 7.1 and 7.34 points, respectively, three months after the intervention compared to the baseline. These findings are consistent with those of previous studies that have shown the effectiveness of educational interventions in improving knowledge and skills among mothers of children with chronic illnesses.[21, 23, 24]

The significant improvement in knowledge scores among mothers in the intervention group suggests that the educational intervention was successful in enhancing their understanding of T1DM and non-pharmacological pain management strategies. This is particularly important in the context of T1DM, where effective pain management is critical for improving quality of life and reducing the risk of complications.[25, 26]

The study findings have important implications for healthcare practice and policy.

The results suggest that educational interventions can play a crucial role in empowering mothers with the knowledge necessary to support pain management in their children, which may contribute to improvements in their overall quality of life. This is particularly important in low-resource settings, where access to healthcare resources and education may be limited.[27-29] The findings also highlight the need for healthcare providers to prioritize education and support for mothers of children with T1DM, as they are critical caregivers and play a vital role in managing their children's condition.[30-32]

The present study successfully demonstrated significant improvements in mothers' knowledge regarding non-pharmacological pain management strategies for children with T1DM. However, it is crucial to recognize that knowledge alone may not fully capture the effectiveness of educational interventions. Attitudes and behaviors are critical components in the practical application of knowledge, particularly in the context of managing chronic conditions like T1DM.

While this study primarily focused on the enhancement of knowledge, future research should aim to assess the impact of educational interventions on attitudes and behaviors as well. Evaluating how increased knowledge influences mothers' confidence, motivation, and actual practices in managing their children's pain would provide a more comprehensive understanding of the intervention's effectiveness.

We acknowledge that the assumption that education increases knowledge is well-established. However, to gain a deeper insight into the true impact of educational programs, it is necessary to explore how this knowledge translates into changes in attitudes

and behaviors. Understanding these aspects would provide healthcare providers with more informative and actionable findings, ultimately leading to more effective and sustainable improvements in patient care. While the increase in knowledge is a positive outcome, it is essential to understand how this knowledge translates into practice and whether it leads to tangible improvements in children's health outcomes. By incorporating assessments of pain intensity, quality of life, and stress both before and after the intervention, future studies can offer a clearer picture of the impact of interventions.

Upon reviewing the data and comparing it to existing literature, our study did not reveal any significant findings that directly contradict previous research on non-pharmacological pain management strategies in children with T1DM. However, it is noteworthy that while some studies have predominantly focused on pharmacological approaches to pain management, our study emphasizes non-pharmacological methods and found that educating mothers significantly improved their knowledge in this area. This aligns with some recent trends in pediatric pain management but contrasts with older studies that did not consider or undervalued the role of parental education in pain management.

One unexpected result was the extent to which the educational intervention improved knowledge retention over three months. While it was anticipated that knowledge would increase immediately following the intervention, the sustained improvement suggests that the educational approach, including the use of the Telegram channel, may have longer-lasting effects than initially expected. This finding could indicate that digital follow-up tools contribute more significantly to knowledge retention than previously understood, a topic that merits further investigation.

Limitations

While this study provides valuable insights into the effectiveness of an educational intervention aiming at improving mothers' knowledge of non-pharmacological pain management for children with Type 1 Diabetes Mellitus (T1DM), there are several limitations to consider when generalizing the findings to other populations or healthcare settings:

1. Cultural and Socioeconomic Context:

- The study was conducted in a specific cultural and socioeconomic context within a single country. The participants' cultural beliefs, health literacy levels, and access to healthcare resources may differ significantly from those in other regions or countries. Therefore, the educational strategies that proved effective in this study may not be directly applicable or as effective in different cultural settings without appropriate adaptations.

2. Sample Characteristics: The study sample consisted of mothers who were willing and able to participate in an educational intervention, which may introduce selection bias. These mothers might be more motivated or have higher baseline knowledge compared to the general population of caregivers for children with T1DM. This limits the generalizability of the findings to mothers who are less engaged or have different educational backgrounds.

3. Healthcare Infrastructure: The healthcare setting in which the study was conducted may have specific characteristics, such as the availability of diabetes education resources, access to healthcare professionals, and the integration of digital tools like the Telegram channel. In healthcare settings where these resources are limited or where different healthcare delivery models are used, the intervention's effectiveness may vary.

4. Digital Literacy: The use of a Telegram channel for follow-up and ongoing support is innovative, but it assumes a certain level of digital literacy and access to technology among the participants. In populations with lower digital literacy or limited access to smartphones and the Internet, the effectiveness of this component of the intervention may be diminished, reducing the overall impact of the program.

5. Duration of the Study: The study measured knowledge retention three months after the intervention, but it did not assess long-term outcomes beyond this period. The sustainability of the knowledge gained and its impact on long-term pain management practices and health outcomes in children with T1DM remain uncertain. Further research is needed to determine whether the effects observed are maintained over a longer period and in different settings.

6-. While the intervention aimed to increase the mothers' knowledge of pain management and emotional support techniques, it was expected that these improvements in maternal knowledge would lead to better pain management for the children, potentially improving their overall quality of life. However, it is important to note that the study did not directly measure outcome variables such as pain intensity, quality of life, or stress levels in children before and after the intervention.

Based on the limitations and findings of this study, specific recommendations for future research: include 1- Future research should explore how the knowledge gained through educational interventions translates into long-term behavioral changes in both mothers and children. Specifically, longitudinal studies could examine whether increased knowledge in non-pharmacological pain management leads to sustained improvements in children's pain management and quality of life over time; 2 - Given the unexpected sustained

knowledge retention linked to the use of the Telegram channel, future research could compare the effectiveness of different digital follow-up tools (e.g., mobile apps, SMS, social media platforms) in supporting continued education and knowledge retention among parents of children with chronic conditions; 3- While this study focused on knowledge improvement, future studies should assess the direct impact of non-pharmacological pain management strategies on clinical outcomes, such as pain intensity, frequency of insulin injections, and overall glycemic control in children with T1DM. This would provide more comprehensive evidence of the practical benefits of these strategies; 4- Further research is needed to identify potential barriers that mothers might face in implementing the non-pharmacological strategies taught during the intervention. Understanding these barriers could lead to the development of more tailored interventions that address specific challenges faced by families in different socioeconomic and cultural contexts; 5- To confirm the findings of this study and enhance their generalizability, future research should involve larger sample sizes and consider employing randomized controlled trials (RCTs). This would help to establish more robust evidence for the effectiveness of educational interventions in non-pharmacological pain management for children with T1DM.

Conclusion

This study demonstrates the positive impact of an educational intervention on mothers' knowledge regarding non-pharmacological methods of pain management in children with T1DM. The results of this study have important implications for healthcare practice and policy and underscore the need for further research into the effectiveness of educational interventions in improving health outcomes for children with T1DM in Iraq and other areas. As the first study of its kind in the field of education for Iraqi mothers, this research provides valuable insights into the potential benefits of targeted educational interventions in improving health outcomes for children with T1DM. While the current study has shown that an educational intervention can significantly improve the mothers' knowledge of non-pharmacological pain management strategies for children with T1DM, future research should also address the impact of such interventions on attitudes and behaviors. This broader approach will provide a more thorough evaluation of the educational program's effectiveness, informing the development of interventions that not only increase knowledge but also foster positive changes in attitudes and behaviors, ultimately leading to better health outcomes for children with T1DM.

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