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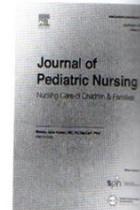
Effects of an educational program on self-efficacy towards type 1 diabetes mellitus disease among parents and adolescents in Jordan

Noor Al-Deen Al-Shorman, MSN, RN [a], Huda Atiyeh, PhD [b], Manal Kassab, PhD [c], Saleem Faek Al-Rjoub, PhD, MSN, BSN, RN [d,*]

[a] A full RN in Hamad Medical Corporation, PO Box 3050, Doha, Qatar
[b] Zarqa University, Faculty of Nursing, Nursing, Jordan
[c] Jordan University of Science and Technology, Faculty of Nursing, Department of Maternal and Child Health Nursing. Clinical research fellows at faculty of health, UTS, Sydney, Australia
[d] The Hashemite University, Faculty of Nursing, Department of Community & Mental Health Nursing, PO Box 330127, Zarqa 13133, Jordan

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ABSTRACT

Background: Type 1 diabetes mellitus is one of the most common childhood chronic diseases worldwide. In Jordan, the prevalence of type 1 diabetes mellitus is increasing rapidly over the last few years. Type 1 diabetes mellitus is a challenging disease since appropriate management of parents' and adolescents' diabetes requires knowledge, skills, and behavioral changes.

Objectives: To assess the effectiveness of a diabetes education program on self-efficacy towards type 1 diabetes mellitus among parents of young children and adolescents.

Methods: A one-group pre-test-post-test study design was used. Participants registered in a diabetes education program and completed both pre-and post-test.

Results: A total of 44 participants; 29 parents and 15 adolescents completed pre- and post-education tests. There was a statistically significant difference in the average mean score from the pre-test ($M = 3.51$, $SD = 0.615$) to the post-test [$M = 4.22$, $SD = 0.484$, $t(43) = 6.704$, $p < 0.000$] for the self-efficacy scale, and overall self-efficacy scores were significantly improved after undertaking the education program.

Conclusion: Based on the findings, it is suggested that providing an evidence-based type 1 diabetes mellitus education program could significantly positively affect the self-efficacy of adolescents and parents of young children with type 1 diabetes mellitus.

Recommendation: Staff nurses should be competent enough to provide basic diabetic health education to the adolescents, parents, and caregivers of children with type 1 diabetes mellitus.

Introduction

Type 1 diabetes mellitus (T1DM) is the most common metabolic disorder among children (Mayer-Davis et al., 2017). It is a chronic disease that occurs when the pancreas cannot produce enough insulin or when the body is unable to use insulin. Insulin is the hormone that the human body utilizes to allow glucose to penetrate the human cells and, in return, generate energy (von Scholten, Kreiner, Gough, & von Herrath, 2021). Type 1 diabetes mellitus can be caused either by genetic factors or viruses. This type of disease mostly occurs during childhood or adolescence but can also develop during adulthood (Nevo-Shenker, Phillip, Nimri, & Shalitin, 2020). Approximately 5% of people with

diabetes have T1DM in which the symptoms develop rapidly and are usually diagnosed among children, adolescents, and young people (Mayer-Davis et al., 2017).

Type 1 diabetes mellitus is quick and progressive in children and adolescents; it could lead to many life-threatening complications, such as diabetic ketoacidosis (Alassaf, Odeh, Gharaibeh, Ibrahim, & Ajlouni, 2019). Some of the symptoms associated with Type 1 diabetes mellitus include the patient feeling very hungry, feeling more thirsty than usual, passing urine frequently, bed-wetting in children, loss of weight without any tries, experiencing blurry vision, feeling irritable or having frequent mood changes, and also feeling tired and weak (Bhutta et al., 2021). Despite the intensive research that has been conducted, type 1 diabetes mellitus has no cure (von Scholten et al., 2021). Type 1 diabetes mellitus treatment has been directed at managing the sugar levels in patients using insulin, lifestyle, and diet to overcome other complications (von Scholten et al., 2021).

* Corresponding author: Department of Community and Mental Health- Faculty of Nursing, The Hashemite University, PO Box 330127, Zarqa 13133, Jordan
E-mail address: saleemf@hu.edu.jo (S.F. Al-Rjoub).

Type 1 diabetes mellitus is highly prevalent globally, with one in every 300 people, and its incidence is increasing steadily by 3% each year (Syed, 2022). This aspect poses a significant challenge to the global population of young children and adolescents. The number of young people under 20 with T1DM is reaching 1,106,500 million (Yisahak, Beagley, Hambleton, & Narayan, 2014). The incidence and prevalence of T1DM as the population grows worldwide in North America, Europe, and the Caribbean; indicate a global problem (Yisahak et al., 2014). It was found that the incidence of T1DM among Jordanian children below 14 years old was 3.2 for each 100.000 (International Diabetes Federation, 2013). Another study on the prevalence of T1DM showed an 18% increase among Jordanian children between 2011 and 2016 (Mohammed, Mohammed, & Fahad, 2017). This increase may indicate that there is a big problem in Jordan and a focus on increasing a better level of health care (Mohammed et al., 2017). With this problem, there is a need for a study that examines the effectiveness of using diabetes education programs on the self-efficacy of adolescents and parents of young children with T1DM.

One recommended approach to providing appropriate self-management is educational interventions to change a certain behavior (Vilarrasa, San Jose, Rubio, & Lecube, 2021). This move will successfully empower young people and care providers to promote self-efficacy. The Health Belief Theory and The Integrated Theory of Health Behavior Change support the study rationale for providing diabetes education to promote diabetes self-efficacy (Harvey & Lawson, 2009; Ryan, 2009). Health Belief Theory explains that, for a patient to adopt a behavior change, they have to understand factors such as the perceived severity of the disease, perceived susceptibility, and perceived benefit of behavior change (Karl, Fischer, Druică, Musso, & Stan, 2021). The patient has to understand the effects of not changing a certain behavior and the benefits of adopting new habits. The approach will thus promote the patients' and their caregivers' self-efficacy (Shabibi et al., 2017). A healthcare system can only do this through sufficient education. Integrated Theory of Health Behavior Change explained that fostering skills and knowledge is the only way to modify community behavior (Ryan, 2009).

Self-efficacy is people's belief in their ability to achieve tasks and goals through their behaviors (Maddux, 2016). This aspect is achieved by setting clear goals to promote positive and healthy behaviors (Maddux, 2016). The diabetes education program is an example of an educational program that is mainly based on the understanding that children and adolescents need an individualized, patient-oriented approach to developing diabetes-related and comprehensive self-efficacy (Brew-Sam et al., 2021). In addition, the diabetes education program has created a multidisciplinary program of monitoring the family and children with T1DM (Brew-Sam et al., 2021). The education activity is performed by clinical nurse specialists who address issues related to medication administration, blood glucose monitoring, and resolution of acute complications and chronic complications (Pihlaskari et al., 2020). They also assess the caregivers' knowledge and skills in monitoring blood sugar and administering insulin. These educational activities are performed before, after, and/or subsequent medical consultation (Lawrence, Cummings, Pacaud, Lynk, & Metzger, 2015).

Furthermore, evidence-based education could effectively enhance the patients' and caregivers' self-efficacy (Nevo-Shenker et al., 2020). Such type of education could dramatically decrease the development of complications and accordingly improve their quality of life. Enhancing self-management among the patients and their caregivers will empower them to take the main role in the management plan (Maddux, 2016). This aspect would reduce the burden of expenditure on T1DM and save the country's resources (Nevo-Shenker et al., 2020). Despite this revelation, it has been established that studies examining the effectiveness of diabetes education programs on the self-efficacy of adolescents and parents of young children with T1DM are very few (Brorsson, Leksell, Andersson Franko, & Lindholm Olinder, 2019; Hamilton et al., 2021; Powers et al., 2016).

Overall, providing education training may not guarantee that the patients and caregivers have adequate knowledge to handle their treatment plans (Hamilton et al., 2021). Therefore, it is important to test the effectiveness of diabetic health education on the patient's and caregiver's self-efficacy to uncover areas that need more emphasis and improvement (Codner, Acerini, Craig, Hofer, & Maahs, 2018). In addition, investigating factors that contribute to the patients' and caregivers' self-efficacy like demographic variables and disease/management–related variables, could considerably help healthcare providers to modify these variables where possible (Powers et al., 2016).

One of the pitfalls in managing diabetes is the failure to provide healthcare for people with diabetes (Brew-Sam et al., 2021). This deficiency may cause poor diabetes education and self-management among children with diabetes and their caregivers (Brew-Sam et al., 2021). This is the reason behind the Jordanian Nursing Council legislates majors in Nursing Law to open the way for care providers to fulfill their role in educating children and adolescents with diabetes (Gharaibeh & Tawalbeh, 2018). In addition, the lack of a structured and uniform diabetic education that is evidence-based could considerably deprive the patients and their caregivers of the adequate knowledge they need to manage T1DM effectively (Garg, Rodbard, Hirsch, & Forlenza, 2020). Consequently, this will disrupt their self-efficacy to achieve the desired outcomes.

Therefore, this study aimed to assess the effect of the diabetes education program on improving the self-efficacy of adolescents and parents of young children with T1DM in Jordan. In addition to getting the baseline data, the findings from this study may encourage stakeholders in Jordan to integrate education regarding the prevention of the complications of T1DM. As a result, they would adopt such interactive teaching strategies to improve the self-efficacy of all adolescents and parents of young children with T1DM in Jordan.

Method

Design, setting, and sample

A one-group pre-test-post-test quasi-experimental design was conducted in a large public hospital in Jordan to test the effectiveness of a structured diabetic educational program on parents of young children and adolescents self-efficacy. Parents of young children and adolescents are educated by a multidisciplinary team including the endocrinologist, diabetic health educator nurse, and nutritionist. Therefore, it was feasible to test the effectiveness of the structured diabetic educational program at this hospital. The sample included 44 participants; 29 parents of young children and 15 adolescents with T1DM. All adolescents and parents of young children were invited to attend the structured educational program for T1DM. The participants who cannot read or write or have difficulty responding to the questionnaire survey were helped by the researcher to complete the questionnaire. Two education sessions were planned to be held during the week. One session was planned on the weekend and another on the weekdays, which, provide more convenient for parents and adolescents to attend the educational session. Participants were asked to inform the health educator about the date of attendance in advance. Educational sessions were held at the same hospital in a convenient and calm room.

Measurements

Data were collected by a newly developed questionnaire survey. The questionnaire included two parts; the first part was designed to collect the background data including demographic variables and disease-related variables that address the patient's medical history and their compliance with the disease management plan. The second part included the T1DM Self-Efficacy Scale which is composed of 21 items, a five-point, Likert-type rating scale (1 = " not able at all" to 5 = "very able") to measure the parents' and adolescents' self-efficacy before

and after receiving education. The items reflect the ten dimensions included in the educational program (Atiyeh, 2020).

Validity and reliability of the instrument

The researcher developed the data collection instrument in collaboration with the diabetic health educator nurse holding a Ph.D. Degree in nursing. First, face validity was performed by asking two parents; one mother and one father, and two adolescents, to evaluate the T1DM Parents' and Adolescents' Self-efficacy Scale for simplicity, understandability of the questions and choices, and to estimate the time needed to complete the questionnaire. Their comments were taken into consideration and suggested changes were made to improve the questionnaire's validity. Second, the contents of the T1DM Parents' and Adolescents' Self-Efficacy Scale were validated according to the steps recommended by Yusoff (2019).

A panel of experts was consulted. The panel team consisted of an endocrinologist, gastroenterologist, pediatrician, a registered nurse expert in pediatric intensive care, a registered nurse expert in medical pediatrics, and a clinical pharmacist. The experts were asked to critically review the questions of the Parents' and Adolescents' Self-Efficacy Scale.

A content validation form was given to each expert to rate the relevance of each item independently based on the following relevant scale (1 = the item is not relevant at all to the measured domain, 2 = the item is not relevant to the measured domain, 3 = the item is quite relevant to the measured domain, and 4 = the item is highly relevant to the measured domain). The scale-level content validity index was based on the universal agreement method (S-CVI/UA) (Polit, Beck, & Owen, 2007). The universal agreement (UA) score was 1 when the item achieved 100% experts in agreement; otherwise, the UA score is 0. The S-CVI/UA has been calculated by the sum of UA scores divided by the number of items (Yusoff, 2019). The revealed S-CVI/UA for the Parents' and Adolescents' self-efficacy Scales were 0.9 and 0.95, respectively. These values were higher than the values reported by Polit et al. (2007) when using six experts. For the reliability test, alpha Cranach's was used for internal consistency the self-efficacy scale and it was ($\alpha = 0.852$).

Intervention

The educational program used in the current study is based on the International Society of Pediatric and Adolescent Diabetes (ISPAD). The International Society of Pediatric and Adolescent Diabetes's Clinical Practice Consent Guidelines are the only comprehensive set of clinical recommendations for children, adolescents, and young adults with diabetes worldwide in which the authors include experts from across the globe and the guidelines included a chapter on limited care for developing healthcare systems (Codner et al., 2018). Education was provided in the Arabic language and multiple images and photos were inserted to make it more simple, clear, and apprehensible. The educational program included 10 dimensions. Table 1 provides descriptions for each dimension.

Finally, supplementary materials were provided for the participants including recommendations for sick day management, ketone levels and appropriate response for each level, and situations that require urgent care and/or hospitalization. In addition, colored mugs with nice pictures including the blood glucose targets before bedtime, exercise, and breakfast were provided.

Procedure

A sample of 44 participants was selected through a purposive sampling to participate in the study. The participants were divided into groups of five individuals, and each group was handled by its educator. The study had 44 participants translated into nine different groups. The study considered both genders by having 26 males and 18

Table 1

The ten dimensions of the educational program.

Dimension	Description
Etiology of T1DM	An explanation of the etiology of type 1 and 2 diabetes, identified the difference regarding the signs and symptoms, and management plans.
Glycemic control targets and glucose monitoring	The recommended times for glucose monitoring; an explanation of the Honey Moon phase; and identified HbA$_{1c}$ targets
Insulin treatment	An explanation about different types of insulin; a clarification about the importance of rotating injection sites; and the appropriate methods for insulin storage indoors and outdoors.
Managing diabetes in preschool children	An emphasized the importance of scanning for comorbidities and identified different strategies that help the families to adjust their lifestyles to control their children's behavior.
Management and support of children and adolescents with T1DM in school	An identification of glucose targets during exams and stress; focus on the management of potentially delayed hypoglycemia following exercise; highlighted the pre-pubertal and pubertal phases and the associated requirements
Diabetic ketoacidosis and the hyperglycemic hyperosmolar state	An identification of signs and symptoms, leading causes, risk factors, and consequences of DKA and hyperglycemic hyperosmolar state
Assessment and management of hypoglycemia in children and adolescents with diabetes	An identification of the signs and symptoms and risk factors of hypoglycemia
Sick day management in children and adolescents with diabetes	An explanation of the effect of the stress hormone and insulin resistance on blood glucose levels
Nutritional management in children and adolescents with diabetes	An explanation of the food groups using the food pyramid
Complications and associated conditions in children and adolescents with diabetes	An explanation of other immunological diseases that could associate with T1DM like celiac disease and thyroid function disorders,

females. Out of this group, there were 15 adolescents and 29 parents of young children. The program made use of 5 educators. Data was collected through focused group discussions, and interview guides on August 13th, 2020, and 22nd, 2020. The researcher explained the study's purpose and the participants' expected benefits, emphasizing their voluntary participation and confidentiality of responses. This process was meant to seek the participant's consent to participate in the program. The patients' contact information was obtained from the health educator records. Participants were required to choose one of three pre-determined dates in advance according to their convenience. Then, the participants were asked to fill out a background data form and rate their abilities in the self-efficacy scale pre-education. The researcher provided any required explanation about the questions. Subsequently, the educational program lasted for 4 h. The program entailed strategies for managing T1DM in young children and adolescents and the challenges affecting this goal's realization. The training was also meant to create awareness in the participants about the symptoms of T1DM and how to avoid them. Finally, the participants were asked to provide their responses to the self-efficacy scale post-education. Participants who asked for further explanations were given appointments for individual sessions by the health educators. The participants' comfort needs were met by serving them refreshments during the study, granting them daily sitting allowances and reimbursing their transport at the end of the training.

Data analysis

Demographic and management-related variables were analyzed using frequencies for categorical variables and means and standard

deviations for continuous variables. Kolmogorov-Smirnov test to describe the test for normal distribution of self-efficacy. Total score and the test result were not statistically significant ($p > 0.05$ for both). Paired t-test was used to test mean differences in self-efficacy scores pre- and post-education. Cohen for effect size was calculated for the paired test based on this equation equals $= t/\sqrt{N}$ (Small $= 0.2$, Medium $= 0.5$, Large $= 0.8$). The alpha level was set at $\alpha \leq 0.05$ and was considered statistically significant. The data were analyzed using SPSS software ver.25.

Ethics

This study was conducted after obtaining the approval of the Institutional Review Board (IRB # 163/132/2020) at a large public hospital in Jordan. Written informed consent was obtained from all participants. The confidentiality of all participants is assured by assigning a number for each participant, which was used to collect and analyze the findings. Data were stored on Universal Serial Bus (USB) flash drive. The storage devices will be physically destroyed after five years of final publication.

Results

Demographics

Out of the 225- participants invited to participate in the study, 44 agreed to participate in the study and entered the pre-test; which were 29 parents of young children and 15 adolescents. The COVID-19 pandemic, associated lockdown, and adherence to social distancing significantly limited the number of participants. The results showed that the study participants' mean age for young children and adolescents was 10.93 years (SD = 3.33), and more than half were males 26 (59.1%), as presented in Table 2. The mean number of years living with diabetes was 4.04 years (SD = 3, 13), where 12(27.3%) of them had co-morbidities with T1DM. The results showed that 73% of young children and adolescents with diabetes were treated by the intensive protocol; having Long-Acting Insulin Short/Rapid Acting Insulin and about 39% had three times daily insulin injections, as present in Table 2.

Table 2
The Participants' Socio-demographic Variables.

Demographic variables	N = 44 (%)
Age in years (Mean = 10.93, SD 3.33)	
Participants	
Parents of young children	29(66)
Adolescents	15(34)
Gender	
Male	26(59.1)
Female	18(40.9)
T1DM Management Variables	N (%)
Is there any co-morbidity with type 1 diabetes mellitus?	
Yes	12(27.3)
No	32(72.7)
Do you test HbA1c every 3 or 4 months?	
Yes	22(50)
No	22(50)
The result of the last HbA1c test.	
5–5.9	4 (9.1)
6–6.9	8 (18.2)
7–7.9	8 (18.2)
8–8.9	3 (6.8)
9–9.9	12 (27.3)
10–10.9	6 (13.6)
11–11.9	3 (6.8)
>12	0(0)
Type of Insulin Treatment.	
Premixed Insulin	12 (27.3)
Long-Acting Insulin (Short/Rapid Acting Insulin)	32 (72.7)

Self-efficacy of parents and adolescents towards T1DM

The paired t-test was used to compare the mean differences of the participants' self-efficacy scores pre- and post-education, there was a statistically significant difference in the average mean score from pre-test (M = 3.51, SD = 0.615) to post-test [M = 4.22, SD = 0.484, t (43) = 6.704, p < 0.000] for the self-efficacy scale. Significant differences were revealed (p < 0.005) regarding the participants' ability to distinguish between type 1 and type 2 diabetes and distinguish the signs and symptoms of hyper and hypoglycemia as presented in Table 3.

Regarding insulin treatment, the results showed significant differences (p < 0.005) in the participant's ability to select the appropriate size of needles for insulin injection and their ability to adjust insulin doses to correct high blood sugar levels, planned meals, and physical activity. The participant's ability to manage hyperglycemia and hypoglycemia during the sick days was significantly improved after receiving education (M = 4.05, SD = 0.888; p = 0.013 and M = 3.95, SD = 0.861; p = 0.008, respectively). Moreover, the results revealed a significant difference in the participants' ability to differentiate between simple and complex carbohydrates as presented in Table 3. A bar graph have been created for direct comparison between pre-and post-test results Fig. 1.

The analysis revealed highly significant results (p < 0.001) regarding the participants' ability to distinguish HbA1c targets and different insulin types. The participants' self-efficacy scores showed a significant difference (p < 0.001) in insulin injection sites' rotation and the ability to test blood ketones at home. The self-efficacy scores demonstrated a significant difference (p < 0.001) in terms of the participant's ability to identify skin atrophy associated with insulin injections, signs and symptoms of celiac disease, and their ability to prepare a balanced meal that includes all food groups in the right way (Table 3).

Discussion

This study aimed to assess the effectiveness of a diabetes education program on the self-efficacy of adolescents and parents of young children with T1DM.

Self-efficacy

Results of this study indicate that diabetic health education was significantly effective in improving the self-efficacy of adolescents and parents of young children with T1DM. The participants' self-efficacy was improved regarding the blood glucose targets. This result is supported by a previous studies that used similar interactive methods for education about T1DM (Adu, Malabu, Malau-Aduli, & Malau-Aduli, 2019; Brorsson et al., 2019; Hamilton et al., 2021; Powers et al., 2016). Powers et al. (2016) explained that educating diabetes patients is essential in improving their ability, skills, and knowledge of diabetes self-care. Through diabetes self-management education, children with diabetes will adopt behaviors that will promote their medication adherence, healthy eating, and other practices that determine diabetes outcomes (Adu et al., 2019).

Although, participants in this study were familiar with insulin, their knowledge about different types of insulin was improved, and accordingly their self-efficacy. Similarly, the participants in this study held some information about injection sites, but the critical need for rotation and its effect on insulin absorption, and how absorption is affected by injection site and physical activity could be new information for most of the participants, which is consistent with previous findings (Brorsson et al., 2019; Hamilton et al., 2021). The study conducted by Hamilton et al. (2021) about the self-management of sustained type 1 diabetes mellitus, involving specification of the behaviors and influences, the researchers established that self-management behaviors are crucial to achieving improvements in glycated hemoglobin popularly known as HbA1c while at the same time minimizing the risks associated with the complications. Thus, the research sought to identify the

Ethical approval

This research was reviewed by the Jordan University of Science and Technology and the Ministry of Health. Informed consent was gained from all participants.

CREDIT Statement

Noor Al-Deen Al-Shorman: Project administration, Conceptualization, Methodology, Formal analysis, Writing - original draft, Investigation. **Huda Atiyeh:** Writing - Review & Editing, Conceptualization, Methodology. **Manal Kassab:** Project administration, Supervision. **Saleem Al-Rjoub:** Conceptualization, Formal analysis, Visualization, Validation, Writing - Review & Editing.

Declaration of Competing Interest

None.

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