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Maternal knowledge, coping strategies, and metabolic control of children with type 1 diabetes

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Abstract

Background: Trends of type 1 diabetes have increased among Egyptian children in the past two decades. Managing a child with type 1 diabetes is a great challenge for parents especially when the child is not developmentally able to manage the disease independently. This study aimed to determine level of diabetes-specific knowledge among diabetic children's mothers, measure maternal diabetes-related stress, identify diabetes-related maternal coping strategies, and to examine the effect of maternal diabetes-specific knowledge, maternal diabetes-related stress, and their adopted coping strategy on glycemic control of their children. A cross-sectional study was conducted in outpatient clinic for diabetic children at a university hospital in Cairo, Egypt. One hundred and four mothers of diabetic children were recruited. Diabetes-specific knowledge was measured by Modified Diabetes Knowledge Questionnaire. Diabetes-related stress and coping strategies were measured by the Ways of Coping Questionnaire. Glycosylated hemoglobin level was obtained from medical records.

Results: 61.5% of mothers had good diabetes-specific knowledge; however, 45.2% had high levels of diabetes-related stress. The most common adopted maternal coping strategy was acceptance of child's illness (71.6%). Glycosylated hemoglobin level in diabetic children was negatively correlated with positive and wishful thinking ($p = 0.042$ and $p = 0.010$ respectively) and acceptance of illness ($p = 0.002$), while positively correlated with cognitive restructuring ($p = 0.007$).

Conclusions: Health education to train mothers to adopt positive coping strategies might maintain a better glycemic control in diabetic children in similar settings.

Keywords: Type 1 diabetes, Knowledge, Stress, Coping, HbA1c

Background

Type 1 diabetes mellitus (T1DM) is a disorder of glucose homeostasis characterized by autoimmune destruction of the insulin-producing pancreatic B cell that progressively leads to insulin deficiency and resultant hyperglycemia. If left untreated, insulin deficiency leads to progressive metabolic derangement, with worsening hyperglycemia, ketoacidosis, starvation, and death [1]. The calculated age-adjusted type 1 diabetes incidence in Egypt among children younger than 15 years old was 0.7, 2.0, and 3.1 per 100,000 in 1996, 2006, and 2011, respectively. The age-adjusted type 1 diabetes prevalence among children younger than 15 years old in the same years were 1.9, 15.5 and 26.8 per 100,000, respectively [2].

Diabetes-specific knowledge of parents is an important factor in proper management of diabetes of their children [3].

The ways of maternal coping have great implications on glycemic control of the child [4]. According to Folkman and Lazarus, coping is "a multidimensional process referring to how individuals deal with stress, involves

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conscious cognitive and/or behavioral efforts to deal with events appraised as stressful, or exceeding the resources of the individual." [5]· Coping responses may be engagement coping or disengagement coping each of them may be primary or secondary. Primary control engagement coping is directed towards rational management of the disease itself. It includes problem solving, emotional expression, and emotional regulation. Secondary control engagement coping focuses on adapting to the difficulties associated with the disease and includes cognitive restructure, positive thinking, acceptance, distraction, and turning to religion. Engagement coping leads to better adaptation and reduces psychological and somatic symptoms. Disengagement coping ways include avoidance, denial, and social isolation as well as behavioral and mental disengagement [6].

Managing a child with type 1 diabetes is a great challenge for parents especially when the child is not developmentally able to manage the disease independently [7]. The special requirements related to glycemic control (frequently reminding the child of taking care of him/herself, frequent clinic or hospital visits), feeling embarrassed when telling others about the child's disease, and worrying about the future of the child may lead to psychological stress to his/her parents. This maternal stress may lead to "diabetes burnout" which is a state of getting tired of the diabetes care responsibilities which may lead to a neglecting behavior towards their children's disease [8]. Children and adolescents with type 1 diabetes are part of a larger environment of family, community, and peer influences that impact health and their quality-of-life. Thus, a family-centered diabetes care approach for children with type 1 diabetes is essential to ensure that all psychosocial influences are addressed [9].

Findings of previous studies revealed that parents of diabetic children who have greater diabetes-specific knowledge tend to use more active coping, planning, instrumental support, and emotional support as coping strategies [10–12]. A study on a group of Egyptian mothers of diabetic children in El-Minia Governorate found that the more disengagement coping strategies (e.g., escape and avoidance) mothers adopt, the worse the results of HbA1c levels of their children [12]. Reaching optimal glycemic control remains challenging, additional research is justified to understand modifiable family factors—especially in the context of Egyptian culture—that promote positive family support for management of diabetes in children and adolescents. Few studies especially in Egypt discussed the relation between maternal diabetes-specific knowledge, their adopted coping strategies, and glycemic control of their children. Understanding this relationship would help targeting audience for health education which in turn helps in disease control process.

Therefore, the objectives of this study were to determine the level of diabetes-specific knowledge, maternal diabetes-related stress as well as coping strategies in response to children's illness among mothers of diabetic children, and to evaluate the effect of maternal knowledge, stress level, and their adopted coping strategies on the glycemic control of their diabetic children.

Methods

Study design, setting, and participants

A cross-sectional study was conducted in the pediatrics outpatient diabetes clinic at a Faculty of Medicine Educational Hospital in Cairo. This clinic was open on Tuesdays and Wednesdays. A list of diabetic children who registered appointments for that day at the clinic was obtained. Mothers of diabetic children were recruited by systematic random sampling, where every fifth mother was selected from the obtained list (number 5 was chosen randomly). Mothers of diabetic children who were (a) 2 to 14 years old were included (because type 1 diabetes is rare below the age of 2 years [2], while above 14 years the child becomes self-dependent, and (b) diagnosed at least 6 months before the study conduction (so mothers could have evolved and maintained their coping strategies). Mothers of children who had: secondary diabetes (secondary to endocrinopathies, infection, or drugs) as well as other chronic diseases (such as hypothyroidism to ensure that the reported maternal coping strategies were directed towards diabetes not any other associated disease) were excluded [13]. (This data was obtained from the history taken from the mother.)

Sample size was calculated using MEDCALC program, setting the type-I error (α) at 0.05 and power (1-β) at 0.9. Result from previous study [14] showed that there was a positive correlation between parental level of diabetes specific knowledge and glycemic control of their diabetic children ($r = -0.33$). Calculations according to these values produce a minimum sample size of 92 mothers of diabetic children. One hundred and fourteen mothers were invited to share in study, 104 accepted to participate. Response rate was 91.2%.

Data collection tools

The interview questionnaire was developed and adapted from previous literature [15–17]. It included five sections: Section 1: *Sociodemographic characteristics* (gender and age of diabetic child, educational level of both parents and family income), Section 2: *Child's clinical characteristics* (diabetes treatment regimen, frequency of blood glucose monitoring and number of years since diagnosis), Section 3: *Maternal diabetes-specific knowledge questionnaire* which was assessed using the *Modified Diabetes Knowledge Test (DKQ-24)* [17]. The DKQ-24 consists of

24 items asking about basic diabetes information (etiology of diabetes, diabetes medications and role of diet and physical activity in managing diabetes), glycemic control (blood glucose monitoring at home and care for hypoglycemia) as well as prevention of complications (vascular, renal and neurological complications). Each item has three response options (yes, no, don´t know). The correct answer was given a score of "1" and if the answer was wrong or don't know it was given a score of "0". The total scores were summated and cut-off values were considered based on Al Adsani et al. 2009 scoring system, where diabetes-specific knowledge was categorized into: poor (< 11), average (11 to 17), and good (> 17) [16].

Section 4: *Maternal diabetes-related stress questionnaire*, and Section 5: *Maternal coping strategies*. The degree and type of coping strategy adopted by mothers was measured using the *Diabetes domain of the Responses to Stress Questionnaire (RSQ)* [15]. This Domain consisted of two parts: (1) first part measured how often mothers experience diabetes-related stress (feeling that the child is different from other children, frequently reminds the child to take care of him/herself, feeling guilty or upset about bad HbA1c levels, worrying about the future of the child). Items in this part were rated on a scale from 0 to 3 indicating the degree to which each item causes stress to the parent (from not at all to a lot). Total score ranged from 0 to 30, where higher scores indicated greater diabetes-related stress. The cut-off values of the diabetes-related stress were calculated using median and interquartile range (IQR), then categorized into low (< 17), moderate (17 to 24), and high (> 24); and (b) Second part consisted of 57 items that represent 19 scales of voluntary coping and involuntary responses to stress in mothers of diabetic children (e.g., acceptance, denial, intrusive thoughts) [15]. Scales in this part were rated from 1 to 4 indicating the degree to which each scale was adopted by the individual (from not at all to a lot). Relative scores for each scale in the *second part* describe the percentage of using each type of coping by the mother. A high relative score for each item means that this type of coping was used more frequent than other types [15]. The relative score was calculated in 3 steps: the average response per scale (dividing the total raw score by the number of items in the scale); summation of the average responses per scale across all scales; and division of the average score for each scale by the sum of the averages for all 19 scales.

The questionnaire was translated into Arabic and the translation was validated by back translation into English. It was tested on 10% of the sample size (i.e., 10 mothers) prior to data collection for testing the appropriateness of the questions and answer categories. Data obtained from pre-testing of the questionnaire was excluded from this analysis. The internal consistency of the questionnaire items related to maternal diabetes-specific knowledge and maternal diabetes-related stress part I and part II was tested by Cronbach's alpha (0.71, 0.82, and 0.89, respectively). Glycemic control was defined based on HbA1c levels as: optimal (< 7.5%), suboptimal (7.5–9.0%), or poor (> 9.0%) [1].

Statistical analysis

Data was coded, entered, and analyzed using SPSS version 20. Quantitative data was presented as mean and standard deviation (SD) or median and IQR. Qualitative data was presented as frequency and percent. Bivariate analysis was performed using chi-square test for qualitative data. Correlation was done between scores in different coping strategies and HbA1c levels. Linear regression was done to find out factors affecting HbA1c levels of the child. A two-sided p value ≤ 0.05 was considered statistically significant.

Results

The mean age of the children at first diagnosis was 5.1 ± 2.7 years. More than half (55.8%) of them were females. Mean ± SD of hospital admission days was 2.3 ± 2.8 days. The mean level of HbA1c was 9.8 ± 2.3%. Most diabetic children (60.6%) had poor glycemic control. Approximately 60% of mothers and 70% of fathers attained above secondary degree level of education. More than half of the families (53.7%) reported a monthly income above 2000 EGP (Table 1).

Approximately two-thirds (61.5%) of mothers had good diabetes-specific knowledge (scores > 17). Most of the study participants (84%) provided correct answers to questions about role of exercise in managing diabetes (Additional file 1: Table S1). However, only 25.0% and 22.0% of the mothers responded with correct answers about general diabetes-related knowledge and symptoms of complications of uncontrolled diabetes, respectively.

A statistically significant association was found between maternal diabetes-specific knowledge, and HbA1c levels. Post-hoc test was performed and revealed a significant difference between optimal and poor ($p = 0.025$), suboptimal, and poor levels ($p = 0.034$). No association was found between maternal diabetes-specific stress level and child's HBA1c level (Table 2).

The most common adopted coping strategies by the mothers were acceptance of their child's illness (71.6%), emotional arousal (69.3%), and avoidance (68.8%). The least adopted coping strategies were involuntary disengagement (inaction, cognitive inference and emotional numbing with relative scores of 29.4%, 29% and 27.3%, respectively (Table 3).

Table 1 Sociodemographic characteristics of diabetic children and their parents as well as clinical characteristics of children

	Characteristics	*N* = 104 *N* (%)
Child gender	Male	46 (44.2)
	Female	55 (55.8)
Level of HbA1c	Optimal (< 7.5%)	16 (15.4)
	Sub optimal (7.5–9%)	25 (24)
	Poor (> 9%)	63 (60.6)
Mother's education status	Secondary or below	41 (39.4)
	Above secondary	63 (60.6)
Father's education status	Secondary or below	31 (30)
	Above secondary	73 (70)
Family income (Egyptian pounds)	< 1000	27(26.0)
	1000-	21(20.2)
	2000-	37(35.6)
	≤ 3000	19(18.2)
Child's age at diagnosis (years)	**Mean ± SD**	5.1 ± 2.7
	Range	3–14
HbA1c	**Mean ± SD**	9.8 ± 2.3
	Range	4–14.5
Mother's age (years)	**Mean ± SD**	37.87 ± 7.2
	Range	26–58
Father's age (years)	**Mean ± SD**	43.15 ± 8.8
	Range	29–63
Hospital admission (days)	**Mean ± SD**	2.3 ± 2.8

N.B One $US=16.0 Egyptian Pound at time of study conduction

Table 2 Relationship of maternal diabetes-specific knowledge, maternal stress levels, and glycemic control of their diabetic children

	HbA1c			*F*	*P* value
	Optimal	Suboptimal	Poor		
Maternal diabetes-specific knowledge level (mean ± SD)	19.9 ± 3.02	19.4 ± 4.02	17.5 ± 4.01	3.96	0.022*
Maternal diabetes-related stress level (mean ± SD)	31.3 ± 9.3	30.5 ± 7.46	29.8 ± 8.7	0.23	0.79

*Statistically Significant

There was a significant difference between HbA1c levels of diabetic children regarding cognitive restructure, acceptance of the child's illness, and emotional numbing ($p = 0.031$, 0.001, 0.036 respectively) (Table 4).

Linear regression analysis shows that higher maternal education college/postgraduate level ($p = 0.043$), home glucose monitoring ($p = 0.001$) and cognitive restructure about the disease ($p = 0.043$) were independently associated with decrease in HbA1c levels of the diabetic child (Table 5). Mothers were allowed to choose more than one coping strategy.

Discussion

The mean age of the children at first diagnosis was 5.1 ± 2.7 years. More than half were females. Most diabetic children (60.6%) had poor glycemic control; only 15.4% of them had optimal HbA1c levels. Approximately two-thirds of mothers had good diabetes-specific knowledge.

There was a significant difference between HbA1c levels of diabetic children regarding the following adopted maternal coping strategies: cognitive restructure, acceptance of the child's illness, and emotional numbing. Higher education of mothers, home glucose monitoring, and cognitive restructure about the disease were independently associated with decrease in HbA1c levels of the diabetic child.

Regarding diabetes-specific knowledge, mothers had higher knowledge about the role of exercise in managing diabetes. On the other hand, they lacked the general knowledge about diabetes as a disease, its symptoms and complications. This may be because health education sessions provided to mothers in the outpatient clinic for diabetic children focused on how to control and deal with diabetes in their children, rather than conveying general information about diabetes, its symptoms and complications. A previous study conducted in Upper Egypt reported similar results; 65% of diabetic children's mothers had good diabetes-specific knowledge, specifically about how to control diet and exercise of the child [18]. This result is alarming; there might be an increasing trend of complications among this group of growing children and adolescents. A study done in a tertiary referral hospital in Egypt 2018 found a considerably high rate of complications among adolescent diabetics [19].

In this study, a statistically significant association between HbA1c levels in the diabetic child and maternal diabetes-specific knowledge level was found. This is similar to recent studies in Poland [20] and Saudi Arabia [21] which found that HbA1c levels in the diabetic child were significantly and negatively correlated with maternal diabetes-specific knowledge level. Mothers who had higher knowledge about diabetes were able to effectively manage their children's illness. However, other studies in Jordan [22], Iran [23], and Egypt [12] found no significant relation between maternal diabetes-specific knowledge levels and glycemic control of the diabetic child.

Table 3 Coping strategies adopted by mothers of diabetic children

Coping strategy[c]	Percentage
Primary control engagement	
Emotional expression (e.g., let others know what I feel)	66.1
Emotional regulation (e.g., keep my feelings under control)	61.9
Problem solving (e.g., try to find different ways to fix the problem)	55.6
Secondary control engagement	
Acceptance (e.g., try to live with things the way they are)	71.6[a]
Cognitive restructure (e.g., think about good things learnt from the situation)	66.5
Positive thinking (e.g., tell myself that everything will be ok)	58.4
Primary control disengagement	
Avoidance(e.g., try to be away from things that remind me of the problem)	68.8[a]
Denial (e.g., tell myself that it is not real)	39.4
Secondary control disengagement	
Wishful thinking (e.g., tell myself that everything would work itself out).	61.6
Distraction (e.g., keep my mind off the problem by doing a hobby, watching TV)	29.4[b]
Involuntary engagement	
Emotional arousal (e.g., during the problem I get upset by things that don't usually bother me)	69.3[a]
Intrusive thoughts (e.g., cannot stop thinking about the problems when I try to sleep, or I have bad dreams about them).	64.4
Physical arousal (e.g., when I have problems, I feel it in my body: my heart races, I feel hot or sweaty)	64.4
Rumination (e.g., I cannot stop thinking about how I am feeling, when I have a problem)	54.8
Impulsive action (e.g., I cannot control what I say or do, when I have a problem)	42.0
Involuntary avoidance (e.g., I cannot stop myself from getting away from things that remind me of the problem)	38.0
Involuntary disengagement	
Inaction (e.g., I cannot do anything, when I have a problem)	29.4[b]
Cognitive inference (e.g., my mind goes blank, when I have a problem)	29.0[b]
Emotional numbing (e.g., I do not feel anything at all, when I have a problem)	27.3[b]

[a] Most commonly adopted coping strategies

[b] Least commonly adopted coping strategies

[c] Mother may choose more than one coping strategy

No statistically significant association was found between levels of maternal diabetes-specific stress and glycemic control of the diabetic child. This finding is supported by a systematic review [24] and other studies [25, 26] which failed to find any association between maternal diabetes-specific stress and glycemic control of the diabetic child. One explanation may be that the maternal reactions -which affected glycemic control of the child- were usually presented as interventional reactions (e.g., searching for different treatment options, trying to support the child) rather than stressful reactions [27]. On the other hand, some suggested that greater diabetes-related stress in care-givers of diabetic children was associated with better glycemic control of the diabetic child [28].

Out of the multiple different coping strategies that can be adopted by mothers of diabetic children, the most commonly adopted strategy for coping was acceptance- a secondary control engagement coping- of child's illness. This may be because the Egyptian society leans on spiritual submission to unfortunate events in their lives. This perspective was regarded since 1981 when Yates et al. mentioned in their study that patients who are spiritual may utilize their beliefs in coping with illness, pain, and life stresses [29]. Some studies indicate that those who are spiritual tend to have a more positive outlook and a better quality of life. The least adopted maternal coping strategy in current study was emotional numbing, a finding that is in line with two other studies conducted in Egypt among mothers of diabetic children [12, 28]. However, another study conducted in two major children's hospitals in Canada found that primary control engagement coping (e.g., problem solving and positive reappraisal) was the most commonly adopted strategy by mothers of diabetic children [30]. This difference can be explained by differences in culture, where western societies tend to use more problem-focused coping strategies [27].

There was a significant difference between HbA1c levels of diabetic children regarding the following adopted maternal coping strategies: cognitive restructure,

Table 4 Scores of coping strategies of the mothers and their relation with HbA1c levels of their diabetic children

	Optimal	Suboptimal	Poor	*F*	*P* value
Problem solving	8.4 ± 3.07	9 ± 2.4	7.5 ± 2.9	2.5	0.085
Emotional expression	8.8 ± 1.8	10 ± 2.5	9.5 ± 2.1	1.5	0.211
Emotional regulation	8.1 ± 3.2	9.8 ± 2.5	8.8 ± 2.8	1.7	0.178
Cognitive restructure	10.9 ± 2.3	10.2 ± 2.3	9.1 ± 3.1	3.5	0.031*
Positive thinking	9.1 ± 1.3	10.2 ± 2.3	8.1 ± 2.5	1.9	0.148
Acceptance	11.8 ± .41	11.1 ± 1.2	9.6 ± 2.6	8.1	0.001*
Avoidance	10 ± 2	9.4 ± 2.8	10.1 ± 2.2	0.93	0.396
Denial	5.5 ± 1.5	5.8 ± 2.1	5.7 ± 2.5	0.09	0.908
Distraction	3.9 ± 1.4	3.8 ± 1.3	4.5 ± 2.6	1.1	0.338
Wishful thinking	10 ± 1.8	9.4 ± 2.9	8.4 ± 2.7	2.6	0.073
Rumination	8.1 ± 2.5	8.2 ± 2.3	7.6 ± 2.9	0.63	0.536
Intrusive thoughts	10.2 ± 2.6	9.3 ± 2.8	9.1 ± 3.4	0.85	0.432
Physical arousal	10.2 ± 2.6	9.3 ± 2.8	9.1 ± 3.4	0.84	0.432
Emotional arousal	10.3 ± 2.1	10.3 ± 2.1	9.8 ± 2.5	0.51	0.598
Impulsive action	5.6 ± 3.1	5.5 ± 3.4	6.3 ± 3.4	0.65	0.524
Cognitive Interference	3.6 ± 1.6	3.8 ± 2.1	4.6 ± 2.9	1.3	0.275
Involuntary avoidance	5.4 ± 3.1	5.8 ± 2.4	5.8 ± 3.1	0.61	0.545
Inaction	4.1 ± 1.8	3.5 ± 1.1	4.5 ± 2.8	1.6	0.189
Emotional numbing	3.6 ± 1.1	3 ± 0	3.9 ± 2.3	3.4	0.036*

Table 5 Linear regression analysis between child's factors, maternal factors, and child's HbA1c (dependent variable)

	Un-standardized β	Standardized Coefficient β	*P* value	95.0% confidence interval for β	
				Lower bound	Upper bound
Age	0.020	0.025	0.829	− 0.166-	0.206
Gender	− 0.771-	− 0.162-	0.093	− 1.674-	0.132
Mother's age	0.065	0.197	0.106	− 0.014-	0.143
Mother's education					
Illiterate/read and write	0.231	0.041	0.716	− 1.025-	1.486
Primary/preparatory	− 0.035-	− 0.005-	0.965	− 1.634-	1.563
College/postgraduate	− 1.452-	− 0.276-	0.043[a]	− 2.861-	-0.044-
Family income					
Less than1000 EP	− 1.121-	− 0.209-	0.223	− 2.939-	0.696
> 1000 to 2000 EP	− 0.924-	− 0.157-	0.289	− 2.645-	0.797
> 2000 to 3000 EP	− 0.743-	− 0.151-	0.327	− 2.242-	0.756
Home glucose monitoring	− 1.779-	− 0.308-	0.001[a]	− 2.830-	-0.727-
Knowledge score	− 0.061-	− 0.104-	0.450	− 0.222-	0.099
Stress core	− 0.003-	− 0.011-	0.923	− 0.067-	0.061
Coping strategy[b]					
Cognitive re-structure	− 0.187-	− 0.226-	0.043[a]	− 0.369-	-0.006-
Acceptance	0.003	0.003	0.981	− 0.234-	0.240
Emotional numbing	0.180	0.179	0.064	− 0.011-	0.371
(Constant)	12.377		0.000	6.827	17.928

[a] Significant

[b] The included coping strategies were significant in the bivariate analysis

acceptance of the child's illness, and emotional numbing. As parents' acceptance of their child's illness increases, so does their engagement in the management of diabetes in their child by talking to healthcare providers, reading more about diabetes, becoming more strict in caring for their diabetic child. Similarly, a study conducted in Portugal [31] reported that maternal positive thinking about their child's illness improves their psychological stability and understanding of the medical situation through communication with other parents [3, 7] and medical staff leading to better glycemic control of the diabetic child. On the contrary to these findings, other studies in Belgium [3, 7] did not find any relation between maternal adoption of coping strategies and glycemic control in their diabetic children with type 1 diabetes. Jaser et al. studied an older age group (8–15 years). This age group might be less dependent on parents in self-care [32].

Strengths and limitations

The study was conducted in one outpatienst clinic including mothers with similar sociodemographic characteristics, which may have affected the external validity of this study. The study design did not allow testing of the temporal relationship between maternal knowledge, coping strategies and HbA1c levels of the diabetic child. Despite these limitations, the strength of this study lies in using validated tools in assessing the outcomes such as the DKQ-24 and the RSQ questionnaires. Different coping strategies adopted by the mothers and their effect on glycemic control of the child were analyzed as well.

Conclusions

The study showed that the most adopted coping strategy by mothers of diabetic children was secondary control engagement coping (e.g., acceptance and wishful thinking). They did not depend on involuntary disengagement mechanisms (e.g., emotional numbing, inaction). The current study did not detect a statistically significant association between maternal diabetes-specific knowledge, their stress levels and HbA1c levels of their diabetic children. Notably, HbA1c levels were significantly and negatively correlated with, positive thinking, acceptance of the disease and wishful thinking. Additionally, the current study revealed that despite the relatively good maternal diabetes-specific knowledge, they lacked knowledge about symptoms of complications and general information about diabetes. Tailored health education messages for raising awareness about coping strategies and training of mothers to adopt these positive coping strategies might maintain a better glycemic control in diabetic children in similar low- and middle-income settings. It is also recommended to perform additional studies to evaluate children's glycemic control after educating mothers about symptoms of complications and general diabetes information.

Abbreviations

DKQ : Diabetes Knowledge Questionnaire; RSQ : Responses to Stress Questionnaire; HbA1c: Glycosylated hemoglobin.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s43045-022-00259-0.

Additional file 1: Table S1. Frequency of correct answers of each category of knowledge questions.

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Authors' contributions

NR analyzed and interpreted the patient data. AF generated the idea of research and was a major contributor in writing the manuscript. AK revised and corrected the manuscript. FM revised the whole work. All authors read and approved the final manuscript.

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Availability of data and materials

The datasets generated and/or analyzed during the current study are not publicly available but are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

Eligible participants provided their written informed consent and assent for their children to record their sociodemographic and clinical data, then completed the interview questionnaire. The purpose of the study was explained to potential participants and they were informed that their participation in the study is voluntary and they were free to withdraw at any time. Ethical approval was sought from Faculty of Medicine, Ain Shams University Ethics Committee (FMASUR17/2020).

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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