

Knowledge and Awareness of Caregivers about Diabetic Ketoacidosis among Type-1 Diabetic Children and Their Action and Response in Riyadh City

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Abstract

Objectives: Diabetic ketoacidosis (DKA) is a life-threatening metabolic disorder in which its complications can be avoidable. The purpose of this study is to identify and measure the level of knowledge and awareness of caregivers about the symptoms of DKA in children in Riyadh city. **Setting and Participants:** This cross-sectional study design was conducted in Riyadh city in Saudi Arabia. A sample size of at least 412 was required. The total number of respondents that were included in the analysis was 414. The method of collection of data done by data collectors. **Results:** Two hundred and sixty-eight (64.7%) of the participants reported that they know about DKA, yet it was still a concerning figure since 35.3% did not know about it, which necessitating diabetes self-management education at national levels in Saudi Arabia. **Conclusion:** This study showed that the majority of type-1 diabetic caregivers had knowledge and awareness regarding DKA in Riyadh, Saudi Arabia. Further studies would assess more factors to enhance the level of knowledge and awareness, and increase the effectiveness toward the right action and response regarding DKA.

Keywords

Diabetes Mellitus, DKA, Children, Caregivers, Emergency

1. Introduction

Diabetic ketoacidosis (DKA) is an acute, serious, life-threatening complication of hyperglycemia, ketoacidosis, and ketonuria. It occurs when absolute or relative insulin deficiency prevents the ability of glucose to enter cells for using it as a metabolic fuel. As a result, the liver rapidly breaks down fat into ketones for use as a fuel source. The overproduction of ketones occurs, causing them to build up in the blood and urine and causing the blood to be acidic. DKA occurs primarily in type 1 diabetes patients, although it is not unusual in some type 2 diabetes patients. The insidious rise in polydipsia and polyuria are the most prominent early symptoms of DKA. Besides, other symptoms such as Malaise, generalized weakness, fatiguability, nausea and vomiting, diffuse abdominal pain and decreased appetite are also seen [1].

Patients and their families have been the object of self-treatment and the administrators of their care. The health care team were the guides who set the stage, efforts when the targets were not reached, rather than being the only diabetes health care team to initiate treatment, patients and parents were encouraged to evaluate their data, recognize patterns, resolve diet and activity issues, and do so based on real blood glucose results [2].

Mothers with more knowledge about diabetes and better education maintained better glycemic control of their children, irrespective of their socio-economic status, and to enhance glycemic control and minimize acute and chronic complications of diabetes in children, knowledge and education of mothers be important [3].

The most common emergency case when having a patient diagnosed with diabetes mellitus is Diabetic ketoacidosis (DKA). Surprisingly, it's more often when we see these patients suffering from DKA type 1 diabetes patients. However, type 2 diabetes patients are never spared from the susceptibility of suffering from this unfortunate emergency. Otherwise, it was noticeable that type 2 DM patients are having a DKA were under the effect of certain situations such as post-operation, trauma or accident, or infectious diseases [4] [5].

DKA is reported to be responsible for more than 100,000 hospital admissions per year in the US and accounts for 4% - 9% of all hospital discharge summaries among patients with diabetes. Alhowaish (2013) has estimated more than 500% acceleration in the expenses incurred for healthcare and treatment of diabetes since 2000 and costed the healthcare budget of Saudi Arabia roughly 25 billion used exclusively for the management of diabetes [6].

Diabetic ketoacidosis diagnosis is basically under few conditions, first of all, we need the patient's plasma glucose concentration to be above 250 mg per dL (usually elevated above this number), and the bicarbonate level to be or less than 18 mEq per L, and the pH level is 7.30 or less. The main course of treatment for DKA is intravenous insulin and fluid replacement therapy, and obviously with precise checkup and monitoring of the potassium levels. To reach the full level of treatment, it is required to educate patients to prevent the recurrence of such

a case [7].

For example, a study by Alwan *et al.* (2017) that studied the awareness about diabetes mellitus among attendees of primary health care centers, Makkah, Saudi Arabia has reported that the main sources for information about diabetes were mass media (57.4%), health sector (29.9%) and educational sector (10.6%) and concluded a satisfactory level of knowledge about regarding risk factors, symptoms, and risks of diabetes but not aware of the diabetes associated secondary complications [8].

Moreover, Illiteracy and low socioeconomic status were significantly associated with poor knowledge and practice of diabetic foot care [9], and that the level of education is the most significant predictor of knowledge regarding risk factors, complications and the prevention of diabetes [10].

Overall, to help in bridging the gap in the literature about the knowledge of caregivers in Saudi Arabia, this study aims to identify and measure the level of knowledge and awareness of caregivers about the symptoms of DKA in children in Riyadh city.

2. Methods

Study Subjects. This study used a descriptive cross-sectional questionnaire-based study design. It was conducted in Riyadh city in Saudi Arabia, from August through November 2020. Four hundred and fourteen persons were randomly selected populations of diabetic pediatric patients and their caregivers were asked to take part in an online-based survey. The inclusion criteria included being a caregiver for a diabetic child who resides in Riyadh during the study period. All participants received an online webpage with an explanation of the study purpose and were requested to provide informed consent before the online questionnaire being proceeded. The participants were encouraged to complete the questionnaire voluntarily within the time interval of the study and at their convenience. Moreover, the participants were given the chance to seek the help of a person of their choice to help them fill the form if they are unable to read or answer the form.

Sample Size. According to the Saudi Arabia General Authority for Statistics, there were 2,470,683 Saudi children aged ≤ 19 years living in Riyadh in 2020. Based on an acceptable error margin equivalent to 5% with a confidence interval of 95%, a sample size of at least 412 was required. The dataset included 431 participants. We excluded participants who were taking care of diabetic patients aged above 16, and if there were refusing, did not know the responses to any of the variables of interest, or missing responses. The final sample size after exclusion was 414.

Data Collection Tool. The questionnaire was adapted with the permission of Othman *et al.* and translated into Arabic. The translation process of the questionnaire included a cross-cultural validation, and a review by the translation committee of our institute. Prevention of responses repetition was made through

the linking of every survey response with an internet protocol. The Medical College Institutional Review Board, Al-Imam Muhammad Ibn Saud Islamic University, Riyadh, Saudi Arabia has approved this study protocol.

Questionnaire. This study employed a self-administrated questionnaire, which included 30 items on related knowledge and awareness of caregivers about DKA among their type 1 diabetic children and their action and response. If the participant is unable to answer the questionnaire due to literacy issues, the participants were given the chance to fill in the questionnaire with the help of another person of their choice. The questionnaire was presented in two major sections: 14 questions on general demographic characteristics, and 16 questions on DKA knowledge, attitudes, actions and responses.

Data Analysis. The data were collected from an online platform, tabulated by using Microsoft Excel 2016 and analyzed using SPSS software version 26. The categorical variables were presented as percentages and frequencies. Both logistic regression tests and univariate chi-square analysis were conducted to determine the associations between the knowledge and attitude and the participants' general characteristics, also their attitude and response to the accepted level of knowledge, to obtain odds ratios for adjusted and unadjusted models. A P-value of <0.05 was considered statistically significant.

3. Results

Demographic features of the respondents concerning their diabetic status

Four hundred and fourteen responded exceeding the estimated sample size of 412. Most of the participants were in the age range of 30 - 49 years old (244; 59%) and non-diabetic (323; 78.0%). Half of the participants (263; 63.5%) are university graduates, and (207; 50%) of the participants are employed (**Table 1**).

The diabetic status of the participants was highest among participants who are less than 20 years (25; 6.0%), with university degrees (56; 13.5%), and among unemployed (57; 13.8%). All of the non-diabetics were educated 323 (10%) (P-value < 0.001).

Knowledge about DKA symptoms, signs, complications and prevention

Two hundred and sixty-eight (64.7%) of the participants reported that they know about DKA.

Table 2 summarizes the awareness and knowledge of the caregivers regarding the symptoms and signs of DKA. The most known symptom of DKA was the characteristic smell of breathing (290; 70.0%) while the least known was the skin coldness (122; 29.5%).

As for the seriousness of DKA, 326 (78.7%) of the participants considered it as a very life-threatening case for the child, compared to 31 (7.5%) who considered it a simple condition. While for the knowledge about complications of DKA, 262 (63.3%) reported that they know about them. 285 (68.8%) reported they knew it could lead to coma, while 255 (61.6%) did not know that it could lead to brain swelling.

Table 1. Demographic features of caregivers of diabetic children (N = 414).

Demographic feature	Not diabetic		Diabetic		Total		Statistical significance		
							X ²	df	P-value
Age									
20 - 29	45	10.9%	21	5.1%	66	15.9%	42.38	4	0.000
30 - 39	102	24.6%	10	2.4%	112	27.1%			
40 - 49	112	27.1%	20	4.8%	132	31.9%			
50 or more	39	9.4%	15	3.6%	54	13.0%			
Less than 20	25	6.0%	25	6.0%	50	12.1%			
Educational level									
Illiterate	0	0.0%	3	0.7%	3	0.7%	26.04	5	0.000
Primary school	2	0.5%	4	1.0%	6	1.4%			
Intermediate-Elementary school	16	3.9%	5	1.2%	21	5.1%			
Secondary School	70	16.9%	23	5.6%	93	22.5%			
University	207	50.0%	56	13.5%	263	63.5%			
Postgraduate Studies	28	6.8%	0	0.0%	28	6.8%			
Employment status									
Health-related	21	5.1%	10	2.4%	31	7.5%	11.48	2	0.003
Not health-related	148	35.7%	24	5.8%	172	41.5%			
Unemployed	154	37.2%	57	13.8%	211	51.0%			

Table 2. Awareness and knowledge of the caregivers regards the sign and symptoms of DKA.

What are the symptoms and signs of DKA?	Frequency	Percentage	
Colic	Don't know	118	28.5
	No	52	12.6
	Yes	244	58.9
Vomiting	Don't know	98	23.7
	No	42	10.1
	Yes	274	66.2
Skin coldness	Don't know	199	48.1
	No	93	22.5
	Yes	122	29.5
Disturbance of consciousness	Don't know	143	34.5
	No	51	12.3
	Yes	220	53.1
Body weakness	Don't know	119	28.7
	No	44	10.6
	Yes	251	60.6
The characteristic smell of breathing	Don't know	86	20.8
	No	38	9.2
	Yes	290	70.0

Also, 262 (63.3%) reported they know that DKA can lead to severe dehydration 368 (88.9%) of the participants that DKA can be prevented by taking insulin as directed, while 366 (88.4%) mentioned continuous blood glucose monitoring.

DKA, 285 (68.8%) agree that DKA can be complicated leading to Coma.

4. Discussion

This research was conducted to assess caregivers' knowledge about pediatric type-1 diabetic in the Riyadh Region. Most of the participants were in the age range of 30 - 49 years old (244; 59%), which is consistent with the overall age distribution of the Saudi population, of whom those in the same age group represent 37% of the population as per the latest census in 2016 [9] [10]. Also, most of the caregivers were non-diabetic (323; 78.0%), which seem to be consistent with the WHO's estimate of the prevalence of DM in KSA at 14.4% [11]. However, there are recent studies that suggest a much higher prevalence of DM in the Saudi population at more than 30% [10] [12] [13]. Half of the participants (207; 50.0%) were university graduates and employed, which is consistent with the national figures that estimate those who are currently studying at universities at more than two million and those employed at more than 3 million [14] [15] [16] [17] [18].

The diabetic status of the participants was highest among participants who are less than 20 years or more (25; 6.0%), which can be explained by the focus of the study, *i.e.* pediatric diabetes. DM was also highest among the unemployed (57; 13.8%), which may be seen as both a cause and a result. For example, Weinstein (2004), Naeem (2015), and Dagenais (2016) suggested that unemployment can be a result of DM due to disability and early mortality by disease [19] [20] [21], while others have suggested that it may contribute to the development of DM as a result of diminished healthy choices, lack of movement, and reduction in income [22] [23].

Most of the participants were unemployed and non-diabetic (154; 37.2%), which could be attributed to the caregivers being mostly women (mothers) who were not working. Moreover, given that the focus of the study is type 1, which is not hereditary, it is unlikely to find as many diabetic mothers.

Interestingly, all of the non-diabetics were educated 323 (10%) (P-value = 0.000). This finding is unlike Seiglie *et al.* (2020) who found that compared with no formal education; greater educational attainment was associated with an increased risk of diabetes across the 29 countries they included, after adjusting for BMI [23].

Regarding the awareness and knowledge of the caregivers regarding the symptoms, signs and complications of DKA, this study seems to reflect better results compared to previous studies, like that by Farran *et al.* (2020) who found that 38.67% of our participants have a poor awareness regarding DKA complications [15].

However, the percentages of those who reported DKA could lead to coma (285; 68.8%) are comparable to the 59.3% they found in the same study.

Although 46% know about DKA and 78.7% know that it is a life-threatening case for a child who is good, yet it was still an alarming figure since 35% did not know about it and 7.5% think it a simple case and that requires diabetes self-management education at national levels in Saudi Arabia. Also, 66% agreed that sign of DKA is vomiting but less apparent symptoms were less known, 28% and 34% for colic pain and disturbance of consciousness, respectively is worrying because they may indicate an emergency indication of DKA.

Caregivers' knowledge about how to prevent the DKA was surprising since generally satisfactory at 88.9% yet those who thought they should wait and continue to monitor the blood glucose level about 88.4%. This requires diabetes educators to educate pediatric patients and the caregiver about "sick day management". Similar conclusions were reached by other authors who studied diabetes in Saudi Arabia and elsewhere [24] [25] [26] [27].

The patients with DKA are prone to dehydration since that hyperglycemia, fever, excessive glycosuria and ketonuria increase fluid losses which must be replaced immediately (fluids should also contain water with salt if there are ongoing losses of fluids such as vomiting or diarrhea. Additionally, in the presence of loss of appetite or decreased blood glucose below approximately 10 mmol/L (180 mg/dL), sugar-containing fluids should also be considered to avoid starvation ketosis).

Diabetes Educators must inform caregivers that during the illness never stop insulin, but must to do Self-monitoring of blood glucose and increase the dose if needed and if they do not improve and ketones become significantly positive, and then they must go to the emergency to prevent further complications of DKA. Since we notice that range 61% to 68% of the responded know the complication of DKA could be coma, swelling of the edema and severe dehydration.

5. Limitations

As would be expected with this kind of studies, there are a few limitations. These include that the study was done in only one region of the country and it used questionnaires as its main data collection method. This could have limited a more geographical variation and may have caused some participants who are not able to read some difficulties filling them. That said, it is worth noting that Riyadh is the home of almost one third of the Saudi population from various regions of the country. Also, the participants were given the choice to seek the help of a person of their choice, should they have difficulties in reading or filling the form. Another limitation was lack of testing of validity and reliability of the study, which may have increased the power and reliability of our findings.

6. Conclusions

Most caregivers in this study show knowledge and awareness regarding the signs and symptoms of DKA, however, they need further education since most of them have lack knowledge of sick day management and how it is critical.

The main factors related to this positive reflection of knowledge and awareness were the level of education of the caregivers. These study findings suggest that it might be beneficial to educate caregivers of type-1 diabetic patients and the patients themselves about DKA's self-management, using insulin, and monitoring of blood glucose to prevent complications. This study has potential limitations. Our study is a cross-sectional study. Therefore, difficulty in recalling is a possibility that could affect the validity of the results. Furthermore, we cannot generalize our result to the kingdom of Saudi Arabia, as this study concerns with the Riyadh region only.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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