

## Awareness of Risk Factors of DKA among Diabetic Adults in KSA

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### ABSTRACT

**Background:** Diabetic ketoacidosis (DKA) is a complication of Diabetes mellitus (DM) that lingers to have high rates of morbidity and mortality regardless of advances in the management of DM. DKA mainly results from insulin deficiency from new-onset diabetes, insulin noncompliance and increased insulin need because of infection. Most persons with DKA have type 1 diabetes however, a subgroup of type 2 diabetes patients might as well have ketosis-prone diabetes. **Aim of the work:** To assess the level of awareness of the risk factors of DKA as well as the adherence of DM patients with drugs.

**Methods:** This is a questionnaire-based cross-sectional study enrolling a total of 100 randomly selected diabetic Saudi adults ensuring diversity in age range and educational stages. Descriptive analysis was done using Statistical Package for Social Sciences (SPSS) 23. Awareness levels for DKA were calculated as absolute frequencies and were reported as overall percentages.

**Results:** a total of 100 randomly selected diabetic Saudi adults (81 females and 19 males), 56% were diagnosed with DM-1 while 44% had DM-2 and only 11% were active sport practitioners. Moreover, only 62% reported a robust adherence to DM medications.

The majority of the respondent scored low knowledge on DKA (54%). Regarding awareness of predisposing risk factors: 9% and 29% of the participants have related DKA to infection and febrile illness respectively. While, 50% of them suggested that there was an association between physical stress and DKA.

**Conclusion:** Our results revealed a compelling need to bridge the disparity in awareness of DKA among Saudi adults with both types. The current knowledge gap doesn't only incur a significant cost burden on the patients and their sponsors because of the high cost treatment and rehabilitation but also and more severely the complications that can be life-threatening if not spotted and treated quickly.

Accordingly, we recommend the launch of education and awareness programs for the public at large, in the hope that this will lead to improved quality of life particularly for DM patients and their caregivers as well as establishing nutrition and sports programs at schools and universities that can teach children and young adults the preventive measures and appropriate management of DKA early on in life. Other public Awareness raising campaign through TV & Radio spots, culture and art activities and informational events would add a great value.

**Keywords:** diabetic ketoacidosis, DKA, type 1 diabetes mellitus, type 2 diabetes mellitus, Cross section, awareness, risk factors.

**Abbreviations:** DKA: Diabetic ketoacidosis, GDP: Gross domestic product.

### INTRODUCTION

Diabetic ketoacidosis is an acute metabolic complication of diabetes which the body cells can't use glucose for energy because there is not enough insulin which lead to increase the glucose then the body uses ketones or fatty acids source for energy, using the chemical imbalance (metabolic acidosis) called diabetic ketoacidosis <sup>[1]</sup>.

It is commonly associated with type 1 diabetes, nevertheless, it can also occur with type 2 diabetic patients where very little of their own insulin secreted. It can also be triggered by infection or other illness, severely dehydration, cardiovascular diseases such as stroke or myocardial infarction <sup>[2]</sup>.

Clinical features of DKA include flushing, hot, dry skin, blurred vision, polydipsia, polyuria, polyphagia, weakness, drowsiness or difficulty waking up. Young children may lack interest in their normal activities,

rapid, deep breathing" Kussmaul respiration ", a strong, fruity breath odor" acetone ", loss of appetite, belly pain, and vomiting, confusion, hypotension, tachycardia, volume depletion is always present <sup>[3]</sup>.

Diagnostic criteria for DKA include presence of blood glucose >250 mg/dL, arterial pH of  $\leq 7.30$ , bicarbonate level of  $\leq 18$  mEq/L, and adjusted for albumin anion gap of >10–12.3. Positive serum and urine ketones may further support the diagnosis of DKA <sup>[4]</sup>.

Mortality rates have fallen significantly in a period of 20 years - from 7.96% to 0.67%. The mortality rate is still high in developing countries and among non-hospitalised patients <sup>[5]</sup>.

The frequency of DKA at diagnosis ranges from 12.8% to 80%, and is lowest in Sweden, the Slovak Republic and Canada and highest in the United Arab Emirates, Saudi Arabia and Romania. The

frequency of DKA is lower in countries where the background incidence of type 1 diabetes is higher and in countries further from the equator and with a lower GDP. The association with background incidence may be due to increased awareness of the condition and hence earlier detection, or it may reflect a different subtype of disease. The association with latitude may similarly reflect different subtypes of disease or geographical factors and is also likely to include socioeconomic factors, including GDP and health expenditure <sup>[6]</sup>.

Thus, the objective of the present study is to assess the awareness level of DKA among a selected sample of diabetic young adults in KSA and address any knowledge gaps and recommendation for mitigation actions to bridge the gap.

## METHODS

### Study design and setting

This is an exploratory cross-sectional study conducted among 100 diabetic patients aged from 16 to above 35 years in Riyadh city, Kingdom of Saudi Arabia.

Both quantitative and qualitative methods were used in this study. The questionnaire was divided into 2 sections, the first section was concerned with information of the participants, while the second section was evaluating the personal knowledge about DKA.

### Statistical analysis

Data analysis was carried out using Microsoft Excel 2016 (Microsoft Corporation, Seattle, WA, USA), and the Statistical Package for Social Sciences version 23 (SPSS Inc., Chicago, IL, USA).

## RESULTS

### Characteristics of the Participants

A total of 100 Saudi diabetic adults were enrolled in the current study, 81% of which were female while 19% were males.

Age groups ranged from 16 to more than 35 years old. Educational stage was also diverse from high school students to graduates. 56% of participants had Type 1 DM while 44% had DM type 2. Participants' characteristics are shown in (table 1).

**Table (1):** Baseline characteristics of the study sample

	Variant	Frequency	Percent	Valid percent	Cumulative Percent
Gender	Male	19	18.8	19	19
	Female	81	80.2	81	100
	Total	100	99	100	
	Missing	1	1		
	Total	101	100		
Age	16-21 years	18	17.8	18	18
	22-28 years	33	32.7	33	51
	29-35 years	18	17.8	18	69
	> 35 years	31	30.7	31	100
	Total	100	99	100	
	Missing	1	1		
Educational Stage	High School	32	32.3	32	32
	College	48	47.5	48	80
	Graduate	20	19.8	20	100
	Total	100	99	100	
	Missing	1	1		
Type of DM	Type 1	44	43.6	44	44
	Type 2	56	55.4	56	100
	Total	100	99	100	
	Missing	1	1		
	Total	101	100		

## SURVEY RESULTS

### *Participants' habits and adherence to oral Insulin medication*

- Practicing sports was not a common habit for most of the participants since only 11% confirmed regular sports practicing however, 63% and 26% of the answers came as “sometimes” and “never” respectively.
- Overall, a regular administration of Insulin oral hypoglycemic treatment was declared by 62% of the respondents while 4% were irregular users. However, we categorized the answers per DM Type and the results were as follows:
  - a. DM Type 1: 27% regularly adhered to oral hypoglycemic treatment, 14% had a semi-regular trend while 3% irregularly followed the treatment protocol.
  - b. DM Type 2: 35% regularly adhered to oral hypoglycemic treatment, 10% had a semi-regular trend while 1% irregularly followed the treatment protocol.

### *Participants' awareness of DKA and predisposing risk factors*

- The level of knowledge was profoundly low since 54% of participants scored "0-4"
- Majority of participants have either assured no relation between infection and DKA (46%) or had no knowledge if the subject (45%) whilst only 9% answered "Yes" to confirm the correlation.
- 41% of participants had a febrile illness accompanied with DKA while 53% correlated febrile illness with DKA onset.
- Only 32% of respondents believed that missing Insulin dose would lead to DKA while 48% claimed no knowledge on the association by answering "I don't know".
- 50% of participants related physical stress to DKA while the other 50% either denied the correlation or declared no knowledge (9% and 41% respectively).

**Table (2):** Participants' answers to the questionnaire

		Frequency	Percent	Valid Percent	Cumulative Percent
How will you evaluate your knowledge about Diabetic Ketoacidosis?					
Valid	0-4	54	53.5	54	54
	6-May	20	19.8	20	74
	9-Jul	9	8.9	9	83
	10	17	16.8	17	100
Missing	Total	100	99	100	
Do you practice sport					
Valid	Never	26	25.7	26	26
	Sometime	63	62.4	63	89
	Always	11	10.9	11	100
	Total	100	99	100	
Missing	System	1	1		
Total		101	100		
System		1	1		
Are you constantly taking Insulin oral hypoglycemic treatment? DM1					
Valid	Irregular	3	7	7	6.8
	Semi regular	14	32	32	38.6
	Regular	27	61	61	100.0
	Total	44	100	100.0	
Are you constantly taking Insulin oral hypoglycemic treatment? DM2					
Valid	Irregular	1	2	2	1.8
	Semi regular	20	36	36	37.5
	Regular	35	63	63	100.0

Awareness of Risk Factors of DKA...

		Frequency	Percent	Valid Percent	Cumulative Percent
Total		56	100	100	
Are you constantly taking Insulin oral hypoglycemic treatment? Total					
Valid	irregular	4	4	4	4
	semi regular	34	33.7	34	38
	regular	62	61.4	62	100
	Total	100	99	100	
Missing	System	1	1		
Total		101	100		
Do you think missing insulin dose would lead to DKA?					
Valid	No	22	21.8	22	22
	I don't know	48	47.5	48	70
	yes	30	29.7	30	100
	Total	100	99	100	
Missing	System	1	1		
Total		101	100		
Do you think the infection cause Diabetic ketoacidosis?					
Valid	No	46	45.5	46	46
	I don't know	45	44.6	45	91
	yes	9	8.9	9	100
	Total	100	99	100	
Missing	System	1	1		
Total		101	100		
Did you have a febrile illness present with DKA?					
Valid	No	41	40.6	41	41
	I don't know	30	29.7	30	71
	yes	29	28.7	29	100
	Total	100	99	100	
Missing	System	1	1		
Total		101	100		
Do you think febrile illness is a risk factor for DKA?					
Valid	No	53	52.5	53	53
	I don't know	30	29.7	30	83
	yes	17	16.8	17	100
	Total	100	99	100	
Missing	System	1	1		
Total		101	100		
Do you think physical stress is risk factors for DKA?					
Valid	No	9	8.9	9	9
	I don't know	41	40.6	41	50
	yes	50	49.5	50	100
	Total	100	99	100	
Missing	System	1	1		
Total		101	100		

Furthermore, a cross tabulation analysis was performed in order to determine the counts for combinations of DM Type with patients' sports practicing habit and the knowledge level of DKA risk factors which can be seen in Table 3.

**Table (3):** Outcome of the stroke awareness assessment questionnaire cross tabulated by DM Type

<b>Do you practice sports?</b>				
	Never	Sometimes	Always	Total
Type 2	14	36	6	56
Type 1	12	27	5	44
Total	26	63	11	100
<b>* Do you think that infection can cause Diabetic ketoacidosis?</b>				
	No	I don't know	Yes	Total
Type 2	22	30	4	56
Type 1	24	15	5	44
Total	46	45	9	100
<b>* Did you have a febrile illness when present with DKA?</b>				
	No	I don't know	Yes	Total
Type 2	28	17	11	56
Type 1	13	13	18	44
Total	41	30	29	100
<b>If you have Diabetic Mellitus which type ? * Are you constantly taking Insulin oral hypoglycemic treatment?</b>				
	Irregular	Semi regular	Regular	Total
Type 2	3	14	27	44
Type 1	1	20	35	56
Total	4	34	62	100
<b>* Do you think febrile illness is risk factors for DKA?</b>				
	No	I don't know	Yes	Total
Type 2	24	25	7	56
Type 1	29	5	10	44
Total	53	30	17	100
<b>* Do you think physical stress is risk factors for DKA?</b>				
	No	I don't know	Yes	Total
Type 2	6	24	26	56
Type 1	3	17	24	44
Total	9	41	50	100

## DISCUSSION

The present study evaluated the level of knowledge and awareness of the risk factors predisposing DKA as well as the compliance of DM patients to medications among the included study sample presented by 100 diabetic Saudi adults (16 years to >35 years), 56 of them were DM-1 and 44 were DM-2.

### General awareness of DKA

Among the study group, the overall awareness of DKA was significantly low (54% of the participants reported a knowledge score from 0 to 4).

This comes in agreement with a retrospective study performed in Saudi Arabia, the authors concluded that the lack health education and awareness of the parents / public and primary health care physicians resulted in a significantly high

percentage of children with newly diagnosed DM-1 still have DKA at the onset of DM. They raised a

flag for continuous medical education and mass media to achieve early diagnosis of type-1 DM before the development of DKA<sup>[7]</sup>.

### Awareness of DKA risk factors

We have also sensed patients' habits through introducing questions on regular sports practice along with the discipline in adherence to medications to the questionnaire which unfortunately scored 11% and 62% respectively. Moreover, 70% of respondents whether didn't know if missing insulin does could relate to DKA or declared no association in the first place. Missing insulin dose may lead not only to DKA but also other diabetic irreversible complications such as renal failure , brain stroke , myocardial infarction

, retinopathy, and end nerves damage, for both DM-1 and DM-2<sup>[8]</sup>. This reveals a clear knowledge gap and an urging need to improve lifestyle and medication habits.

Additionally, knowledge of other risk factors such as infection and febrile illness was assessed. Infection is known to cause inflammation, pro-inflammatory cytokine release, and a counter-regulatory response that collectively lead to insulin resistance and metabolic decompensation, moreover, a history of infection or febrile illness was associated with an increased risk of DKA<sup>[9]</sup>.

In our study, the participants response was somewhat surprising since only 9% related infections to the onset of DKA while 91% with declared no association or claimed no knowledge. Similarly, only a small percentage (17%) related febrile infection to DKA.

Furthermore, our results have also revealed a lack of knowledge on the physiological stress correlation to DKA which can contribute to the initiation and progression of DKA for DM patients since only 50% of the participants acknowledged the attribution.

A study by Ovalle *et al.* suggested that any physiological stress (including pregnancy, menstruation) has the potential to initiate DKA. Medication (notably corticosteroids, sympathomimetics, alpha-blockers, beta-blockers and diuretics) may provoke an episode of DKA. Some women are more likely to go into DKA at the time of menstruation<sup>[10]</sup>.

## CONCLUSION

Our results revealed a compelling need to bridge the disparity in awareness of DKA among Saudi adults with both types. The current knowledge gap doesn't only incur a significant cost burden on the patients and their sponsors because of the high cost treatment and rehabilitation but also and more severely the complications that can be life-threatening if not spotted and treated quickly.

Accordingly, we recommend the launch of education and awareness programs for the public at large, in the hope that this will lead to improved quality of life particularly for DM patients and their caregivers as well as establishing nutrition

and sports programs at schools and universities that can teach children and young adults the preventive measures and appropriate management of DKA early on in life. Other public Awareness raising campaign through TV & Radio spots, culture and art activities and informational events would add a great value.

## REFERENCES

1. **International Diabetes Federation (2011):** Diabetes Atlas. 5th ed. Available from URL:<http://www.idf.org/diabetesatlas/news/fifth-edition-release>.
2. **Singh H, Thangaraju P, Kumar S, Aravindan U, Balasubramanian H, Selvan T (2014):** Knowledge and Awareness of Diabetes and Diabetic Ketoacidosis (DKA) Among Medical Students in a Tertiary Teaching Hospital: An Observational Study. *J Clin Diagn Res.*, 8:HC04–06.
3. **Misra S, Oliver NS (2015):** Diabetic ketoacidosis in adults. *BMJ.*, doi: 10.1136/bmj.h5660.
4. **Kitabchi AE, Umpierrez GE, Miles JM, Fisher JN (2009):** Hyperglycemic crises in adult patients with diabetes. *Diabetes Care*, 32(7):1335–1343.
5. **Joint British Diabetes Societies Inpatient Care Group (2013):** Management of Diabetic Ketoacidosis in Adults. 2nd Edition. <https://abcd.care/joint-british-diabetes-societies-jbds-inpatient-care-group>
6. **Usher-Smith JA, Thompson M, Ercole A, Walter FM (2012):** Variation between countries in the frequency of diabetic ketoacidosis at first presentation of type 1 diabetes in children: a systematic review. *Diabetologia*, 55(11):2878-94.
7. **Al Qahtani A, Shati AA, Alsheel AM, Abbag FI (2013):** Diabetic ketoacidosis as an initial presentation of type-1 diabetic children in Aseer region of Saudi Arabia. *International Journal of Current Research and Review*, 5(20):41.
8. **WH Herman, TW Donner, RJ Dudl et al. (2016):** Standards of medical care in diabetes Summary of revisions. *Diabetes Care*, 39 (1):S4–5.
9. **Usher-Smith JA, Thompson MJ, Sharp SJ, Walter FM (2011):** Factors associated with the presence of diabetic ketoacidosis at diagnosis of diabetes in children and young adults: a systematic review. *BMJ.*, 343:d4092.
10. **Ovalle F, Vaughan TB 3rd, Sohn JE et al. (2008):** Catamenial diabetic ketoacidosis and catamenial hyperglycemia: case report and review of the literature. *Am J Med Sci.*, 335(4):298-303.