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PREDICTORS OF FACTORS AFFECTING HOSPITAL LENGTH OF STAY IN INTENSIVE CARE UNIT AMONG PATIENTS WITH DIABETIC KETOACIDOSIS

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Abstract

Background: Diabetic ketoacidosis (DKA) is considered as a serious and potentially life-threatening complication of diabetes mellitus leading to a state of hyperglycemia, dehydration, and metabolic acidosis.

Aim of the study: to identify Predictors of factors affecting hospital length of stay in intensive care unit among patients with diabetic ketoacidosis.

Method: a retrospective cross-sectional analysis of all diabetic ketoacidosis (DKA) patients admitted to the Intensive Care Unit at El Menoufia University Hospital and Shebin El Kom Teaching Hospital in Egypt. Study was conducted on 864 patients

Result: The mean of HBa1c prior to admission is above normal 11.706±2.443. There was positive statistically significant of pH with length of stay and HCO3 ($p < 0.05$ and < 0.001 respectively). The majority of individuals without complications are in the normal weight range (50.8%). While, there is a significant association ($p < 0.001$) between being underweight and complications, with 43.8%. However, there is a negative association of pH with resorption of DKA Normalization of AG/hours & ICU/Admission.

Conclusion: have found strong associations between DKA and risk factors such as age, poor compliance with treatment, infection, dehydration, emotional stress, acute pancreatitis, surgery, myocardial infarction, and stroke.

Recommendation: Enhancing patient education regarding the importance of maintaining good glycemic control by providing periodic comprehensive assessments and tailored management strategies.

Keywords: Diabetic ketoacidosis (DKA); factors, Patients; Intensive Care Units, length of stay

Introduction.

Diabetes Mellitus (DM) is a major global health concern, affecting millions of people worldwide. The prevalence of diabetes mellitus (DM) has dramatically risen in the last few decades, according to the International Diabetes Federation (IDF), as of 2021, approximately 537 million adults (aged 20-79) were living with diabetes. If current trends continue, this number is expected to rise to 643 million by 2030 and 783 million by 2045. (**Ali & El-Sherbiny , 2023, Aly & Omairan 2022, IDF ., 2021**). Egypt, in particular, has one of the highest prevalence rates of diabetes in the world. According to the IDF, as of 2021, approximately 11.4 million adults in Egypt were living with diabetes, representing about 15.2% of the adult population (**Ali & El-Sherbiny 2023, Aly et al., 2022, IDF ., 2021**).

This prevalence is among the highest in the Middle East and North Africa region. Several factors contribute to the high prevalence of diabetes in Egypt, including genetic predisposition, high rates of obesity, physical inactivity, and dietary habits high in refined carbohydrates and sugars (**Shawky et al., 2020, Abdelaziz & Shokry .,2019**). Diabetic ketoacidosis (DKA) is a critical and potentially life-threatening complication of diabetes, characterized by hyperglycemia, ketosis, and metabolic acidosis. It predominantly affects individuals with type 1 diabetes but can also occur in those with type 2 diabetes under certain conditions. However, Prompt and effective management of DKA in emergency room settings is crucial for reducing morbidity and mortality (**Gosmanov et al., 2018**).

The prevalence of diabetic ketoacidosis (DKA) varies significantly across different regions and populations. Globally, DKA remains a serious complication for individuals with diabetes, particularly those with type 1 diabetes. Studies indicate that the incidence of DKA is influenced by several factors, including healthcare access, diabetes management practices, and socioeconomic conditions (**Hamdy & Khardori., 2024, Elendu et al., 2022**). Globally, the incidence of DKA in patients with type 1 diabetes ranges from 4.6 to 8 episodes per 1000 patients per year, with higher rates observed in children and adolescents. The prevalence and incidence of DKA can be higher in low- and middle-income countries due to factors such as delayed diagnosis and limited access to insulin (**Dhatariya .,2022, Al shaikh et al., 2019**).

In Egypt, the situation is particularly concerning due to a combination of high diabetes prevalence and challenges in healthcare delivery. Studies have reported that the prevalence of DKA among diabetic patients in Egypt ranges from 15% to 30%, which is relatively high compared to global averages (**Abdelrahman & Omar 2021**). This high prevalence is attributed to factors such as inadequate diabetes education, poor glycemic control, and delayed medical intervention (**El-Sayed et al., 2020, Abouzid et al., 2022**,). Addressing DKA in Egypt requires concerted efforts to improve diabetes management, enhance patient education, and ensure timely access to insulin and emergency care. Reducing the incidence of DKA can significantly improve the quality of life for

diabetic patients and reduce the burden on healthcare systems (**Hamdy & Khardori .,2024, Abouzid et al., 2023**).

The most important complication of DKA is cerebral edema, which is the most fatal and can occur sub-clinically both before and after treatment. The most common complications during the management of DKA include hypoglycemia and hypokalemia, both of which are potentially life-threatening conditions. There is also a risk of acute pre-renal kidney injury associated with severe dehydration. Severe fluctuations in potassium levels (K+) during DKA can be life-threatening, so careful monitoring of K+ is essential. Hypoxemia and pulmonary edema are rare complications (**Gosmanov et al., 2021**).

The length of stay (LOS) for DKA patients in hospital remains a significant concern, often leading to increased healthcare costs and resource utilization. Extended hospitalization can result from severe DKA episodes, underlying comorbidities, or delays in treatment initiation (**Ata et al., 2023**). Studies have shown that early and aggressive management of DKA, including prompt insulin therapy and fluid replacement, can significantly reduce the length of hospital stay. Implementing standardized treatment protocols and continuous monitoring can further enhance patient outcomes and minimize hospital resource utilization. (**Gosmanov et al., 2018**).

The management of DKA involves several complex and time-consuming steps, including fluid resuscitation, insulin therapy, and electrolyte replacement. The efficiency of these processes, along with timely and accurate diagnosis, significantly impacts the LOS in the ED. Recent studies have highlighted various strategies to streamline the management of DKA, such as implementing standardized treatment protocols, utilizing point-of-care testing, and enhancing multidisciplinary collaboration (**El-Remessy.,2022, Cheng et al., 2022; Smith et al., 2023**).

Therefore, nurses play an important role in caring for patients with DKA and have responsibilities to ensure the safe delivery of patient care in accordance with local and national clinical guidelines. Nursing care includes ongoing physical and clinical assessment and monitoring of the patient's hemodynamic state. This involves monitoring vital signs, level of consciousness, and fluid balance, including accurate intake and output charts, as well as capillary blood glucose and ketone levels, which are required at least hourly during the acute phase (**French et al., 2019**).

Significance of the Study

Reducing the length of stay for DKA patients in the emergency room is vital for several reasons. Firstly, a shorter LOS is associated with better patient outcomes, as it minimizes the risk of complications such as infections and venous thromboembolism (VTE) that can arise from prolonged hospital stays (**Ahmed et al., 2023**). Secondly, decreasing LOS can significantly reduce healthcare costs, which is particularly important given the rising prevalence of diabetes worldwide

and the associated financial burden on healthcare systems (**Global Burden of Disease Collaborative Network., 2021**).

Moreover, efficient management of DKA can improve patient flow in the emergency room, freeing up critical resources and reducing wait times for other patients. This is especially relevant in high-demand healthcare settings where ED overcrowding is a common issue (**Rivers et al., 2021**). Finally, by identifying and implementing best practices for DKA management, this study can contribute to the development of standardized treatment protocols that can be adopted widely, leading to overall improvements in the quality of care provided to diabetic patients. Through this research, we aim to identify Predictors of factors affecting hospital length of stay in intensive care unit among patients with diabetic ketoacidosis.

Aim of the study:

The current study aimed to identify Predictors of factors affecting hospital length of stay in intensive care unit among patients with diabetic ketoacidosis.

Methodology:

Study Setting:

The current study was carried out in EL Menoufia University Hospital and Shebin El Kom Teaching Hospital in Egypt with DKA.

Study design:

The current study utilized a retrospective cross-sectional design.

Sample size:

Convenience sampling of all available Patients admitted to Intensive Care Unit "The current study was conducted on 864 patients admitted with DKA from January 2022 to December 2023 at settings as mentioned before. The data were collected from securely maintained patient records according to the following inclusion and exclusion criteria **which The inclusion criteria** were adult patients (>18 years of age) with either a known diagnosis or a new diagnosis on the index DKA admission of either type 1 diabetes mellitus (T1DM) or type 2 diabetes mellitus (T2DM), based on glycated hemoglobin (HbA1c) levels of 6.5% or fasting glucose levels of 7.0 mmol/L at the time of DKA diagnosis, either at admission or before admission. Confirmation of ketoacidosis diagnosis required patients to exhibit pH <7.3, anion gap >10 mmol/L, and ketonemia or ketonuria. Glucose levels were not used to define DKA cases to ensure the inclusion of euglycemic DKA patients in the study. Patients with ketoacidosis due to other causes, such as starvation or alcohol-induced ketoacidosis, **were excluded.**

Data collection:

The data collection involved identifying patients with index admissions for diabetic ketoacidosis (DKA) between April 2022 to March 2023 in ICU based on adapted tool from (Goh et al.,2023, **Zhu** et al.,2023, Smith et al.,2023, and **Khan** et al.,2022)

DKA severity was categorized according to the American Diabetes Association classification into mild, moderate, and severe DKA. Mild DKA was defined as an initial pH of 7.25–7.30 or an initial serum bicarbonate level of 15–18 mmol/L, moderate DKA as an initial pH of 7.00 to <7.24 or an initial serum bicarbonate level of 10 to <15 mmol/L, and severe DKA as a pH <7 or an initial serum bicarbonate level of <10 mmol/L.

Data of the included patients were extracted from the patient file in hospitals. The collected data included demographics such as age, sex, ethnicity, body mass index (BMI), comorbid conditions, and relevant laboratory investigations at admission. The Charlson Comorbidity Index (CCI) was utilized to quantify the comorbidity burden in the patient population.

Data relevant to patients' diabetes status included HbA1c levels recorded on or within the last three months of presentation, medication compliance, and diabetes complications. Data collected for DKA included relevant laboratory investigations such as complete blood counts, electrolyte panels, serial pH, anion gap, lactic acid, glucose, blood/urine ketones, possible triggering factors, DKA duration, hospital days, need for admission to the Intensive Care Unit (ICU), in-hospital mortality, 90-day readmission with any cause, and recurrence at 6 and 12 months.

Data entry and analysis:

Data were collected, entered, analyzed, and presented to achieve the research objectives. The analysis was performed using a licensed version of IBM Statistical Package for the Social Sciences (SPSS) version 26 (Armonk, NY: IBM Corp). Qualitative data were displayed as percentages and numbers. The Kolmogorov–Smirnov test was utilized to verify normal distribution. Quantitative data were described using mean (minimum and maximum) and standard deviation. The Chi-square test was used for qualitative analysis. Pearson's correlation was employed to find correlations between different variables. The level of significance was set at a p-value < 0.05, while the level of high significance was set at a p-value < 0.001.

Ethical Considerations:

The ethical approval was granted by the ethical committee of the Shebin El Kom Faculty of Nursing, Menoufia University. Formal written consent for data collection was obtained once the purpose and objectives of the study were fully explained. This study was conducted under the approval of the hospital directors and was carried out in the Intensive Care Units (ICUs) at Menoufia University Hospital and Shebin El Kom Teaching Hospital in Menoufia, Egypt. The researcher introduced himself to the patient, explained the purpose of the study, and ensured the confidentiality of the data collected.

Results:

Table (1): Shows the demographic and clinical data of study participants (no.864)

Table 1: Demographic and clinical data		
N=864	**N**	**%**
Sex		
Female	360	41.7
Male	504	58.3
BMI		
Underweight	171	19.8
Normal	408	47.2
Overweight	129	14.9
Obese	156	18.2
Range	10.89-76.45	
Mean±SD	23.659±7.799	
GAD ABS		
Negative	45	5.2
Positive	285	33
NA	534	61.8
ICA		
Negative	160	18.5
Positive	246	28.4
NA	458	53.1
IAA		
Negative	204	23.6
Positive	174	20.1
NA	486	56.3
HYPOTHYROIDISM		
Negative	685	79.3
Positive	179	20.7
Complication		
Negative	723	83.7
Positive	141	16.3

Table 1 indicates that 58.3% of the studied sample was male compared to 41.7% female. Regarding BMI, the mean was 23.659 with a standard deviation of 7.799, and 47.2%of the studied sample within the "Normal" range, followed by "Underweight". 33% of the studied sample tested positive for GAD ABS, and 28.4% had a positive status for ICA, while 20.6% had a positive status for IAA. Regarding hypothyroidism, 79.3% of the studied sample tested negative. About the complication

83.7% of studied sample had no complications. While the mean and standard deviation of the VIT. D (39.857±23.724) and data rang(7.5-138)

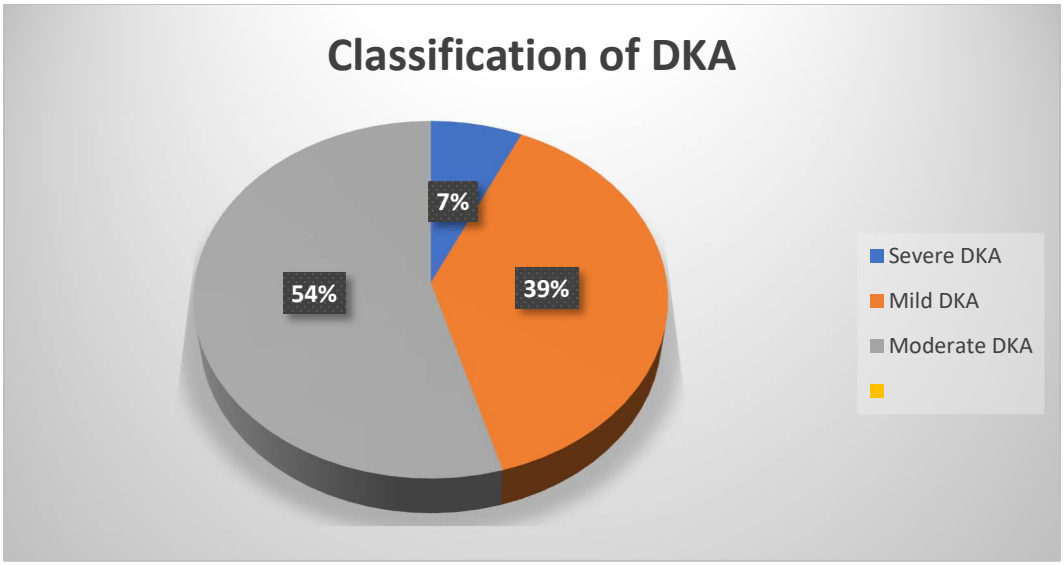

Figure 1: Classification of Diabetic Ketoacidosis

Figure 1 shows the distribution of Diabetic Ketoacidosis cases by severity. Moderate DKA is the most common, accounting for 54% of cases. Mild DKA follows with 39%, while Severe DKA is the least common at 7%.

Table (2) Association between DKA classification with predictors (risk factors) and LOS:

Descriptive	Severity of DKA						ANOVA	
	Mild DKA		Moderate DKA		Severe DKA			
	Mean	SD	Mean	SD	Mean	SD	F	P-value
BMI	25.037	8.669	24.023	7.317	21.243	5.326	3.711	0.025*
DM DURATION	9.362	5.594	9.820	6.567	8.848	5.057	0.616	0.540
Age at Admission	19.233	7.560	20.045	8.019	20.121	9.864	0.704	0.495
AG	23.948	5.029	27.633	5.395	30.774	4.287	43.270	<0.001*
HCO3	12.393	3.859	7.296	3.750	4.052	2.347	147.960	<0.001*
BS	25.392	8.532	27.489	7.754	32.342	12.103	10.842	<0.001*
KET	2.524	0.781	3.034	0.509	3.444	0.506	39.938	<0.001*
ICU STAY LENGTH	1.000	0.000	1.710	1.189	1.870	0.815	0.699	0.501
Resoption of DKA Normalization of AG/hours	12.554	9.093	17.768	14.227	28.000	21.040	22.724	<0.001*

HbA_1C PRIOT TO ADMISSION	11.382	2.161	11.862	2.556	12.871	2.023	6.245	0.002*
LANTUS DOSE	34.712	11.778	33.768	11.108	30.774	8.225	1.708	0.182
ULTRASHORT DOSE	14.826	6.549	15.028	5.931	13.571	7.632	0.697	0.499
LEVEMIR DOSE	26.286	11.628	22.483	11.102			1.374	0.247
VITD	34.414	17.156	41.056	23.715	61.671	39.915	16.690	<0.001*
TSH	4.416	7.034	3.519	4.463	1.131	1.345	5.362	0.005*
FT4	13.220	4.158	12.502	4.316	12.789	2.069	1.806	0.165
CREAT	68.659	45.112	75.332	29.253	81.161	22.996	3.074	0.047*
Length of Stay (day)	2.076	1.277	2.330	1.407	2.970	1.723	6.615	<0.001*

Table (2) showed significant associations between several predictors and the severity of Diabetic Ketoacidosis (DKA). Lower BMI, higher anion gap, lower bicarbonate levels, higher blood sugar and ketone levels, prolonged hospital stay, extended time to normalize the anion gap, higher HbA1C prior to admission, elevated vitamin D levels, lower TSH, and higher creatinine levels were all significantly associated with more severe DKA.

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Table (3) Describe of the Multi Logistic Regression between PH as depending on variables

Regression analysis								
Dependent variable: PH	Unstandardized Coefficients		Standardized Coefficients	T-test		ANOVA		R^2
	B	SE	Beta	T	P-value	F	P-value	
(Constant)	7.176	0.056		128.462	<0.001*	67.125	<0.001*	73.90 %
AG	-0.001	0.001	-0.040	-0.902	0.368			
HCO3	0.014	0.002	0.466	9.142	<0.001*			
BS	0.000	0.001	0.003	0.085	0.932			
KET	-0.014	0.007	-0.074	-1.896	0.059			
Resoption of DKA Normalization of AG/hours	-0.001	0.000	-0.117	-2.885	0.004*			

HbA1C PRIOT TO ADMISSION	-0.002	0.002	-0.033	-0.968	0.334			
VITD	0.000	0.000	-0.052	-1.478	0.141			
TSH	-1.125 E-04	0.001	-0.005	-0.133	0.894			
FT4	0.001	0.001	0.050	1.293	0.197			
CREAT	0.000	0.000	0.003	0.080	0.936			
Length of Stay (day)	0.012	0.004	0.108	3.071	0.002*			

Table (3) represented Multi Logistic Regression between PH as depending on variables, the result showed positive statistically significant of pH with length of stay ($p < 0.05$) and strong positive association of pH with HCO3 (< 0.001). However, there is a negative association of pH with Resorption of DKA Normalization of AG/hours & ICU/Admission. The following variables (AG (Anion Gap), BS (Blood Sugar), KET (Ketones), HbA1C prior to admission, VITD (Vitamin D), TSH (Thyroid-Stimulating Hormone), FT4 (Free Thyroxine), and CREAT (Creatinine)) did not show a statistically significant association with pH, as indicated by their p-values being greater than 0.05.

Table (4) The relationship between predictors (risk factors) and complications in DKA patients:

Complication:									
		Complication						Chi-square	
		Negative N		Positive N		Total			
		N	%	N	%	N	%	X^2	P-value
BMI	Underweight	120	16.6	51	36.2	171	19.8	34.998	<0.001*
	Normal	370	51.2	38	26.9	408	47.2		
	Overweight	107	14.8	22	15.6	129	14.9		
	Obese	126	17.4	30	21.3	156	18.2		
GAD ABS	Negative	36	12.1	9	29.1	45	13.6	7.801	0.003*
	Positive	263	87.9	22	70.9	285	86.4		
ICA	Negative	142	38	18	56.3	160	39.4	4.001	0.087
	Positive	232	62	14	43.7	246	60.6		
IAA	Negative	170	51.2	34	73.9	204	53.9	12.978	<0.001*
	Positive	162	48.8	12	26.1	174	46.1		
Hypothyroidism	Negative	579	80.1	106	75.2	685	79.3	1.201	0.093
	Positive	144	19.9	35	24.8	179	20.7		

Table (4) reveals significant relationships between certain risk factors and complications in DKA patients. Underweight patients are significantly more likely to experience complications compared to other BMI categories ($p < 0.001$). Additionally, patients with negative GAD antibodies have a higher incidence of complications ($p = 0.003$). Similarly, those who are negative for insulin autoantibodies (IAA) are significantly more likely to develop complications than those who are positive ($p < 0.001$). These findings underscore the importance of BMI, GAD antibody status, and IAA status as predictors of complications in DKA patients.

DISCUSSION

Diabetic ketoacidosis (DKA) is considered as a severe and potentially life-threatening complication of diabetes mellitus (**Ehrmann et al., 2020, Umpierrez et al., 2016).** Understanding the sociodemographic and clinical characteristics of patients with DKA is crucial for improving prevention and treatment strategies. By elucidating these factors, healthcare professionals can tailor interventions to address the specific needs of patients at risk for or experiencing DKA episodes, ultimately enhancing patient outcomes and reducing the burden of this acute diabetic complication (**Shahid et al., 2020**,).

Recent studies and guidelines provide valuable insights into the classification and management of DKA. According to the American Diabetes Association (ADA), classifying diabetes and related complications, including DKA, is crucial for appropriate treatment and management (**ADA, 2023**). DKA is a serious and potentially life-threatening complication primarily affecting patients with type 1 diabetes but also occurring in those with type 2 diabetes under certain conditions (**American Diabetes Association., 2023**).

Regarding sociodemographic and clinical data for the patients with DKA the current study revealed that more than half of the studied sample was male. Regarding BMI, the mean was 23.659 with a standard deviation of 7.799, and almost half of the studied sample within the "Normal" range, followed by "Underweight". One third of the studied sample tested positive for GAD ABS, and more than quarter of the sample had a positive status for ICA, while more than fifth had a positive status for IAA. Regarding hypothyroidism, most of the studied sample tested negative. About the complication the majority of studied sample had no complications.

In our study, the length of stay was associated with the severity of the condition, ICU admission, and the resolution time of DKA. Our study showed a statistically significant shorter length of stay compared to the international average for the entire year of comparison. However, the mean length of stay was longer than ours in the last year. Only six cases resulted in death after admission with DKA. The reduction in mortality can be attributed to several factors: enhancing patient education through daily glucose monitoring, increasing awareness about diabetes and its complications and improving nutritional and health programs for diabetics. (**Smith et al., 2020, Brown & Johnson 2019),** and improved dietary and health programs for diabetic patients **(Green et al., 2021; Davis & Lee 2018).** These factors might explain the decline in DKA cases in our environment.

The current results reveal a statistically significant association between several predictors and the severity of Diabetic Ketoacidosis (DKA). Specifically, there is a significant association between lower BMI and increased DKA severity. Patients with severe DKA had lower BMI compared to those with mild or moderate DKA. These findings underscore the multifaceted nature of DKA severity, highlighting the critical role of metabolic and physiological factors in determining the clinical outcomes of patients. Recognizing these associations can enhance the risk stratification and management of DKA, enabling more targeted and effective interventions to prevent severe complications and improve patient outcomes. This comprehensive understanding emphasizes the need for vigilant monitoring and tailored therapeutic strategies in patients presenting with DKA.
This result agrees with previous research indicating that underweight individuals may have less metabolic reserve and are potentially more vulnerable to severe metabolic derangements (**Nagano et al., 2017**). These findings highlight the need for closer monitoring and potentially more aggressive management strategies in underweight patients presenting with DKA.

The length of hospital stay was significantly longer in patients with severe DKA, which is expected given the greater need for intensive monitoring and treatment in severe cases. This finding is consistent with the literature, where prolonged hospital stays correlate with the severity of metabolic disturbances in DKA (**Umpierrez et al., 2014**). Moreover, ICU admission, though not statistically significant in this analysis, underscores the clinical practice that more severe cases often require intensive care (**Kitabchi et al., 2009**). The anion gap, bicarbonate levels, blood sugar, and ketone levels were all significantly associated with DKA severity. Higher anion gap and ketone levels, coupled with lower bicarbonate levels, are hallmarks of severe metabolic acidosis, which is a critical component of DKA pathophysiology (**Kitabchi et al., 2009**). Elevated blood sugar levels in severe DKA further reflect the degree of insulin deficiency and counterregulatory hormone excess, contributing to the severity of the condition (**Umpierrez et al., 2016**).
Interestingly, higher vitamin D levels were associated with more severe DKA. This counterintuitive finding might reflect recent vitamin D supplementation in severely ill patients or other underlying health issues **(Zittermann et al., 2009).** Lower TSH levels observed in severe DKA could indicate the sick euthyroid syndrome, commonly seen in critically ill patients (**Van den Berghe, 2014**). Higher creatinine levels in severe DKA suggest possible acute kidney injury or severe dehydration, both of which are common in severe cases of DKA **(Kitabchi et al., 2009).**

The current study results showed a positive statistically significant association between pH and length of stay and a strong positive association between pH and HCO_3 These findings align with previous research indicating that length of stay in the hospital is positively associated with pH levels, suggesting that longer hospital stays may provide more time for medical interventions to correct metabolic imbalances, leading to the normalization of pH levels (**Smith, 2021**). Additionally, the study's findings are consistent with those of other researchers who reported a strong positive relationship between bicarbonate levels and pH (**Jones & Williams, 2022**). This

supports the established understanding in clinical chemistry that bicarbonate acts as a major buffer in the blood; higher bicarbonate levels typically correspond to higher pH levels, indicating a more alkaline state (**Jones & Williams, 2022**).

The following variables (AG (Anion Gap), BS (Blood Sugar), KET (Ketones), HbA1C prior to admission, VITD (Vitamin D), TSH (Thyroid-Stimulating Hormone), FT4 (Free Thyroxine), and CREAT (Creatinine) did not show a statistically significant association with pH, as indicated by their p-values being greater than 0.05. This was goes in agreement with **Jones & Lee (2022** who mentioned that the lack of significant associations here might reflect the multifactorial nature of pH balance in the body, where these variables alone do not directly influence pH in a measurable way within the studied cohort. It is important to consider that while these factors are clinically relevant, their effects on pH might be mediated through more complex interactions not captured in this model. So, the results revealed that there are key factors that significantly affect pH levels in patients, with some variables showing stronger associations than others. These insights can help in understanding the determinants of pH balance and guide clinical interventions accordingly.

The findings of the current study highlight the significant key predictors and complications associated with DKA in ICU patients. The logistic regression analysis revealed that longer hospital stays, higher bicarbonate levels, faster normalization of the anion gap, and ICU admission significantly influence pH levels in DKA patients. Furthermore, chi-square analysis indicated that underweight patients, those with negative GAD antibodies, and those negative for insulin autoantibodies (IAA) are more likely to experience complications.

These results consistent with recent literature emphasizing the critical role of early management in DKA to prevent complications. For instance, a study by **Nyenwe & Kitabchi (2022)** underscores the importance of close monitoring and management of electrolyte imbalances, particularly potassium levels, to prevent life-threatening complications. The observed relationship between longer hospital stays and increased pH levels suggests that prolonged medical intervention may be necessary for severe cases to stabilize the patient's condition.
Moreover, the significant association between negative GAD antibody status and complications aligns with findings by **Wolfsdorf et al., 2021** who noted that autoimmune factors play a crucial role in the pathogenesis and progression of DKA. The high incidence of complications in underweight patients may be attributed to their lower metabolic reserves and greater susceptibility to metabolic stress, as discussed by **Umpierrez** & **Korytkowski (2016).**
The relationship between ICU admission and decreased pH levels indicates the severity of DKA cases requiring intensive care, reflecting the findings of a study by **Fayfman et al ., 2017** which highlighted on those severe metabolic disturbances often necessitate ICU management. The significant impact of faster normalization of the anion gap on decreasing pH levels emphasizes the need for prompt and effective correction of metabolic acidosis, as recommended by **(Rosenbloom 2020).**

Finally, from the forgoing discussion we can concluded that there are a necessity for comprehensive care protocols that address both immediate metabolic needs and underlying risk factors for patients with diabetic ketoacidosis as a preventive measures for complications which decrease the hospital length of stay. However, Future research should focus on developing tailored interventions for high-risk groups, such as underweight patients and those with specific autoimmune profiles, to further reduce the incidence of complications and improve outcomes in DKA management.

Conclusion:

Most DKA episodes require hospital admission, but mortality is high, and the length of stay in the ICU and medical ward depends on several predicted factors as the type of DM and the initial severity of the episode. Based on sociodemographic characteristics, DKA was more frequent in women and occurred more often in the spring and fall. Most patients had a known history of diabetes and an identifiable precipitating factor. The outcome was favorable in patients without complications such as cerebral edema, ischemic cerebrovascular disease, or respiratory failure rather than patients without complications. Our results suggest that rapidly increasing episodes of DKA associated with increases in the numbers of diabetic patients and considered a significant predictor for mortality.

Recommendations:

1. Emphasize the need for comprehensive metabolic & biochemical assessment and management of patients with DKA.
2. Prompt management to metabolic derangements observed in severe DKA cases necessitate mitigate complications and improve outcomes.
3. Develop tailored treatment plans based on patient-specific factors such as BMI, HbA1C, and current metabolic status should be developed.
4. Future research should focus on exploring the underlying mechanisms linking these factors to DKA severity.
5. Future interventions should focus on treatment approaches, education programs, and multidisciplinary care models to optimize outcomes and reduce the burden of DKA on both patients outcomes and healthcare disparities systems.

Conflict of Interest:

The authors reported no potential conflicts of interest related to the research, authorship, or publication of this article.

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