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Seasonal Variation of Diabetic Ketoacidosis in Nangarhar University Teaching Hospital

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ABSTRACT
Diabetic ketoacidosis is a life threating acute complication of diabetes mellitus aquiring special care. The aim of the study was to find out seasonal variation in the prevalence of diabetic ketoacidosis in diabetic patients. It was a cross sectional hospital based study conducted over both male and female diabetic patients admitter at the internal medicine ward of Nangarhar University Teaching Hospital during one year. Mean age across DKA was 53.9 ± 14 for DKA negative patients versus 51.3 ± 17.2 for DKA positive patients, P value = 0.26. Winter season was demonstrated with peak DKA positive cases 21 (43.7%) followed by fall 6 (22.2%), summer 11 (12.2%) and spring 10 (10.3%), respectively (P value = 0.01). Common associated factors included infection (72.2%), ischemia (8.2%), insulin withdrawal (7.7%), and others (6.9%) though not statistically different across seasons. There was significant seasonal variation in the prevalence of diabetic ketoacidosis denoting winter season with peak diabetic ketoacidosis. In fact, infection followed by ischemia and insulin withdrawal was the leading associated factor contributing to the prevalence of diabetic ketoacidosis. Season specific special attention should be paid the relevant symptoms of diabetic ketoacidosis for the early detection and treatment of the disease in order to avoid morbidity and mortality.

Keywords: Diabetes, Ketoacidosis, Prevalence, Season, Afghanistan

INTRODUCTION
Diabetic ketoacidosis (DKA) is a life threatening medical emergency in both types of diabetic patients bearing complication if not diagnosed and treated early; it is diagnosed by hyperglycemia, ketosis and acidosis (Dhatariya, 2007).Variation in the seasonal prevalence of diabetic ketoacidosis has been controversially reflected in the literature. A study by Babar et al. in Pakistan demonstrad winter season having peak incidences and non adherence to therapy was the leading associated factor present in majority of the patients (Babar & Aamir, 2022). Moreover, Turtinen and his colleagues in a study also have shown peak incidences of type 1 diabetes in colder seasons, fall, and winter; in fact, type 1 diabetes often clinically present as DKA (Turtinen et al., 2022). A study on acute metabolic complications in type 2 diabetes in Portugal by Carlos Gomez et al. also have demonstrated statistically significant peak incidences in winter season. However, a descriptive study by Gaikwad et al. in Maharashtra, India over diabetic ketoacidosis in type 1 diabetes demonstrated peak incidences in summer and spring and more specifically in hot summer (Gaikwad et al., 2020). In addition, Miyamura et al. in a study on the association of ambient temperature and hyperglycemic complications in Japan, demontrated high incidences with high temperature (Miyamura et al., 2022).

Despite many researches on the association of temperature i.e. season with DKA, it still remains controversial what season specifically is associated with higher incidences of the disease. We aimed to conduct this cross sectional study to find out the incidences of DKA in four seasons of the year in Nangarhar university teaching hospital so that it could increase awareness about the peaks and maybe associated factors.

MATERIALS AND METHODS
Study Area
It was a cross sectional study including both male and female diabetic patients admitted in the ward of internal medicine of Nangarhar university teaching hospital during one year. Materials of the study included patient files, computer and statistical program (SPSS version 26).

Samples Collection

Data was collected from the prefilled patientS' files during last year. Data included patient demographic details, baseline characteristics, month of admission, and a diagnosis of diabetes mellitus and its hyperglycemic complication, DKA. Patient identity was hidden for ethical purpose and medical record number was used instead.

Statistical Analysis

Data was analyzed using statistical package for social sciences (SPSS) version 26 by using mean and standard deviation or median and interquartile range for continuous variables after confirming for data normality via Kolmogorov Smirnov test and categorical variables were presented as frequencies and percentages. Chi square test was applied to show whether DKA prevalence was different across the four seasons. Twelve months of the year were categorized in four seasons as spring (Mar-May), summer (Jun-Aug), fall (Sep-Nov), and winter (Dec-Feb). Statistical significance was set at $P < 0.05$.

RESULTS

The study included 262 both male and female (83 and 179 respectively) diabetic patients, 48 (18.3%) of whom were admitted with DKA. In fact, DKA prevalence across the four seasons in the region was significantly different i.e. winter season was demonstrated with peak DKA positive cases (43.7%) followed by fall (22.2%) and summer (12.2%) respectively as shown in Table 1.

Table 1. Shows difference of DKA prevalence across seasons.

Seasons	**DKA negative**	**DKA positive**	**Total**
Spring	87 (89.7%)	10 (10.3%)	97 (100%)
Summer	79 (87.8%)	11 (12.2%)	90 (100%)
Fall	21 (77.8%)	6 (22.2%)	27 (100%)
Winter	27 (56.3%)	21 (43.7%)	48 (100%)
Pearson Chi-Square test, test statistic = 11.252, P value = 0.01.			

Mean age of the study population was not significantly different across DKA groups (53.9 ± 14 for DKA negative patients versus 51.3 ± 17.2 for DKA positive patients, P value = 0.26). Mean diabetes duration across DKA group was 8.35 ± 5.2 versus 7.28 ± 4.8, P value 0.19.

The leading associated factors with DKA prevalence included infections, Ischemia, and insulin withdrawal as shown in Figure 1.

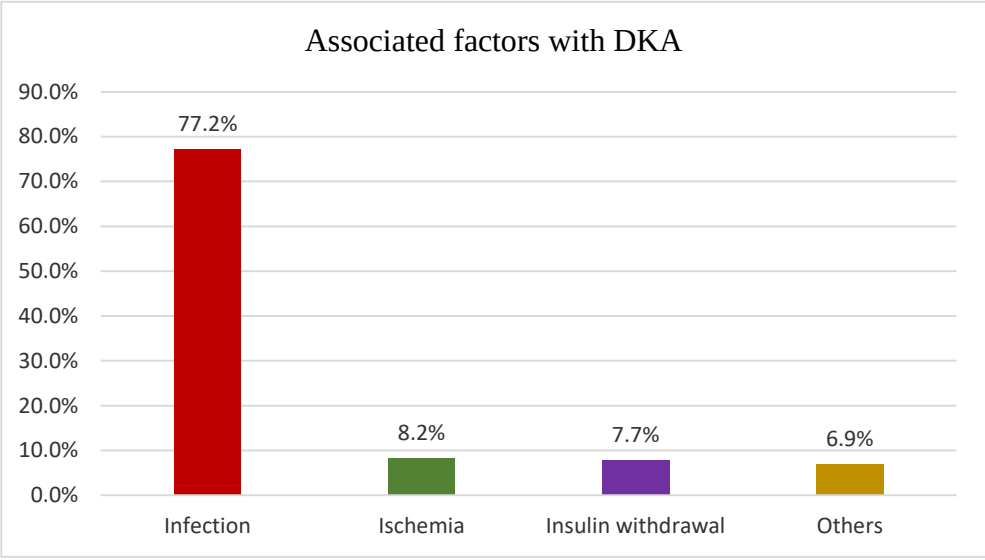

Figure 1. Shows the percentage of associated factors

In addition, we further categorized infection into categories based on their ranking as urinary tract infection was the most prevalent (31.3%) followed by respiratory tract infection (27%), skin infection (12.5%), and acute gastroenteritis (6.3%) respectively. However, the distribution of associated factors was not statistically significantly different. Furthermore, UTI (urinary tract infection) prevalence in spring, summer, fall and winter season was 13.3%, 60%, 6.7%, and 20% respectively. However, the prevalence of respiratory tract infection was different in the four season being 15.4%, 7.7%, 23.1%, and 53.8% respectively.

DISCUSSION

The major finding of the study indicated winter season with peak DKA positive cases and infection as the leading associated factor. In fact, urinary tract infection was highly prevalent in hot seasons while respiratory tract infection was more prevalent in cold seasons. Our finding is half way concordant with the finding of a study by Bakht Babar and Aamir in Pakistan demonstrating peak incidences in winter but unlike our study, the leading associated factor was insulin withdrawal (Babar & Aamir, 2022). In addition, another study in China in 2016 by Chin li lu et al. which included the data of 14 years also stated that cold season was associated with peak DKA incidences (Lu et al., 2016). However, a descriptive study by Vijay Gaikwad et al. from Maharashtra, India demonstrated peak DKA incidences in spring and summer (Gaikwad et al., 2020); the reason for the difference is long summer in these areas. In fact, heat exposure in studies is shown to cause the elevation of counter regulatory hormones specifically growth hormone and glucagon (Kappeltsf et al., 1997).

CONCLUSION

There was significant seasonal variation in the prevalence of diabetic ketoacidosis denoting winter season with peak diabetic ketoacidosis. In fact, infection followed by ischemia and insulin withdrawal was the leading associated factor contributing to the prevalence of diabetic ketoacidosis. Season specific special attention should be paid towards the relevant symptoms of diabetic ketoacidosis for the early detection and treatment of the disease in order to avoid morbidity and mortality.

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Authors Contributions: Teaching assistant Ibrahimi contributed in methodology, software, analysis and report writing. Hayatullah Ahmadzai contributed in resources and review. Salam Jan Shams contributed in conceptualization and review and editing.

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