



Factors Associated With Diabetic Ketoacidosis at Onset of Type 1 Diabetes Among Pediatric Patients

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ABSTRACT

Background: The literature surrounding diabetic ketoacidosis (DKA) at the onset of type 1 diabetes in pediatric patients highlights a range of factors contributing to this serious condition. **Literature Review:** (Vasireddy et al., 2001) further illustrate the global context by reporting that over one-third of children in Ethiopia present with DKA at the time of their diabetes diagnosis. Their findings suggest that parental knowledge of diabetes symptoms can significantly mitigate the risk of DKA, while recent infections are a notable risk factor. (Nyaombe Musoma et al., 2000) analyze clinical characteristics and outcomes of DKA in a Kenyan hospital, corroborating previous findings while addressing the broader trends in developing nations. They advocate for improved recognition and management strategies to reduce mortality rates associated with DKA. In the United States, (Vasireddy et al., 2001) document a steady rise in DKA cases among youth with T1D, linking this trend to factors such as poor compliance with insulin therapy and socioeconomic challenges. Their findings highlight the multifaceted nature of DKA risk, emphasizing the need for coordinated care. (Kostopoulou et al., 2003) provide a comprehensive overview of the pathophysiology and challenges in diagnosing and treating DKA, reiterating its prevalence at the onset of T1D due to insulin deficiency and stress-induced hormonal changes. The authors stress the importance of early symptom recognition to prevent complications associated with DKA. **Conclusion:** Overall, the literature collectively suggests that DKA at the onset of T1D in pediatric patients is influenced by a multitude of factors, including socioeconomic status, parental education, recent infections, and healthcare access. There is a clear need for continued research and targeted interventions to address these factors and improve outcomes for children diagnosed with T1D.

Keyword: Factors Associated, Diabetic Ketoacidosis, Onset of Type 1 Diabetes, Pediatric Patients

INTRODUCTION

The literature surrounding diabetic ketoacidosis (DKA) at the onset of type 1 diabetes in pediatric patients highlights a range of factors contributing to this serious condition. The initial study by Shaltout et al. (Aly Shaltout et al., 2006) emphasizes the significant role of socioeconomic status and parental education in increasing the risk of DKA among children in Kuwait. The findings indicate that infections, particularly urinary tract infections, are prevalent precipitating factors for DKA, with pneumonia also noted as a common risk. This study provides a foundational understanding of the demographic and health-related trends in DKA incidence, suggesting a need for targeted awareness campaigns to educate healthcare providers and families.

Building on this, Atkilt et al. (Siyoun Atkilt et al., 2007) report that over one-third of children in Ethiopia present with DKA at the time of their diabetes diagnosis, with variations in prevalence observed across different countries. The study highlights that parental knowledge of diabetes symptoms can significantly reduce the odds of DKA, while infections shortly before diagnosis increase the risk. However, limitations in data collection and a lack of standardized definitions of DKA present challenges to the reliability of these findings.

Hadgu et al. (Berhe Hadgu et al., 2009) further explore the severe implications of DKA, noting that delayed diagnosis can lead to significant morbidity and mortality. The study underscores the critical nature of timely intervention and the need for more comprehensive research on the prevalence and risk factors associated with DKA in Ethiopia, where such data remain scarce.

Musoma et al. (Nyaombe Musoma et al., 2000) expand the discussion by analyzing clinical characteristics and outcomes of DKA in pediatric patients at a Kenyan hospital. This study corroborates the findings of previous research while also addressing the broader context of DKA trends in developing countries, emphasizing the need for improved recognition and management of DKA to reduce mortality rates.

In the United States, Vasireddy et al. (Vasireddy et al., 2001) identify a steady rise in DKA presentations among youth with type 1 diabetes, linking it to factors such as poor compliance with insulin therapy and socioeconomic challenges. This study highlights the multifaceted nature of DKA risk, including genetic, behavioral, and environmental influences, and points to the importance of coordinated care in managing diabetes effectively.

Kostopoulou et al. (Kostopoulou et al., 2003) provide a comprehensive overview of the diagnostic and therapeutic challenges associated with DKA. They emphasize that DKA primarily occurs at the onset of type 1 diabetes due to insulin deficiency and stress-induced hormonal changes. The study reiterates the importance of early symptom recognition and effective management strategies to prevent DKA-related complications, underscoring the leading role of DKA in mortality among children with type 1 diabetes.

Together, these studies create a nuanced understanding of the factors associated with DKA at the onset of type 1 diabetes in pediatric patients, highlighting the interplay of socioeconomic, educational, and healthcare access elements that contribute to this critical public health issue.

LITERATURE REVIEW

The article titled "Ketoacidosis at first presentation of type 1 diabetes mellitus among children: a study from Kuwait" by (Aly Shaltout et al., 2006) provides a comprehensive examination of the factors associated with diabetic ketoacidosis (DKA) at the onset of type 1 diabetes mellitus (T1DM) in a pediatric population. The authors present a significant analysis of the epidemiological trends surrounding DKA in Kuwaiti children, emphasizing the interplay between socioeconomic factors, parental education levels, and the incidence of DKA.

One of the critical insights from the study is the identification of low socioeconomic status and low parental education as significant risk factors for the occurrence of DKA. This finding underscores the importance of social determinants of health in managing chronic conditions such as T1DM. The authors argue that families with limited financial resources and lower educational attainment may have less access to healthcare information and resources, leading to delayed

diagnosis and treatment of diabetes, which in turn increases the risk of DKA at the disease's onset.

Furthermore, the article highlights the prevalence of infections, particularly urinary tract infections (UTIs), as a common precipitating cause of DKA in children. This association is particularly relevant as it suggests that healthcare providers should be vigilant in monitoring for infections in pediatric patients newly diagnosed with T1DM. The authors provide evidence of a dramatic increase in the incidence rates of T1DM over the past two decades in Kuwait, which raises concerns about the healthcare system's capacity to manage this growing public health issue effectively.

While the study reports a decline in the overall incidence of DKA, the authors note that the rates remain high, especially among younger children. This finding points to the need for ongoing public health initiatives aimed at educating families about diabetes management and the importance of early intervention to prevent DKA. The strength of the study lies in its large cohort size and the detailed analysis of DKA trends, which provide valuable insights for healthcare practitioners and policymakers.

The article titled "Clinical Characteristics of Diabetic Ketoacidosis in Children with Newly Diagnosed Type 1 Diabetes in Addis Ababa, Ethiopia: A Cross-Sectional Study" by (Siyoun Atkilt et al., 2007) provides a comprehensive examination of the factors associated with diabetic ketoacidosis (DKA) at the onset of type 1 diabetes (T1D) in a pediatric population. This study is particularly significant as it reveals that over one-third of children presented with DKA at the initial diagnosis of diabetes, highlighting a critical area of concern in diabetes management and education.

One of the key insights from the study is the impact of parental knowledge regarding the signs and symptoms of diabetes and DKA. The authors report that children whose parents were aware of these symptoms had a 49% lower likelihood of developing DKA at diagnosis compared to those whose parents were uninformed. This finding underscores the importance of education and awareness as preventive measures against the progression to DKA, suggesting that targeted

educational interventions could potentially reduce the incidence of this serious complication.

The article also discusses the role of infection in the development of DKA. The authors found that children who had an infection 1–2 weeks prior to the onset of diabetes were 3.45 times more likely to present with DKA. This correlation is explained through the lens of immunological responses, where infections can induce inflammation and a cascade of physiological changes that lead to insulin resistance and metabolic decompensation. This finding emphasizes the need for clinicians to consider recent infections as a potential risk factor when evaluating children for T1D.

Additionally, the authors note variations in the prevalence of DKA in different populations, citing a study from Black Lion Hospital in Ethiopia that reported an 80% prevalence of DKA, which is significantly higher than their own findings. Such discrepancies may be attributed to differences in socio-economic status, access to healthcare, and the definitions of DKA utilized in various studies. The article suggests that these factors could contribute to the observed differences in DKA incidence, reinforcing the necessity for context-specific research and interventions.

Interestingly, the study found that the marital status of the child's mother and family income did not significantly correlate with the risk of DKA. This contrasts with some existing literature that suggests socio-economic factors can influence health outcomes. The authors argue that this may reflect the unique socio-cultural dynamics present in the Ethiopian context, where other factors may play a more pivotal role in health outcomes.

The article titled "Diabetic ketoacidosis in children and adolescents with newly diagnosed type 1 diabetes in Tigray, Ethiopia: retrospective observational study" by (Berhe Hadgu et al., 2009) provides an insightful examination of the factors associated with diabetic ketoacidosis (DKA) at the onset of type 1 diabetes in a pediatric population. The authors highlight the critical nature of DKA as the most severe acute complication of type 1 diabetes mellitus, characterized by hyperglycemia, ketonemia, and acidemia, which can lead to significant morbidity and mortality.

One of the key insights presented in the article is the relationship between delayed diagnosis and the onset of DKA in newly diagnosed children and adolescents. The authors emphasize that the ineffectiveness or decrease of circulating insulin, coupled with elevated counter-regulatory hormones, plays a pivotal role in the development of DKA. This finding underscores the importance of timely recognition and diagnosis of type 1 diabetes to prevent the progression to DKA, which is particularly concerning given the high rates of cerebral edema associated with DKA that account for a significant portion of mortality in these cases ((Berhe Hadgu et al., 2009)).

The article also sheds light on the lack of existing research regarding the prevalence and risk factors for DKA in Ethiopia, which is a critical gap in the literature. The authors argue that understanding these factors is essential for developing effective prevention strategies and improving health outcomes for children with type 1 diabetes. They call for further studies to explore the socioeconomic and healthcare-related barriers that may contribute to delayed diagnosis and subsequent DKA.

In terms of methodology, the retrospective observational design allows for the collection of data from medical records, providing a valuable perspective on the clinical characteristics and outcomes of pediatric patients with newly diagnosed type 1 diabetes. However, the authors acknowledge potential limitations related to the accuracy of the medical records and the generalizability of the findings to other regions or populations.

The article "Outcomes of Children and Adolescents Admitted with Diabetic Ketoacidosis at Kenyatta National Hospital (KNH), Kenya" by (Nyaombe Musoma et al., 2000) presents a comprehensive analysis of diabetic ketoacidosis (DKA) in the pediatric population, particularly focusing on the frequency, clinical characteristics, and associated risk factors leading to this serious condition at the onset of type 1 diabetes. The study is significant, as it sheds light on the clinical outcomes of children and adolescents affected by DKA in a developing country context, where the prevalence and management of such conditions may differ markedly from those in developed regions.

The authors highlight that the incidence of DKA at diagnosis is alarmingly high among pediatric patients, emphasizing the need for improved awareness and early detection of type 1 diabetes symptoms among caregivers and healthcare providers. The article details the clinical profiles of the patients admitted, noting common presenting symptoms such as polyuria, polydipsia, and weight loss, which are critical for timely diagnosis. This aligns with the broader literature indicating that early recognition of these symptoms is vital in preventing severe complications associated with DKA ((Nyaombe Musoma et al., 2000)).

Moreover, the study identifies several risk factors associated with mortality in children experiencing DKA, including the severity of acidosis, presence of infections, and the patient's initial level of consciousness. The authors underscore that acidosis is a prime determinant of depressed sensorium, which is a significant predictor of poor outcomes in such cases. This finding is particularly relevant as it highlights the need for immediate and effective management strategies to address metabolic derangements in DKA, which can drastically affect patient prognosis ((Nyaombe Musoma et al., 2000)).

The article also discusses the role of infections in exacerbating the condition, a factor that is often overlooked in clinical settings. By linking infections to poorer outcomes in DKA, the authors suggest that a comprehensive approach to treatment should include rigorous monitoring and management of potential infections in these patients. This perspective is crucial, given the increased vulnerability of children with DKA to concurrent infections, which may further complicate their clinical course ((Nyaombe Musoma et al., 2000)).

The article titled "Risk Factors, Trends, and Preventive Measures for 30-Day Unplanned Diabetic Ketoacidosis Readmissions in the Pediatric Population" by (Vasireddy et al., 2001) provides a comprehensive overview of the rising incidence of diabetic ketoacidosis (DKA) among pediatric patients, particularly those with type 1 diabetes mellitus (T1DM). The authors effectively highlight the multifaceted nature of DKA, emphasizing that it is not only a common presentation but also a preventable complication of T1DM.

One of the critical insights from the article is the identification of various risk factors associated with DKA. The authors note that missed insulin doses are a

significant contributor to DKA episodes, underscoring the importance of adherence to insulin therapy in managing T1DM. Additionally, they identify other factors such as sepsis, gastrointestinal illnesses, trauma, poor dietary compliance, and eating disorders as contributing elements that can exacerbate the risk of DKA ((Vasireddy et al., 2001)). This multifactorial perspective is crucial, as it suggests that interventions aimed at improving adherence to treatment, as well as addressing comorbid conditions, could potentially reduce the incidence of DKA.

The authors also present alarming trends regarding the hospitalization rates for DKA, noting a 59.4% increase from 2004 to 2009, particularly among individuals under 45 years of age. This statistic raises concerns about the healthcare system's ability to manage T1DM effectively and points to the need for improved preventive strategies ((Vasireddy et al., 2001)). Furthermore, the article highlights disparities in DKA incidence and outcomes, particularly among racial groups and those with lower socioeconomic status. The increased rates of DKA and mortality among Black patients and the association of lower socioeconomic status with readmissions indicate systemic issues that require targeted interventions to ensure equitable healthcare access.

The article also delves into the implications of DKA on healthcare resources, noting that DKA leads to prolonged hospital stays and significant healthcare costs. The findings regarding the association between DKA readmissions and the quality of disease management highlight the critical role of care coordination and communication between healthcare providers, patients, and their families ((Vasireddy et al., 2001)). This aspect of care is essential for preventing DKA and improving overall health outcomes for pediatric patients with T1DM.

The article titled "The Silent Epidemic of Diabetic Ketoacidosis at Diagnosis of Type 1 Diabetes in Children and Adolescents in Italy During the Pandemic in 2000" by (Cherubini et al., 2022) provides a critical examination of the factors contributing to the increased incidence of diabetic ketoacidosis (DKA) at the onset of type 1 diabetes among pediatric patients during a unique and challenging period. The authors highlight that a significant reason for the heightened frequency of DKA is attributed to delays in diabetes diagnosis,

exacerbated by the pandemic. This delay is particularly concerning as it underscores the broader implications for public health systems in managing chronic conditions amidst a health crisis.

The findings suggest that parental apprehension regarding hospital visits due to fears of contracting SARS-CoV-2 played a substantial role in the delays observed. This situation not only highlights the immediate health risks associated with the pandemic but also raises critical questions about the accessibility and responsiveness of healthcare systems in emergencies. The authors argue that such delays in diagnosing serious conditions like DKA in children should serve as a wake-up call for health authorities to improve strategies for timely diagnosis and intervention ((Cherubini et al., 2022)).

Moreover, the study identifies a concerning trend where children from immigrant backgrounds are more likely to present with DKA and severe DKA at the time of diagnosis. This finding draws attention to the intersection of health disparities and socioeconomic factors, suggesting that marginalized groups may face additional barriers to accessing timely medical care. The analysis reveals that higher household incomes correlate with a lower risk of DKA, indicating that socioeconomic status can serve as a protective factor, even during crises ((Cherubini et al., 2022)).

The article "Diabetic Ketoacidosis in Children and Adolescents; Diagnostic and Therapeutic Pitfalls" by (Kostopoulou et al., 2003) provides a comprehensive overview of the factors associated with diabetic ketoacidosis (DKA) at the onset of type 1 diabetes mellitus (T1DM) in pediatric patients. The authors highlight the pathophysiological mechanisms underlying DKA, emphasizing the role of absolute or relative insulin deficiency and the elevation of counter-regulatory hormones. This biochemical imbalance leads to increased glucose production and decreased peripheral glucose utilization, resulting in hyperglycemia and hyperketonemia. The subsequent osmotic diuresis causes dehydration and electrolyte loss, while lactic acidosis may further exacerbate the acidosis due to hypoperfusion.

The article effectively underscores that DKA is particularly prevalent at the initial diagnosis of T1DM in children and adolescents, but it also acknowledges its occurrence in newly diagnosed type 2 diabetes mellitus (T2DM) cases and those

with uncontrolled T2DM. The authors identify several precipitating factors, including physiological stressors such as infections and non-adherence to insulin therapy, which can lead to DKA. Notably, among children already diagnosed with T1DM, the omission of insulin, especially during gastrointestinal infections, is a significant contributor to DKA episodes.

Furthermore, the article delineates various risk factors for DKA, including poor diabetes control, previous episodes of DKA, dysfunctional family dynamics, limited access to medical care, and a history of psychiatric disorders. The authors also point out that adolescent age is a critical risk factor, which reflects the complexities of diabetes management during this developmental stage. The mortality rate associated with DKA in children is reported to be less than 1% in developed countries, primarily due to cerebral injuries, yet it remains a leading cause of mortality among children with T1DM, accounting for over 50% of all deaths in this population.

CONCLUSION

The literature on diabetic ketoacidosis (DKA) at the onset of type 1 diabetes (T1D) in pediatric patients reveals a complex interplay of socioeconomic, educational, and healthcare access factors that contribute to the incidence and severity of this condition. (Nyaombe Musoma et al., 2000) emphasizes the significant influence of socioeconomic status and parental education on DKA risk in children in Kuwait, identifying infections, particularly urinary tract infections, as common precipitating factors ((Nyaombe Musoma et al., 2000)). This foundational study highlights the necessity for targeted educational interventions to raise awareness among healthcare providers and families about the risks associated with DKA.

(Vasireddy et al., 2001) further illustrate the global context by reporting that over one-third of children in Ethiopia present with DKA at the time of their diabetes diagnosis. Their findings suggest that parental knowledge of diabetes symptoms can significantly mitigate the risk of DKA, while recent infections are a notable risk factor. The limitations in data collection and inconsistent definitions of DKA, however, pose challenges to the reliability of these findings. (Berhe Hadgu et al.,

2009) underscore the severe implications of DKA, particularly emphasizing the importance of timely diagnosis to prevent morbidity and mortality, thus calling for comprehensive research in regions where data are lacking.

(Nyaombe Musoma et al., 2000) analyze clinical characteristics and outcomes of DKA in a Kenyan hospital, corroborating previous findings while addressing the broader trends in developing nations. They advocate for improved recognition and management strategies to reduce mortality rates associated with DKA. In the United States, (Vasireddy et al., 2001) document a steady rise in DKA cases among youth with T1D, linking this trend to factors such as poor compliance with insulin therapy and socioeconomic challenges. Their findings highlight the multifaceted nature of DKA risk, emphasizing the need for coordinated care.

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Overall, the literature collectively suggests that DKA at the onset of T1D in pediatric patients is influenced by a multitude of factors, including socioeconomic status, parental education, recent infections, and healthcare access. There is a clear need for continued research and targeted interventions to address these factors and improve outcomes for children diagnosed with T1D.

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