Diabetic Ketoacidosis at Diagnosis of Type 1 Diabetes is Associated with Lower Socioeconomic Status

Sando Ojukwu MD MPH[1], Terri Lipman PhD CRNP [1,2], Elizabeth Lowenthal MD MSCE [3], and Colin P Hawkes MD PhD[1,3]

[1]Division of Endocrinology and Diabetes, The Children's Hospital of Philadelphia, Philadelphia, PA, USA
[2]School of Nursing, University of Pennsylvania, Philadelphia, PA, USA
[3]Department of Pediatrics, The Children's Hospital of Philadelphia, Philadelphia, PA, USA

Background

- Diabetic Ketoacidosis (DKA) is seen in one in three children at time of diagnosis of Type 1 Diabetes (T1D)[1]

- The highest prevalence of DKA at diagnosis is seen in children under age 5 (39%) and lowest prevalence in older adolescents (23%) [2]

- DKA at presentation of T1D is associated with:
    - Increased mortality
    - Longer hospitalizations
    - Shorter remission periods
    - Poorer long term glycemic control[3]

- Lower socioeconomic status is associated with increased morbidity and mortality across the lifespan for a myriad of health conditions including diabetes[4]

- Census tracts are "small, relatively permanent statistical subdivisions of a county designed to be relatively homogenous with respect to population characteristics, economic status and living conditions and average about 4,000 inhabitants." [5] Census tract data is reported every 5 years through the American Community Survey. Census tract data can provide additional socioeconomic information beyond patient insurance type.

- DKA at presentation is preventable and is often caused by delayed care secondary to low diabetes awareness in the community and among health care providers. We need to better identify neighborhoods with low diabetes awareness

Objective

- To determine if socioeconomic status (SES) is associated with severity of DKA at presentation of newly diagnosed T1D, at each age group.

Methods

- Retrospective chart review of patients admitted to the Children's Hospital of Philadelphia with new onset diabetes from January 2009 to December 2018

- Included patients were <19 years old, had recorded pH and/or bicarbonate at diagnosis, and were positive for at least one diabetes autoantibody: Insulin antibody, GAD65 Antibody, ICA512 Antibody and/or Znt8 Antibody

- Patient addresses were geocoded and linked with census tract level characteristics obtained from the 2013 American Community Survey [5].

- We assessed whether United States census track derived data on median household income was associated with DKA (venous pH <7.3 and/or serum bicarb <15 mmol/L) at diagnosis of type 1 diabetes. Census tract median household income was divided into quartiles with lowest quartile earning <$53,863 and highest quartile earning >$94,784. Data was analyzed using Mann-Whitney U and Kruskal-Wallis tests

Results

- Initial pH at diagnosis of T1D was lower in patients in the lowest quartile of census tract median household income who had government insurance compared with patients in the highest quartile of census tract median household income who had private insurance (p<0.001). This relationship held across age groups

- HbA1c at diagnosis was higher in children <6 years who had government insurance and were in the lowest income quartile compared to those in the highest income quartile that had private insurance (p<0.001)

- Initial bicarb at diagnosis of T1D did not statistically differ by insurance type combined with census tract median household income quartile
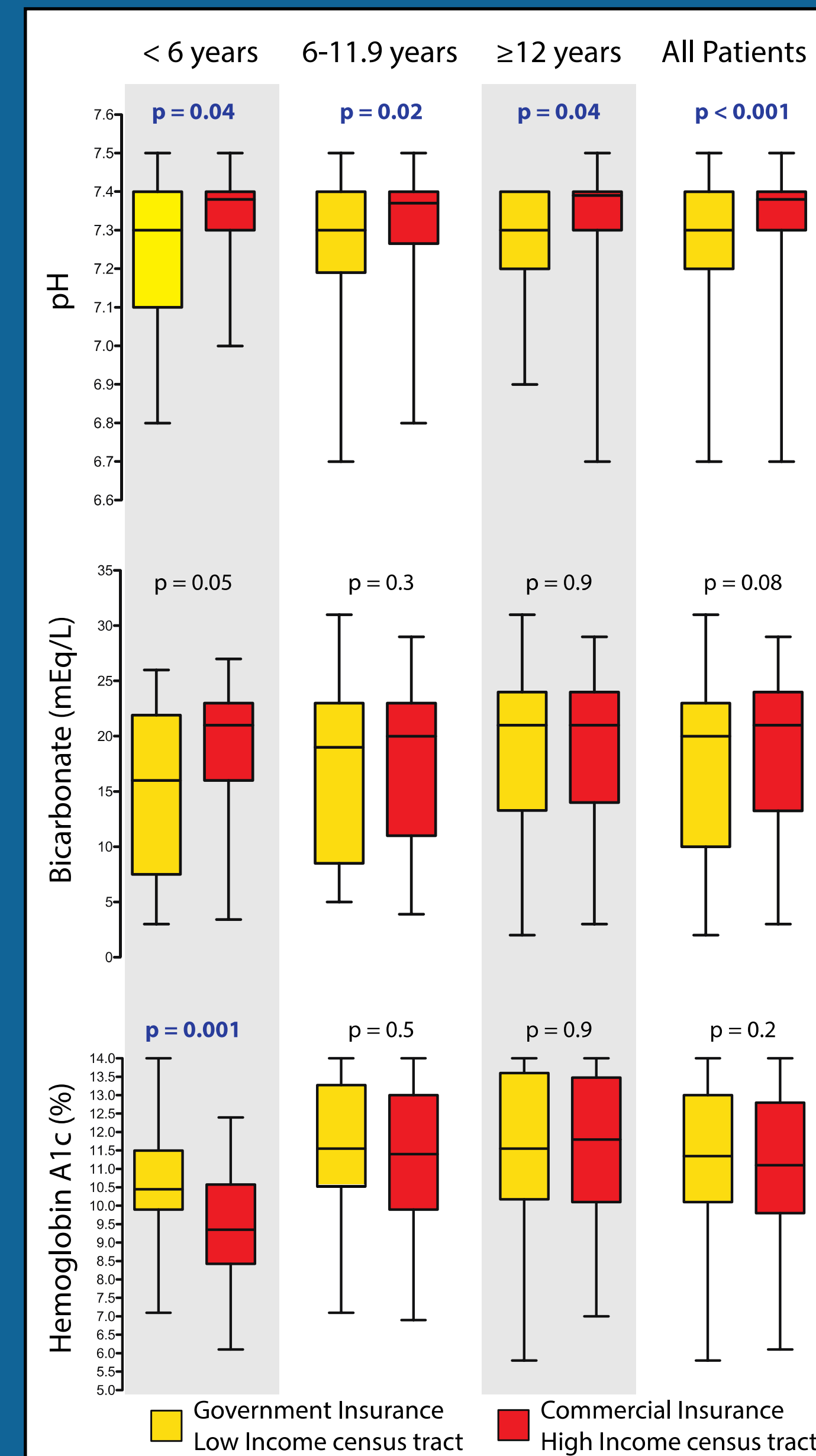

Figure 1: Initial pH, bicarbonate and HbA1c at diagnosis in patients in the highest income quartile who had private insurance compared to the lowest income quartile with government insurance across age groups

Table 1: Patient demographics at diagnosis of T1D

Characteristic	Lowest Quartile Median Household Income with Government Insurance	Highest Quartile Median Household Income with Private Insurance	p-value
Age, years (median, IQR)	10.5 (6.1)	11.0 (6.5)	0.276
Age Group, n(%)			
<6 years	31 (17%)	45 (13%)	
6-11.9 years	88 (46%)	158 (46%)	
12-19 years	67 (37%)	138 (41%)	0.445
Female, n (%)	87 (48%)	145 (42%)	0.225
Race/Ethnicity, n(%)			
Non-Hispanic White	30 (17%)	294 (87%)	
Non-Hispanic Black	109 (62%)	11 (3%)	
Hispanic	22 (12%)	8 (2%)	
Other	16 (9%)	24 (9%)	<0.001
Initial pH at diagnosis (median, IQR)	7.30 (0.2)	7.38 (0.1)	<0.001
Initial Bicarbonate at diagnosis (median, IQR)	20 (13)	21 (10.5)	0.083
HbA1c at diagnosis (median, IQR)	11.4 (2.9)	11.1 (3.0)	0.234
Median Household Income of Patient's Census Tract, $ (median, IQR)	33,733 (16,391)	112,778 (23,218)	<0.001
Persons Below 18 Years Living in Poverty in Patient's Census Tract, % (median, IQR)	34.8 (26.9)	2.2 (4.0)	<0.001

Conclusions

- Socioeconomic status defined by census tract derived median household income and individual insurance type is associated with initial pH at diagnosis at all ages.

- Children under 6 years of age are at highest risk of severe DKA at diagnosis, but this risk is even higher in children of lower socioeconomic status.

- Further studies are required to identify and address the factors associated with delayed presentation of new onset T1D in children from lower SES.

Selected References
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