

# Assessing Risk, Outcomes and Disparities in Pediatric Asthma

APCD Data Users Group Webinar  
April 26, 2023

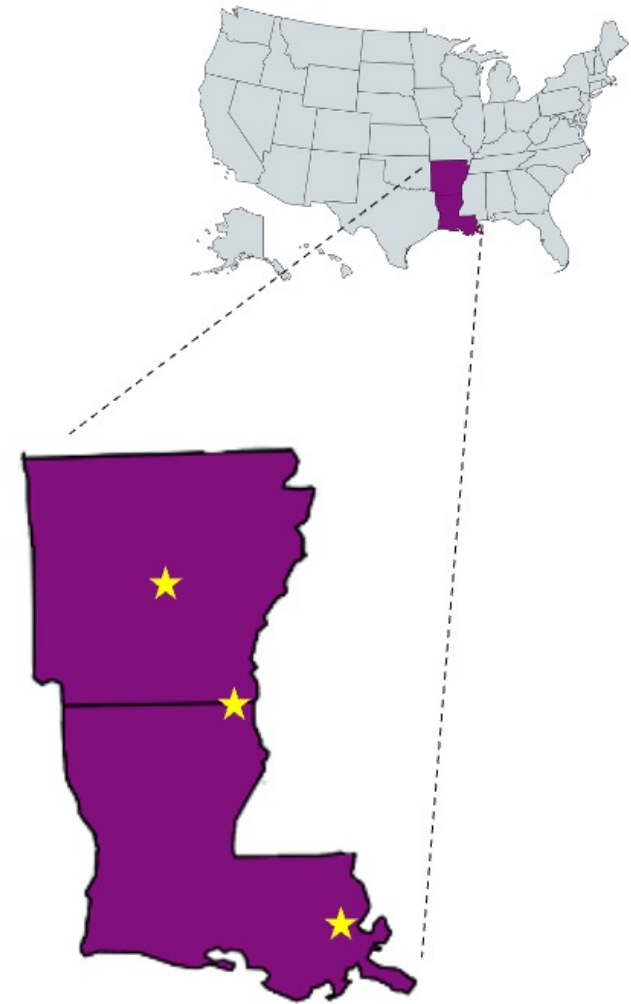
Akilah A. Jefferson, MD, MSc  
Assistant Professor of Pediatrics  
Division of Allergy and Immunology  
University of Arkansas for Medical Sciences  
Arkansas Children's Research Institute



# Objectives

- KL2 project background and review
- Progress to date, next steps

- Overall Research Focus:
  - Pediatric Asthma, Health Disparities, and Population Health
- KL2 Project:
  - Assessing Risk, Outcomes, and Disparities in Pediatric Asthma



# Pediatric Asthma

- The most common chronic condition among U.S. children
  - 8% national prevalence
    - 14.2% Black children
    - 5.6% White children
- Differences in outcomes by race/ethnicity, gender, insurance payer, sociodemographic status, geography.
- Roughly 10% of children have asthma in Arkansas (average)
  - ~19% in some areas (Delta region)

# Pediatric Asthma in Arkansas

- Previous studies in Arkansas:
  - Pesek et al: Study of school children in urban and rural Arkansas
    - High rates of at-risk urban and rural children identified based on frequency of symptoms, reliever use, activity limitation
    - Rural children more likely to have moderate to severe asthma
  - Perry et al: Study of rural children in Delta region of Arkansas
    - High reliever inhaler use with 32% of children using albuterol daily
    - Inadequate controller inhaler use with 49% of all children using no controller
- No large state-wide analyses

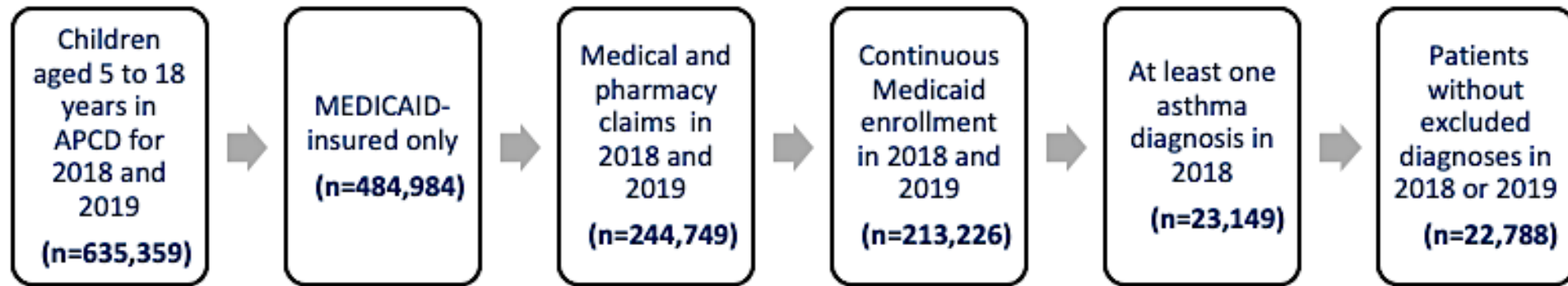
# Preliminary Project

- Assess current population health strategies for asthma
  - Association between the quality metric – asthma medication ratio (AMR) – and asthma outcomes

$$\text{AMR} = \frac{\text{asthma controller medication claims}}{\text{total number of asthma medication claims (controller + reliever)}}$$

- Hypothesis: Improved quality of care, measured by the AMR, within all populations should be associated with decreased risk of poor asthma outcomes

# Preliminary Project Data



- AMR performed poorly in a broad sample to identify risk for poor outcomes
  - Poor performance for Black children
  - Regression Analysis:
    - Large differences in risk of AAEs for White children (low AMR 5.6pp\* increased risk of ED visit)
    - **Minimal differences in risk of AAEs for Black children (low AMR 0.6pp increased risk of ED visit)**
- Suggests additional factors differentially impacting Black children not captured by the AMR
  - Increased ED visits
  - Access to primary care/specialists
  - Medication compliance
  - Physician prescribing patterns (under-prescribing of controllers)
  - Social determinants of health

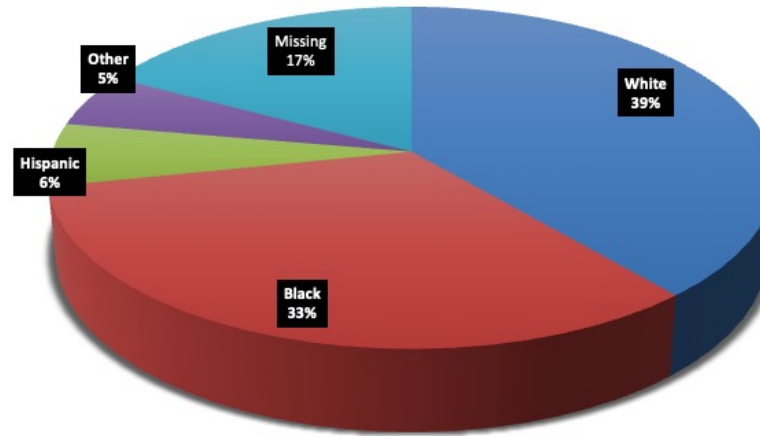
# KL2 Project

- Assessing Risk, Outcomes and Disparities in Pediatric Asthma
  - State-wide analysis using the APCD
    - Focus on Medicaid populations for now
- Aim 1: Examine the role of race/ethnicity and rurality in identifying children at-risk for asthma-related acute healthcare utilization across pediatric populations in Arkansas
- Aim 2: Develop asthma predictive models linking clinical data, patient sociodemographic variables including race/ethnicity and geospatial SDOH data (rurality vs. urbanity, child opportunity).

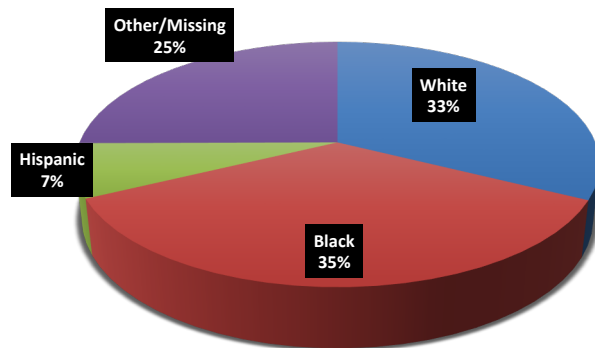


# Identified 25,087 children with asthma in 2019

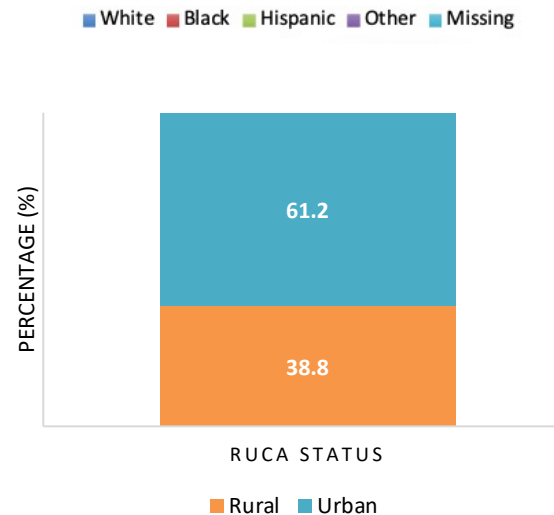
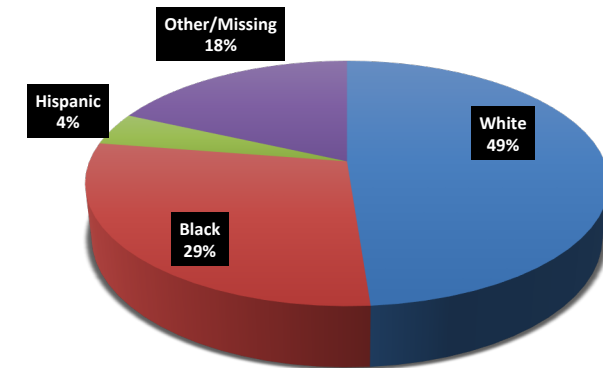
Cohort, Race/Ethnicity



Urban Cohort



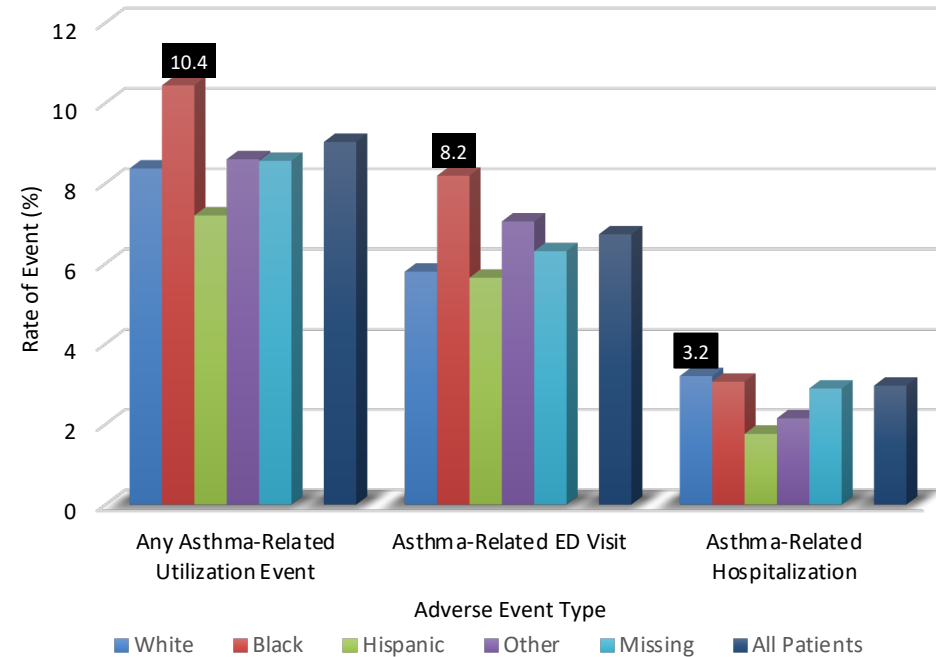
Rural Cohort



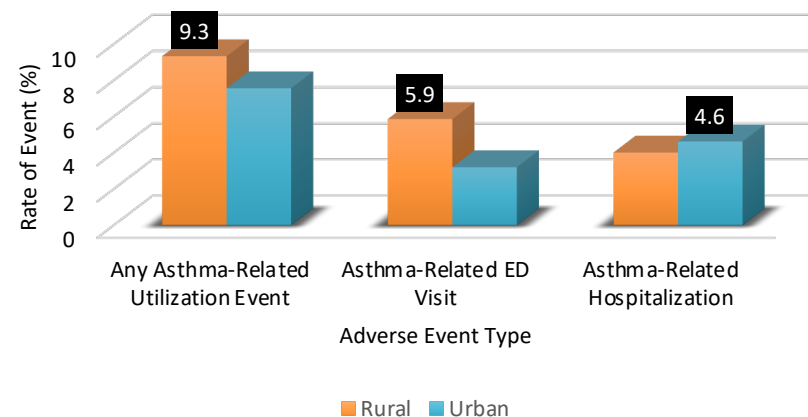
- 9.0% AAE
  - 6.7% ED visit
    - Black children (8.2%\*)
  - 3.0% hospitalization
    - White children (3.2%\*)
- Rural: 9.3% AAE
  - 5.9% ED visit
  - 4% hospitalization
- Urban: 7.6% AAE
  - 3.2% ED visit
  - 4.6% hospitalization

\* pending AAE by rural/urban and race/ethnicity

Rates of Asthma-Related Utilization Events, by Race and Ethnicity, 2019



Rates of Asthma-Related Utilization Events, by Rural/Urban, 2019



# Patients Stratified by Outcome

Characteristics	Total N=22,631	Patients with Adverse Event(s) (N=2,042) (%)	Patients without Adverse Event(s) (N=20,589) (%)	P-value
<b>Age</b>				
5-11	9375	882 (43%)	8493 (41%)	0.09
12-18	13256	1160 (57%)	12096 (59%)	
<b>Sex: Female</b>	9446	895 (44%)	8551(42%)	NS
<b>Race</b>				
Non-Hispanic White	8786	735 (36%)	8051 (39%)	<0.01
Non-Hispanic Black	7451	778 (38%)	6673 (32%)	
Hispanic	1358	98 (4.8%)	1260 (6%)	
Other	1147	100 (4.9%)	1047(5%)	
Missing	3889	331(16.2%)	3558 (17%)	

Demographic Characteristics stratified by Outcome

Characteristics	Total N=22,631	Patients with Adverse Event(s) (N=2,042) (%)	Patients without Adverse Event(s) (N=20,589) (%)	P-value
<b>Baseline conditions</b>				
Allergic Rhinitis	12008	1093 (53%)	1091 (53%)	<0.01
Food Allergy	1028	150 (7%)	878 (4.2%)	<0.01
Chronic Sinusitis	730	85 (4.2%)	645 (3.1%)	0.02
Atopic Dermatitis	2650	314 (15%)	2336 (11.3%)	<0.01
Eosinophilic esophagitis	95	<10 (0.4%)	87 (0.4%)	NS
Gastroesophageal reflux	1521	170 (8%)	1351(6.5%)	<0.01
Obesity	1581	183 (9%)	1398 (6.8 %)	<0.01
Hypertension	289	48 (2.3%)	241 (0.12%)	<0.01
Diabetes	178	31(1.5%)	147 (0.7%)	<0.01
Primary Immunodeficiency	101	15 (0.7%)	86 (0.42%)	
Vitamin D deficiency	299	45 (2.2%)	254 (1.2%)	NS
Sickle Cell Disease	99	26 (1.3%)	73 (0.35%)	<0.01
Iron Deficiency Anemia	98	21(1%)	77 (0.3%)	<0.01
Depression	1588	266 (13%)	1322 (6.4%)	<0.01
Anxiety	2414	299 (15%)	2115 (10.2%)	<0.01
Autism	543	38 (1.9%)	505 (2.4%)	0.12
Sleep-related breathing disorders	600	70 (3.4%)	530 (2.6%)	0.03

Characteristics	Total N=22,631	Patients with Adverse Event(s) (N=2,042) (%)	Patients without Adverse Event(s) (N=20,589) (%)	P-value
<b>Healthcare Utilization</b>				
ED visits in 2018	1038	561(15%)	1492 (3.5%)	<0.01
Hospitalization in 2018	2053	312 (27%)	726 (7%)	<0.01
<b>Medications</b>				
<i>Controllers</i>				
Total controller prescriptions (mean)		4	2.8	<0.01
Budesonide-formoterol	452	85 (4.2%)	367 (1.7%)	<0.01
Fluticasone-salmeterol	67	14 (0.7%)	53 (0.3%)	<0.01
Mometasone-formoterol	219	39 (1.9%)	180 (0.9%)	
Beclomethasone	322	41 (2%)	281 (1.3%)	0.02
Fluticasone	10632	1189 (58%)	9443 (46%)	<0.01
Montelukast	4538	545 (27%)	3993 (19%)	<0.01
<i>Relievers</i>				
Total reliever prescriptions (mean)		3	2.1	<0.01
Albuterol	17943	1727 (84%)	16216 (79%)	<0.01
Levalbuterol	593	39 (1.9%)	554 (2.7%)	<0.01
<i>Other</i>				
Oral Corticosteroid	7600	987 (48%)	6613 (32%)	<0.01

Characteristics	Total N=22,631	Patients with Adverse Event(s) (N=2,042) (%)	Patients without Adverse Event(s) (N=20,589) (%)	P-value
<b>RUCA code</b>				<0.01
1	11467	1103 (54%)	10364 (50%)	
2	2093	181 (9%)	1912 (9%)	
3	240	16 (8%)	224(1%)	
4	3288	265 (13%)	3023 (15%)	
5	1263	87 (4.3%)	1176 (6%)	
6	65	8 (0.4%)	57 (<1%)	
7	2644	266 (13%)	2378 (12%)	
8	366	25 (1.2%)	341 (2%)	
9	80	4 (0.2%)	76 (<1%)	
10	1125	87 (4.3%)	1038 (5%)	

Geographic Characteristics stratified by Outcome

RUCA 1-3: urban

RUCA 4-10: rural

Characteristics	Total N=22,631	Patients with Adverse Event(s) (N=2,042) (%)	Patients without Adverse Event(s) (N=20,589) (%)	P-value
<b>Social Determinants of Health</b>				
Problems related to education and literacy	281	33 (1.6%)	248 (1.2%)	0.13
Problems related to housing and economic circumstances	79	14 (0.68%)	65 (0.3%)	<0.01
Problems related to social environment	95	11 (0.5%)	84 (0.4%)	0.49
Problems related to upbringing	624	138 (6.7%)	486 (2.3%)	<0.01
Other problems related to primary support group, including family circumstances	328	56 (2.7%)	272 (1.3%)	<0.01
Problems related to other psychosocial circumstances	124	29 (1.4%)	95 (0.4%)	<0.01
Stress	145	16 (0.8%)	125 (0.6%)	0.41

## SDOH Characteristics stratified by Outcome

ICD-10-CM Code Category	Problems/Risk Factors Included in Category
<b>Z55</b> – Problems related to education and literacy	Illiteracy, schooling unavailable, underachievement in a school, less than a high school diploma, no general equivalence degree (GED), educational maladjustment, and discord with teachers and classmates.
<b>Z56</b> – Problems related to employment and unemployment	Unemployment, change of job, threat of job loss, stressful work schedule, discord with boss and workmates, uncongenial work environment, sexual harassment on the job, and military deployment status.
<b>Z57</b> – Occupational exposure to risk factors	Occupational exposure to noise, radiation, dust, environmental tobacco smoke, toxic agents in agriculture, toxic agents in other industries, extreme temperature, and vibration.
<b>Z58</b> – Problems related to physical environment	Inadequate drinking-water supply, and lack of safe drinking water.
<b>Z59</b> – Problems related to housing and economic circumstances	Sheltered homelessness, unsheltered homelessness, residing in street, inadequate housing, housing instability, discord with neighbors, lodgers and landlord, problems related to living in residential institutions, inadequate food, lack of adequate food, food insecurity, extreme poverty, low income, and insufficient social insurance and welfare support.
<b>Z60</b> – Problems related to social environment	Adjustment to life-cycle transitions, living alone, acculturation difficulty, social exclusion and rejection, target of adverse discrimination and persecution.
<b>Z62</b> – Problems related to upbringing	Inadequate parental supervision and control, parental overprotection, upbringing away from parents, child in welfare custody, institutional upbringing, hostility towards and scapegoating of child, inappropriate excessive parental pressure, personal history of abuse in childhood, personal history of neglect in childhood, personal history of unspecified abuse in childhood, parent-child conflict, and sibling rivalry.
<b>Z63</b> – Other problems related to primary support group, including family circumstances	Absence of family member, disappearance and death of family member, disruption of family by separation and divorce, dependent relative needing care at home, stressful life events affecting family and household, stress on family due to return of family member from military deployment, and alcoholism and drug addiction in family.
<b>Z64</b> – Problems related to certain psychosocial circumstances	Unwanted pregnancy, multiparity, and discord with counselors.
<b>Z65</b> – Problems related to other psychosocial circumstances	Conviction in civil and criminal proceedings without imprisonment, imprisonment and other incarceration, release from prison, other legal circumstances, victim of crime and terrorism, and exposure to disaster, war and other hostilities.

# Next Steps

- Complete Aim 2
  - Develop asthma predictive models linking clinical data, patient sociodemographic variables including race/ethnicity and geospatial SDOH data (rurality vs. urbanity, child opportunity).
  - Objective: Explore the importance of race and social determinants of health for asthma exacerbations in predictive models



# Child Opportunity Index

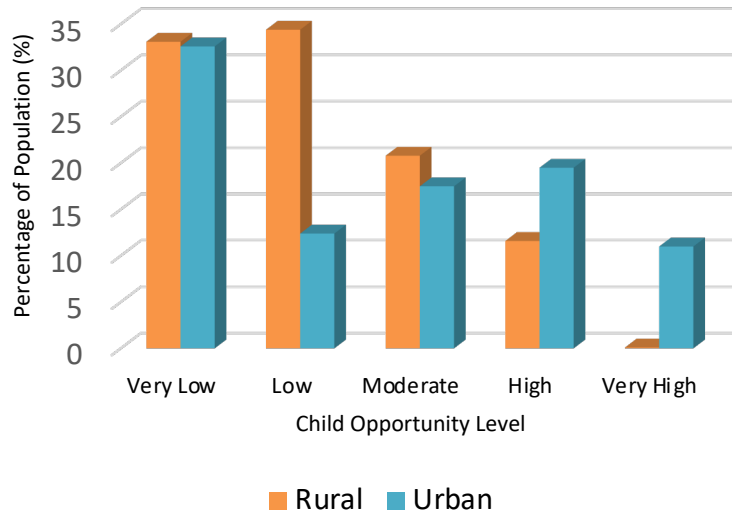
## “Why neighborhoods matter”

- Composite of 29 area-level factors
- Quantifies relative “opportunity” of neighborhoods
- Overall + 3 domains
  - education, health & environment, social & economic
- Associations among sociodemographic and geospatial factors (SDOH) and outcomes
- Half of all Arkansas zip codes are very low or low-opportunity

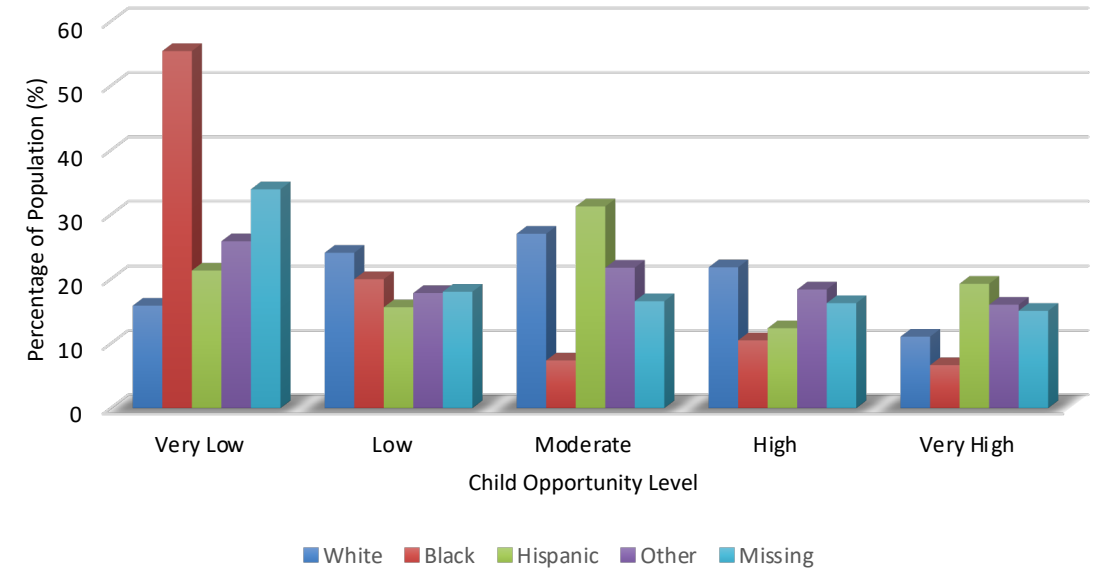
HEALTH & ENVIRONMENT	<b>Healthy environments</b>	
	Access to healthy food	Percent households without a car located further than a half-mile from the nearest super-market, reversed (USDA)
	Access to green space	Percent impenetrable surface areas such as rooftops, roads or parking lots, reversed (CDC)
	Walkability	EPA Walkability Index (EPA)
	Housing vacancy rate	Percent housing units that are vacant, reversed (ACS)
	<b>Toxic exposures</b>	
	Hazardous waste dump sites	Average number of Superfund sites within a 2-mile radius, reversed (EPA)
	Industrial pollutants in air, water or soil	Index of toxic chemicals released by industrial facilities, reversed (EPA)
	Airborne microparticles	Mean estimated microparticle (PM2.5) concentration, reversed (CDC)
	Ozone concentration	Mean estimated 8-hour average ozone concentration, reversed (EPA)
<b>Health resources</b>		
Extreme heat exposure	Summer days with maximum temperature above 90F, reversed (CDC)	
Health insurance coverage	Percent individuals ages 0-64 with health insurance coverage (ACS)	

# Preliminary rurality/geography data

Child Opportunity Level, by Rural/Urban, 2019



Child Opportunity Level, by Race/Ethnicity, 2019



- Among rural children, majority in very-low and low opportunity areas
- Among urban children, majority in very-low and high to very-high opportunity areas.
- Overall, Black children more frequently live in very-low or low opportunity areas (75.4%).

# Acknowledgements

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