

2022

## Relationship between Poverty and ED Visit Rate (per 10,000) with Primary Diagnosis of Asthma Amongst Ohio Counties

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### Repository Citation

Schneider, E. (2022). Relationship between Poverty and ED Visit Rate (per 10,000) with Primary Diagnosis of Asthma Amongst Ohio Counties. Wright State University. Dayton, Ohio.

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Relationship between Poverty and ED Visit Rate (per 10,000) with Primary Diagnosis of Asthma  
Amongst Ohio Counties

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MS4

Scholarship in Medicine Final Report

**Abstract**

*Objective:* Previous literature have found mixed results regarding poverty as a risk factor for asthma prevalence. More recently, national data obtained from Medicaid has shown that there is no association between poverty and asthma prevalence but has shown an association with asthma-related Emergency Department (ED) visits and hospitalizations. The objective of this study is to determine if this relationship is evident amongst the 88 counties in Ohio. *Methods:* Pearson correlations were conducted with the following variables: percent in poverty under age 18 and the ED visit rate with a primary diagnosis of asthma amongst children in each Ohio county. This data was further characterized by urban and rural counties and statistical analysis repeated. *Results:* There is an association between poverty and ED visit rates for children with the primary diagnosis of asthma in urban counties within Ohio ( $r = 0.421$ ;  $p < 0.01$ ).

**Key Words:** poverty, low-socioeconomic status, asthma, wheezing, epidemiology, childhood asthma, Emergency Department visits, ED Visit Rate.

## **Introduction/Literature Review**

Asthma is a chronic airway inflammatory disease. Chronic inflammation impairs breathing and can lead to airway obstruction.<sup>1,2</sup> During acute asthma exacerbation, bronchospasm of the smooth muscle of the airways, edema of the airways and mucus hypersecretion.<sup>1-3</sup> The constriction of the smooth muscle of the airways results in air trapping within the lungs; since exhalation of air is impaired, wheezing may be heard during auscultation.<sup>1,2</sup>

Asthma is a multifactorial disease, in which genetics, environment, and microbiome etiologies have been implicated.<sup>1,2</sup> Most commonly, type 2 inflammation<sup>1</sup> is the source of the clinical symptoms noticed in asthmatic patients.<sup>2</sup> This inflammatory response includes, T helper lymphocytes, IL-4, IL-5, IL-14, eosinophils, mast cells, basophils, and IgE producing plasma cells.<sup>1,2</sup> The chronic airway inflammation that asthmatic patients experience can result in in tissue remodeling of the airways. Tissue remodeling produces smooth muscle hypertrophy, mucosal gland hypertrophy, goblet cell hyperplasia, subepithelial fibrosis/collagen deposition, and as previously mentioned, inflammatory cell influx.<sup>2</sup>

The exact etiology of asthma is unknown, but many risk factors have been determined thus far. Some of the described risk factors are respiratory infections early in life, genetics, exposure to various toxins, sensitization to inhalant allergens, individual microbiomes, vitamin D, and diet.<sup>1,2</sup>

Several studies have focused on social determinants of health as risk factors for asthma. There is evidence of a higher prevalence of asthma in urban areas with high poverty rates, such as New York City, New York and Chicago, Illinois.<sup>4</sup> Asthma is more prevalent among males, individuals living below the poverty level, and African Americans.<sup>5</sup> Gergen et al., found that African American children in Maryland were at increased risk for hospitalization for asthma, but

when adjusted for poverty, these rates were not significantly different. This data provides additional evidence that poverty is a significant component of the difference in asthma prevalence amongst African Americans.<sup>6</sup> Not all studies substantiate this association as they were unable to prove a correlation between asthma prevalence and lower socio-economic status.<sup>7</sup> A more recent study looked at 1.5 million children with asthma enrolled in Medicaid from 2009-2010.<sup>8</sup> This study corroborated Gergen et al., and demonstrated that children living in poor urban areas did not have an increased prevalence for asthma but did find an association with asthma-related ED visits and hospitalizations (risk ratio, 1.48; 95% CI, 1.24-1.36; and 1.97; 95% CI, 1.50-1.72, respectively).

A literature review focused on factors contributing to asthma amongst children living in urban neighborhoods identified several variables that could be responsible for an increase in asthma. Air pollution in the form of NO<sub>2</sub> and O<sub>3</sub> appear to be associated with asthma and wheezing. Additionally, asthma prevalence was found to be associated with public housing within New York and more specifically the presence of cockroaches within public housing. Other allergens were found to be increased in neighborhoods with high asthma prevalence, such as mouse, cat, and dust mite. Environmental factors such as increased crime, decreased sense of safety, and increased sense of stress were found to be associated with asthma prevalence.<sup>9</sup>

With inconsistencies existing within the literature, more studies are necessary to clarify how poverty affects asthma and whether confounding variables can explain these inconsistencies. This is important because addressing risk factors associated with asthma is an ideal way to aid in a multi-faceted approach to decreasing morbidity and mortality associated with asthma in children. This study aims to substantiate this discussion of risk factors for asthma and the associated use of ED care amongst children in the 88 Ohio counties.

## Research Questions

RQ1: Is poverty associated with ED visit rates for asthma amongst children in Ohio?

RQ2: How is the association affected when the data is separated by rural vs. urban counties?

## Methods

### *Context/Protocol*

This study utilized data collected from public data sets accessible through the Ohio Department of Health website and the Small Area Income and Poverty Estimates (SAIPE) tool on the United States Census Bureau website. The Ohio Department of Health released a document titled, “Emergency Department and Hospital Visits for Asthma in Ohio” based on data taken from the Ohio Hospital Association Clinical-Financial Database.<sup>10</sup> The Small Area Income and Poverty Estimates (SAIPE) tool details the number in poverty and percent in poverty for each state and county.<sup>11</sup>

### *Data Collection*

Data for the ED visit rate (per 10,000) with a primary diagnosis of asthma for each Ohio county was collected from Ohio Department of Health Website. The “Ohio Surveillance System for Asthma” tab was used to access the document for “Emergency Department and Hospital Visits for Asthma in Ohio 2019”. This data was shared with the Ohio Department of Health by the Ohio Hospital Association which compiles hospital ICD that is offered on a voluntary basis by Ohio Hospitals. Table 7 “Emergency Visit Rates and Inpatient Hospital Rates for Patients with a Primary Diagnosis of Asthma, by County, 2016” was used for data collection in this

study. Table 7 includes emergency visit rates with the ICD-9-CM Code 493.0–493.9X as the primary diagnosis for each of the 88 Ohio counties in 2016.<sup>10</sup>

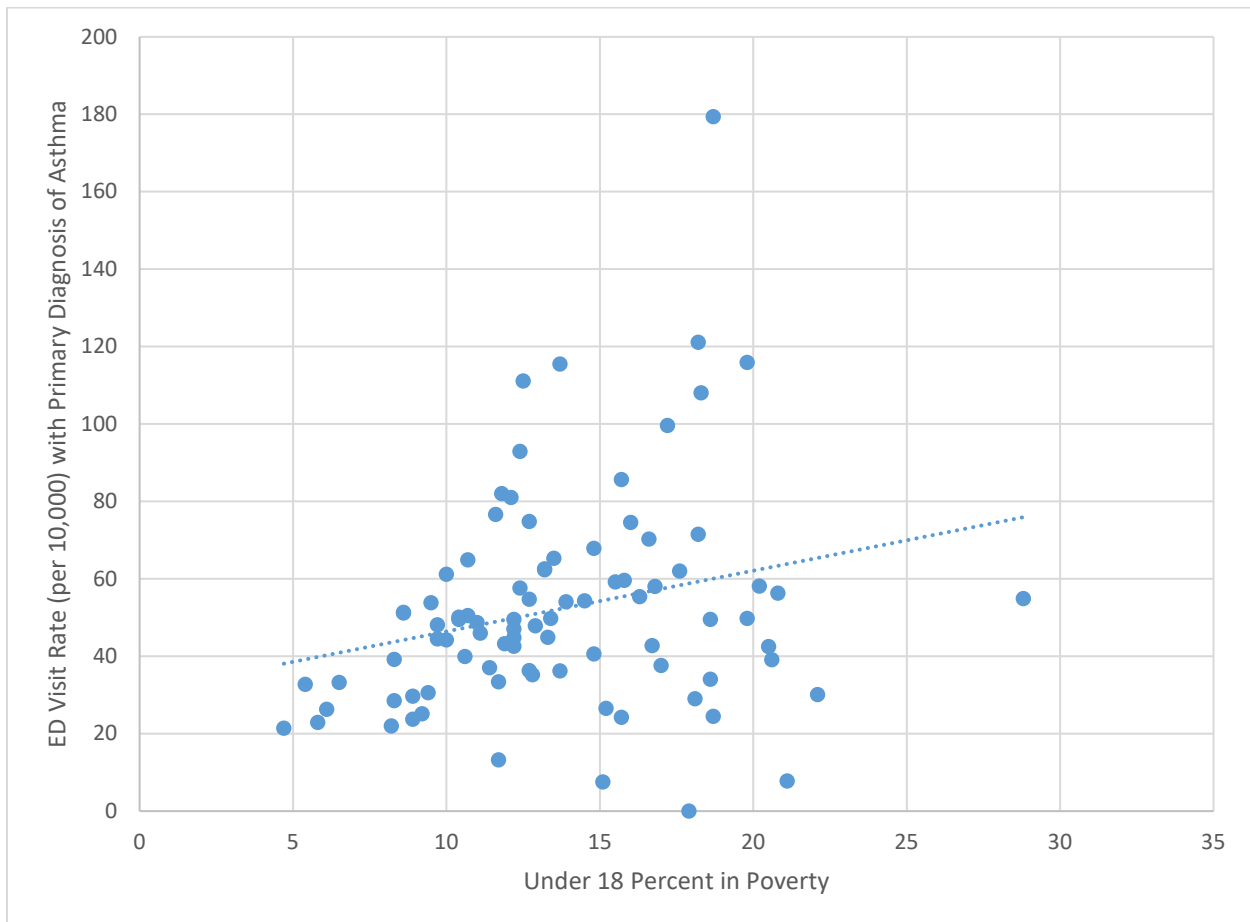
The Small Area Income and Poverty Estimates (SAIPE) tool on the United States Census Bureau website was accessed to collect data for percent poverty for each Ohio County. Data provided by this tool is not a direct count but is an estimate based on survey data from the American Community Survey including the number of child exemptions on tax returns where gross income fell below the poverty threshold, SNAP benefit recipients, estimated resident population, total number of child exemptions on tax returns and the Census estimate of the number of people under age 18 in poverty. Data for the percent poverty under 18 years old for each of the 88 Ohio counties was taken from 2016 to correlate to the data used in the “Emergency Department and Hospital Visits for Asthma in Ohio 2019” document.<sup>11</sup>

#### *Data Analysis*

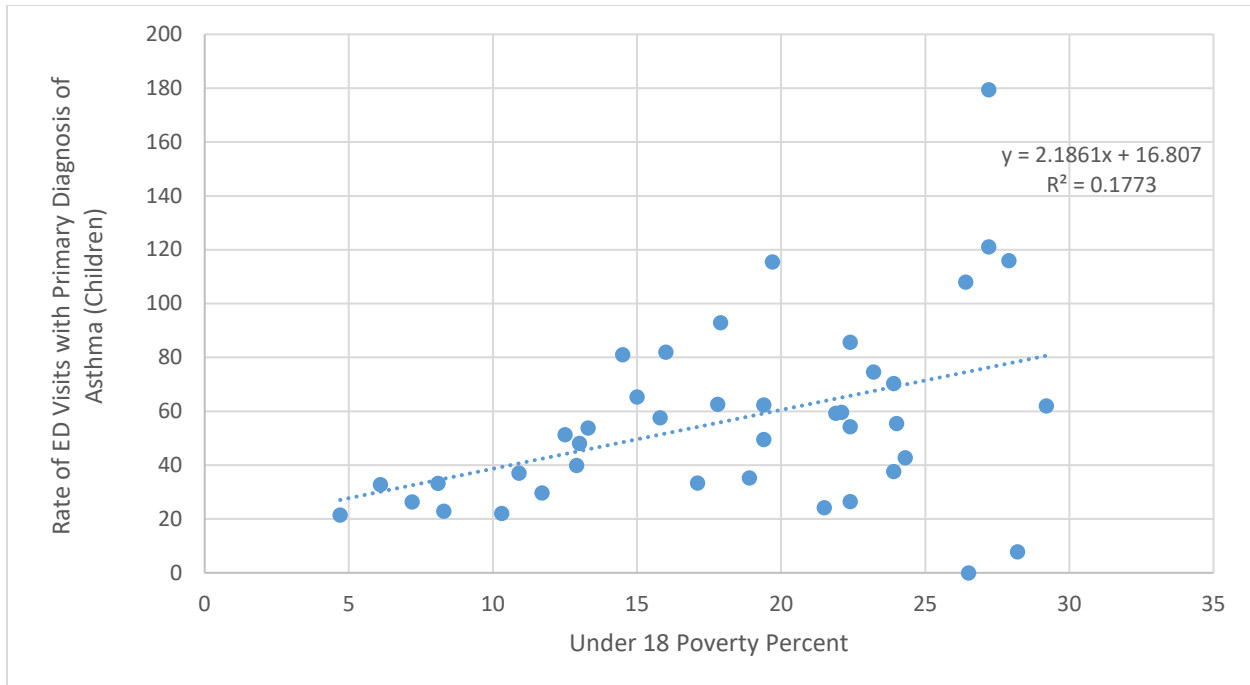
To determine if poverty is a potential risk factor for ED visits related to asthma, a Pearson correlation was performed with the percent poverty of individuals under the age 18 and the ED visit rate (per 10,000) with a primary diagnosis of asthma amongst children as variables, matched by each Ohio county. The data was further specified based on the United States Office of Management and Budget (OMB) classification of rural and urban counties. The previously described statistical analysis was conducted on the 46 rural Ohio counties and the 42 urban Ohio counties separately.

## Results

When a Pearson correlation was performed between the percent poverty of individuals under age 18 and ED visit rate (per 10,000) amongst children matched by Ohio county, a small but significant correlation was found ( $r = 0.232$ ;  $p < 0.05$ ) (**Figure 1.**). The data further divided into rural and urban counties based on the United States Office of Management and Budget (OMB) classification. When filtered into the 46 Ohio counties considered rural, there was no statistically significant correlation ( $r = 0.207$ ;  $p = 0.207$ ). When filtered into the 42 Ohio counties considered urban, there was a significant moderate degree of correlation ( $r = 0.421$ ;  $p < 0.01$ ) (**Figure 2.**)



**Figure 1.** All Ohio Counties: Percent in Poverty Under 18 vs. ED Visit Rate (per 10,000) with Primary Diagnosis of Asthma



**Figure 2.** Urban Counties in Ohio: Percent in Poverty Under 18 vs. ED Visit Rate (per 10,000) with Primary Diagnosis of Asthma

### Discussion

The statistical analysis performed comparing percent in poverty under 18 and ED visit rate (per 10,000) for children with primary diagnosis of asthma in the 88 Ohio counties, it is apparent that there is a correlation between the severity poverty and asthma necessitating ED care amongst Ohio children. After filtering the data set to classify the Ohio counties into urban versus rural, it is evident that this correlation is present primarily in urban counties in Ohio. There was no significant correlation between these variables in rural Ohio counties and the correlation increased to 0.421 ( $p < 0.01$ ) once the rural counties were excluded from the analysis.

These results were unexpected as the relationship between poverty and asthma exacerbations would be expected to be present in urban and rural communities if poverty is the sole contributing factor. The results of this study suggest that there is another factor that contributes to the increased ED visit rates for asthma amongst urban counties that does not exist



the rural counties in Ohio. This study was limited by the use of public datasets, as such the link between poverty and asthma exacerbations cannot be established on an individual basis. Further research should be conducted to determine if this relationship can be explained by the variables discussed in the literature review: air pollution, public housing, allergens, crime, safety, or stress.<sup>9</sup>

These links are important for the clinical treatment of children as recognition of risk factor can facilitate prompt diagnoses and expedite lifesaving treatment. Also, understanding what factors contribute to asthma prevalence and asthma exacerbations will aid in educating guardians on what may be contributing to the patients' disease process and may offer a way to circumvent asthma exacerbations prior to necessitating a visit to an ED.

These benefits are useful in practicing medicine beyond the United States. Many studies have found a difference between asthma prevalence in rural and urban communities globally. Asthma symptoms were more common amongst adolescents in Caruaru (urban) Brazil versus Santa Maria (rural) Brazil.<sup>12</sup> A lower prevalence of asthma and atopy was found in rural Beijing compared to urban Beijing.<sup>13</sup> A study comparing prevalence of asthma in Tamil Nadu, India found a similar prevalence of 'diagnosed' asthma, but a greater prevalence of asthma symptoms in urban children 6-12, suggesting that the prevalence of asthma may be greater in urban Tamil Nadu.<sup>14</sup> Rural Egyptian students that were fed farm milk had less allergic symptoms. Rural students were found to be exposed to greater amounts of endotoxin and had higher FEV1/FVCs, which supported the authors' claims that endotoxin exposure may be protective for asthma.<sup>15</sup> Additionally, studies have reported that rural areas in China, Papua New Guinea, Russia, Africa or Latin America have lower rates of asthma prevalence than urban areas.<sup>16</sup> Though the differences between rural and urban prevalence of asthma and asthma symptoms is well

documented, inconsistencies in the literature exist. Studies conducted in Arkansas, Turkey, Cyprus, and Korea have provided evidence of equivocal rates of asthma prevalence in urban and rural communities and higher rates of asthma prevalence in rural areas.<sup>17</sup> Further research should be conducted to delineate these differences in the literature to help identify a cause for the variation.

## **Conclusion**

This study further substantiates previous studies showing a relationship between poverty and asthma. In Ohio, there is an association between poverty and use of ED resources to treat asthma in children, specifically within urban counties. This data is significant as it is evidence that the problem of poverty influencing ED use for asthma persists in Ohio, despite being considered a largely rural state. By identifying risk factors associated with asthma a proactive approach may be taken to decrease morbidity and mortality associated with asthma in children. Further studies are needed to ascertain the cause of this association, and whether it can be explained by other variables such as a greater severity of asthma in urban children, air pollution, public housing, allergens, crime, safety, stress, or any other potential confounding factors.<sup>9</sup> This association may exist for a variety of reasons that cannot be addressed by the public datasets used in this study as they do not report additional characteristics for the study population. Additionally, with using public datasets which characterizes this data on the county-level there is potential for error in this analysis. Further studies should be conducted comparing poverty and ED utilization for asthma matched by individuals.

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