Environmental Impacts on Autism Classification Rates in NJ School Districts

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Abstract

According to a CDC study in 2008, 1 in 49 children in New Jersey is diagnosed with autism, twice the national rate. Pollution and exposure to heavy metals are considered a major factor that causes a child to develop autism. This paper analyzes the impact of environmental factors such as lead, superfund sites, air quality and population density on public school autism classification rates. Autism classification data and enrollment information was collected from 81 public school districts throughout New Jersey, ensuring differences in demographics, income level, population density and level of urbanization between the districts. After data analysis, air quality and population density are statistically significant.

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Introduction:

Autism-spectrum disorders (ASDs) are a group of developmental disabilities characterized by impairments in social interaction and communication and by restricted, repetitive, and stereotyped patterns of behavior. Symptoms typically are apparent before age 3 years (Baio, 2012). The national rate for children with autism is 1 in 88, though the rate in New Jersey is nearly double that at 1 in 49 children (Washburn 2012). I want to understand why the rate of autism in New Jersey is nearly double the national average by analyzing the environmental factors that may contribute to the development of the disorder.

Specifically, I tested correlations between autism classification rates in public schools throughout New Jersey and the Air Pollution Level (represented as the Air Quality Index) of the township, number of EPA Superfund sites in the township, the number of lead poisoning cases in the county (used to compare levels of heavy metals in the area), the number of cars traveling through the township via state, county and federal highways and the level of population density in the township.

The increase of autism rates nationally, as well as in New Jersey, is of concern. The financial burden on a family with an autistic child can be crushing. According to Harvard School of Public Health, a family may spend up to $3.2 million during a child's lifetime for treatment and therapy (Datz, 2006). In many cases, one of the parents must stop working in order to provide all-day care for their child, adding further stress to their financial situation. These costs to society can grow if the rate in which children are diagnosed with autism continues at its current pace.

This paper contributes to the understanding of environmental factors in the development of autism within New Jersey school districts. Results concerning environmental factors and autism classification rates would be useful in policy creation and implementation.

Literature Review:

The essential features of an autistic disorder are the presence of markedly abnormal or impaired development in social interaction and communication and a markedly restricted repertoire of activity and interests. Individuals with autism may have a range of behavioral symptoms, including hyperactivity, short attention span, impulsivity, aggressiveness, self-injurious behaviors, and, particularly in younger children, temper tantrums. The behavioral issues are sometimes the result of frustration due to a need or want that cannot be expressed easily. There may be odd responses to sensory stimuli (e.g., a low threshold for pain, oversensitivity to sounds or being touched, exaggerated reactions to light or odors, fascination with certain stimuli). The onset of autism is usually prior to three years old. Parents may observe behavioral problems or retardation in mental and social skills. In most cases, there is an associated diagnosis of mental retardation, commonly in the moderate range of a 35-50 IQ score, though highly functional children with autism are not uncommon. There is no known single cause for autism, but it is generally accepted that it is caused by abnormalities in brain structure or function. The abnormalities could be caused by genetic factors or environmental factors such as pollution and toxins causing the immune system to fail and/or overreact. (American Psychological Association, 1994).

According to the Individuals with Disabilities Education Act (IDEA), states and public agencies must provide early intervention, special education, and related services to children with disabilities. By law, school districts must provide the best possible education to children diagnosed with autism from ages 3-21 (IDEA, 2012). Dealing with autism in the classroom requires special resources that must be flexible to cater to the students' needs, as the complex nature of autism prevents a "one program fits all" approach to education. Additional resource needs include a low student-to-teacher ratio, a curriculum that focuses on improving social

interaction and communication, facilities that do not over-stimulate students due to sensory sensitivity, and a flexible, responsive program that keeps track of the students' progress. Flexibility and systematic planning are crucial to the students' success. (Kluth, 2010)

According to the Individuals with Disabilities Education Act (IDEA) made in 1990, schools are required to provide free and appropriate education for all students with disabilities. Financial aid is provided if public schools require extra resources. As a result, all schools are given a set amount of financial aid depending on the number of students classified with disabilities. The placement of the student in one of the special-education programs also requires the preparation of the child's yearly Individualized Education Program (IEP). The IEP is mandated by the federal regulations put forth by the creation of IDEA. An IEP defines the individualized objectives of a child who has been found with a disability, as defined by federal regulations. The IEP is intended to help children reach educational goals more easily than they otherwise would. As a result, the classification of the student in their special education programs is important and may alter how much aid a school will receive. (Ajayi, 2013)

According to a CDC study in 2008, 1 in 49 children in New Jersey is diagnosed with autism. This is twice the national rate, making this a potentially large problem for educators. The study used a sample of 7,000 children within Union County, New Jersey (Baio 2012). The study states that the area near metropolitan Newark is representative of the entire state due to its population density, demographics and level of industry. However, the high amount of pollution and toxins in the county (autism can be the reaction to an overload of toxins in the body), and the relatively small sample size provides doubt that the sample may not be representative of the entire state. This is the major reason why I wish to collect data from individual school districts.

Data collected from townships would provide a diverse sample across New Jersey, rather than a specific geographical region.

The development of autism has a bias toward males; boys are five times more likely to develop autism compared to their female counterparts. The disorder is also more prevalent in whites compared to other races. The racial breakdown of children with autism in New Jersey is 43% white, 28% Hispanic, 23% black, and 5% Asian or Pacific Islander. (Centers of Disease Control, 2010).

Since autism is a whole-body disorder, many autistic children may have sensitivity to gluten or dairy products. It is estimated that over 70% of children with autism have this sensitivity to gluten or dairy products. Ingestion of these proteins may cause digestive problems, such as lower intestinal pain, inflammation, insomnia, nutritional deficiencies and diarrhea, among other complications. This discomfort may cause children to lose focus, become agitated or have tantrums, increasing the severity of symptoms associated with this disorder. Since many children with autism may have sensitivity to pain and may be unable to tell their parents that they are having stomach or intestinal pains, tantrums may be the only way they can express their discomfort or express their frustration. As a result, parents are recommended to provide their child with gluten-free, dairy-free meals and snacks. (Winter, 2010)

The presence of heavy metals or similar pollutants is a major risk factor for a child who may develop autism. According to Blaurock-Busch, hair analysis of autistic children vs. nonautistic children between the age 3 to 9 year show that there is a positive correlation between verbal communication impairment and the presence of heavy metals, particularly lead. (Blaurock-Busch, 2012) Curtis J. Thomas agrees with this conclusion. He examined the effects of chronic metals ingestion on social behavior in the normally highly social prairie vole to test

the hypothesis that metals may interact with central dopamine systems to produce the social withdrawal characteristic of autism. He specifically tested the effects of mercury and cadmium on the voles' social activities and interactions. There was a significant increase in social avoidance with a male-oriented bias, two hallmark characteristics of autism. These results suggest that metals exposure may contribute to the development of autism. (Curtis, 2010)

Andrey Rzhetsky, from the University of Chicago, found that exposure environmental toxins may contribute greatly to the increase of autistic children. To identify potential environmental links, Rzhetsky and his team analyzed an insurance claims dataset that covered nearly one third of the U.S. population. They used congenital malformations of the reproductive system in males as an indicator of parental exposure to toxins. Male fetuses are particularly sensitive to toxins such as environmental lead, sex hormone analogs, medications and other synthetic molecules. Parental exposure to these toxins is thought to explain a large portion of congenital reproductive malformations, which have a high correlation with children diagnosed with autism. Rzhetsky's work on prenatal development shows that heavy metals and other pollutants have an effect on developing newborns. (Rzhetsky, 2014)

Gayle C. Windham performed a study to test whether there is a link between the prevalence of ASD's and exposure to hazardous air pollution in the San Francisco area. The results suggest a potential association between autism and metal concentrations in ambient air around the birth residence. Overall, these studies support that heavy metal pollutants may be a major factor in the development of autism. (Windham, 2006) These studies all link heavy metal pollutants to the development of autism, but provide little connections to demographics or geographical regions. I would like to understand the extent to which air pollution can increase the autism classification rates in the area.

According to a study by Joachrim Hallmayer in 2011, the development of autism may have a greater connection with the physical environment than genetic factors. Because of the reported high heritability of autism, a major focus of research in autism has been on finding the underlying genetic causes, with less emphasis on potential environmental triggers or causes. Hallmayer calls for more studies that specifically look at environmental factors that contribute to the development of autism, such as the home and the surrounding geographical area during the child's early development. (Hallmayer 2011)

Increased usage of vehicles adds to pollution and increases an area's pollution index, as seen by a township's Air Quality Index. According to Heather E Volk, traffic-related air pollution may contain substances such as heavy metals that have adverse prenatal effects. The results of her study concluded that living near a freeway does contribute to the chances of a child developing autism. However, her study does not correct for magnitude of freeway activity, though she did correct for the distance mothers lived from major freeways. In order to analyze the amount of traffic or human activity in the area, I plan on calculating the population density of each school district. (Volk, 2011)

The diagnosis and classification of children with autism has evolved over the past thirty years. The main source physicians use when diagnosing children with developmental or mental disorders is the Diagnostic and Statistical Manual of Mental Disorders (DSM). The manual outlines the specific criteria that must be met to receive a diagnosis, as well as the corresponding label and numerical code that is sometimes used by insurance companies to identify the diagnosis. The main purpose is to provide standard guidelines for clinicians to use for the diagnosis of different psychological disorders and conditions. Autism was first mentioned in the third edition of the DSM and was simply mentioned as a subset of infantile schizophrenia with

no formal guidelines on its diagnosis or classification. The DSM-IV identified a set of Pervasive Developmental Disorders that are considered autism spectrum disorders. These include Autistic Disorder, Asperger's Disorder, and Pervasive Developmental Disorder Not Otherwise Specified (PDD-NOS). The guidelines between DSM-IV and the revised fourth edition (DSM-IV-R) have not explicitly changed. As a result of the defining features of autism changing over the course of two decades, it would be possible that the increase of autism would be due to the changing definition on what an autistic individual is, as opposed to a language-impaired or emotionally disturbed individual. A study done by William Mcmahon in 2012 concluded that autism rates would not have changed between the 1980s and the 1990's if the diagnostic criteria was kept constant during that time period, supporting this explanation for increasing autism rates. (McMahon, 2012) However, it may not be the sole reason why autism has raised so dramatically in the last decade.

The DSM V, published in 2013, completely overhauled the autism diagnosis and made the criteria significantly stricter. The DSM-V criteria emphasize obsessive and repetitive behaviors of autistic individuals, something that was not completely necessary under the DSM-IV-R guidelines. The subcategories of autism have been eliminated in favor of one umbrella-classification of autism. If diagnostic processes are to blame for the rise of autism diagnosis rates in the past decade, the stricter guidelines should make it very visible within the next five years. However, it is more likely that the rise of autism diagnosis rates are due to a combination of environmental factors as well as the changing diagnosis criteria. The alterations in diagnostic criteria are worth mentioning because this paper is trying to answer the question of why autism rates are increasing throughout the nation, especially New Jersey. To clarify, the data analysis this paper discusses is unaffected by changes in diagnostic criteria because the classification

rates are collected for the same year, meaning the diagnosis criteria is constant across school districts.

A major issue that is worthy of note is the difference between a child who is classified with autism compared to a child who is diagnosed by a medical physician. Diagnosis is a medical term, while classification is an administration concept within the public education system. A child is diagnosed with autism by a physician, while a student is classified with autism if the child has a noticeable behavior issue or learning disability that can be connected to autism (New Jersey Administrative Code, 2006). Most children classified with autism are diagnosed with autism, but not all children diagnosed are classified because they may be high-functioning enough to succeed with neurotypical peers, or require needs that are more suitable for children who are classified as "multiple disabled." As a result, gathering classification rates from schools may not provide a complete picture of autism rates within the township, though this difference is not large enough to affect my project's validity. According to a discussion with Sandy Howell, a medical sociologist working with the New Jersey Department of Education, the classification rates are estimated to be about 20%-25% lower than diagnosis rates for autism. To clarify, 20%-25 of children who medically have autism are classified in other categories or are simply not classified at all if they are perfectly capable of keeping up with the demands of schoolwork.

The Model and Data:

I hypothesize that autism-classification rates in New Jersey townships[1] depend on environmental factors, specifically, the pollution index (formally known as the Air Quality Index (AQI), the higher the index the more polluted the township is) of the township, number of EPA Superfund sites in the township, the number of lead-poisoning cases in the county (used to compare levels of heavy metals in the area), and population density (used to as a proxy for

pollution and human activity) within the school district. (Data sources are described in Appendix 1.) I hypothesize that each of these indicators will have a positive relationship with autism incidence.

Specific information on the variables used is listed below:

***Autism classification rates and general enrollment information*:** I collected the autism classification rates in the general population (grades kindergarten through 12th grade), the percentage of total children who require special education and total enrollment of students in school districts throughout New Jersey. The New Jersey Department of Education has this on file and I have collected data from 78 schools that have full enrollment information concerning students classified with autism. I have collected general enrollment information of all students, as well as the total number of students classified under special education from the school budget summaries. This data was for the 2013-2014 school year.

After calculating the average percentage of children who have autism within the school districts and comparing the numbers with what the CDC calculated in the 2008 New Jersey autism report, one notices a high level of consistency. The average percentage of children who are *classified* with autism is about 1.4%, about 31.6% lower than the children *diagnosed* (2.04%) with autism according to the 2008 CDC report. The difference can be attributed to improper classification methods where children diagnosed with autism are classified as multiple disabled, mentally retarded or emotionally disturbed in order to provide the student with proper accommodations such as therapy. Despite the problems between diagnosis and classification, the classification rates are done according to similar state and federal codes. As long as the standards of the child study teams remain constant from school district to school district, education classification rates should not provide a spurious result. (New Jersey Administrative Code, 2006)

Township Pollution Index (from the township AQI) of each school district: This is a general pollution index that can be used to assess the general air quality of the district. The background literature I have examined does not seem to differentiate between pollutants ingested through the respiratory system or digested. I would like to examine both kinds of pollutants. CLR Choice Realty (2013) has created these pollution indexes from data taken from the EPA Air Quality Indexes from each township. This allows easy data collection by school districts. The EPA calculates the AQI for five major air pollutants regulated by the Clean Air Act: ground-level ozone, particle pollution (also known as particulate matter), carbon monoxide, sulfur dioxide, and nitrogen dioxide. When interpreting this data, it must be understood that the Air Quality Index is a measure of pollutants in the air. The scale is 0-500, with a score of 0 meaning perfect air with absolutely no pollutants and a score of 500 meaning incredibly deadly levels of pollutants. The national average is set at an AQI score of 100.

Number of EPA Superfund Sites in the township: The presence of these areas where environmental spills or disasters have taken place can be major sources of pollutants. I counted the number of Superfund Sites in each township to see if there is a correlation between these sites and autism classification rates. The source used is from the EPA and documents every Superfund Site in the State of New Jersey, along with the township they are located in.

Number of lead poisoning cases within the county the township is located: A measurement of lead levels within each township in the study in order to gauge the presence of heavy metals in the area would have been preferred. However, due to the inability of a comprehensive record of lead levels by township, lead poisoning rates will have to be used as a measure of the town's lead levels. Since there was no township-level data concerning lead poisoning, county data was used in its place. Of course, there are major problems that may arise from this lack of data. Since the

demographics, infrastructure, population density and other factors may vary across the county; this may not be an accurate measure. The source of this data is the New Jersey Department of Health and measures the percentage of children between the ages of 6 months to 29 months each county who has elevated blood levels of heavy metals (blood lead level of 5 μg/dL). This data is only on the county level, so I will simply match the county data with the counties the school districts are in. The year in which this data was collected is 2008. This six year delay is acceptable because the measure for autism is classification rates are something that would not be seen in the school system until the child becomes five or six years old and enters elementary school.

***Traffic volume*:** The average number of cars that travel through a township along state, federal, county and interstate highways in a 24 hour period. This data was collected by the New Jersey Department of Transportation between the years of 2006 and 2008. As stated before, this delay is acceptable.

Population Density: The population density of the township acts as an indicator of human activity, and the pollutants that come with it, in the area. This data was collected from the U.S Census office. The density is calculated by total residents divided by the land area of the township.

Please see appendix 2 for the means, standard deviations, maximums and minimums of this data. The full data set can be found in appendix 4.

Data Analysis and Results

In order to provide an understanding of possible correlations between variables, I ran a Pearson Correlation test on the variables. The results are provided in table 1.

(table 1 goes about here)

According to table 1, traffic volume has a significant positive correlation with percentage of students classified with autism. There is also a negative correlation between population density and percentage of students classified with autism, meaning that there are fewer children in population-dense areas compared to other townships in New Jersey. One should also note that there is a negative correlation between lead-poisoning statistics and percentage of students diagnosed with autism, though it is not significant at the 95% confidence level. There is also a correlation between *popdense* and *airpollution,* which is an intuitive conclusion. Areas with high population density would clearly have more air pollution in the area due to high human activity.

The type of model that best fit the data was a log-level regression model. I will first discuss the results of the first regression with all the variables (see table 2) and then discuss the results from the final regression where variables with low significance were removed (see table 3). The variable *lnpk12autism* is simply the log of *pk12autism*. Since the dependent variable of autism classification is a percentage, the log of the variable will produce consistent estimates that are not affected by the size of the general school population within the township. The initial regression that is presented below was corrected for heteroskedasticity and are the robust results.[1]

(table 2 goes about here)

The two variables that are significant in the initial particular log-level regression are *airpollution* (p-value 0.028) and *popdense* (p-value 0.005). This means that air pollution does have a significant positive effect on the children classified with autism in the school district. According to this model, the more a township is considered polluted as seen from the Air Quality Index the more likely a child may develop autism. There is also a negative correlation between

[1] Breusch-Pagan/Cook-Weisberg test for heteroscedasticity proved that there was no constant variance (Chi-square value of 8.62, p-value of .0033). Results presented in this paper were corrected for heteroskedasticity.

population density and percentage of autistic children in the township. I will go into more detail concerning possible explanations for this in the discussion section of the paper.

After several combinations of variables I narrowed the equation to simply having *popdense* and *airpollution*. The linear regression results for the log-level formula can be found in table 3. As seen from the regression shown in table 3, *airpollution* (p-value 0.003) and *popdense* (p-value 0.000004) are the main variables that had statistical significance. The final regression is presented below was corrected for heteroskedasticity and are the robust results.[2]

(table 3 goes about here)

Discussion:

In nearly every regression done with the data, the presence of Superfund sites is of little importance. This may be due to the varying nature of Superfund sites in magnitude and the area of impact. These sites were also relatively old, the average time since their registration with the EPA has been roughly 10-15 years. Since the presence of Superfund sites had such a low significance, it may have thrown off the accuracy of the other variables if included in the regression.

Trafficvol was insignificant in the regression tests. As seen from the Pearson correlation (figure 1), there was no significant correlation between traffic volume and population dense areas, a surprising result. This leaves three possible conclusions: either traffic volume has absolutely no bearing on a child developing autism, or the fashion in which the data was collected was not completely accurate due to limitations in the data available, or this variable is

[2] Breusch-Pagan/Cook-Weisberg test for heteroscedasticity proved that there was no constant variance (Chi-square value of 3.06, p-value of .0802). Results presented in this paper were corrected for heteroskedasticity.

collinear with others, such as *airpollution* which is designed to capture the same underlying cause.

Airpollution was a significant variable in the final regression. From the data collected from these school districts, air pollution in the township does have an effect on autism classification rates. This confirms what was found in the literature concerning air quality and the increased risk of developmental disorders.

Leadcount was largely insignificant. The proxy for lead contamination in the school district is the lead-poisoning rates in the county. Though logically connected to a county's lead levels, such rates provide a very indirect method of measuring the underlying factor and determining or predicting autism classification rates. This lack of significance can also be explained by the lack of township level data (county data was used instead). *Leadcount* was significant at the 90% confidence level with a p-value of .07. This is most likely a spurious result because the coefficient in the initial log-level regression (-6.42) is negative, meaning increased levels of lead are connected to lower levels of autism diagnosis within the township. This conclusion is not at all in line with the literature, and it is clearly doubtful that lead is the cure to the United States' autism epidemic.

Popdense was a significant variable (p-value 0.000004) with a coefficient of -.000015, meaning that autism is lower in population dense areas. This is contrary to the literature indicating that there is a higher risk of developing autism in an area with a lot of pollutants that one would find in a population dense area. This may be a classification error made by schools in urban areas or a result of families with autistic children moving out of urban areas in search of better autism programs in suburban schools. It is also possible that students are classified as

"multiply disabled," "mentally retarded" or "emotionally disturbed" because the schools may have not have the facilities required to serve students who are under the "autism" classification.

Conclusion and Future Research:

The increase of autism in children throughout the United States should logically have a cause, either by environmental factors, by changes due to diagnosis criteria or by some factor that is yet to be understood or observed. This study did find that there is a significant correlation between pollution (as seen from the township's Air Quality Index), population density and the percentage of total children in the school district with autism.

There is still work to be done on this topic. The biggest issue would be the major differences in autism classification between urban areas and suburban areas, as this may provide insight on possible flaws in classification criteria or the subjectivity of classifying students. To start, understanding the process behind classification, as well as the precise amount of funding received from children diagnosed with autism and the costs associated with making class sizes smaller, may provide some insight. The motivations outside of what may be best for the student may also have an effect on classification rate, such as classifying students in order to save resources. There is also little formal literature on the link between prenatal dietary considerations and possible links to autism.

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Appendix:

Appendix 1: Data Sources

Variable	Source	Additional Instructions
Pollutionlevel	CLR Choice Realty. *nd* . United States Real Estate and Demographics. http://www.clrsearch.com/Sitemap/New-Jersey. Accessed 01 Dec. 2013.	Search zip code of townships
pk12autism	Number of Classified Students by Eligibility and Placement, Ages 6-21. (2013, January 1). *2012 Special Education Data* . Retrieved March 10, 2014, from http://www.state.nj.us/education/specialed/data/2013.htm	Click on "Classification" and download excel file
leadcount	New Jersey Department of Health (2012). *Childhood Lead Poisoning in New Jersey* . Retrieved from New Jersey Department of Health website: http://www.nj.gov/health/fhs/documents/childhoodlead2012.pdf	
trafficvol	New Jersey Department of Transportation. *N.d.* "NJDOT Traffic Counts: Roadway Information and Traffic Monitoring System Program Interactive Traffic Count Reports." http://www.state.nj.us/transportation/refdata/roadway/traffic_counts/. Accessed 01 Nov. 2013.	Search zip codes of townships, find every county, state, U.S and interstate highway and record the traffic volume that passes through the township.
superfund	US Environmental Protection Agency (EPA). "Superfund Sites."21 Oct. 2013. http://www.epa.gov/region02/cleanup/sites/njtoc_name.htm. Accessed 01 Dec. 2013.	
popdense	U.S Census Office	Search by zip code, divide total population by land area
k12pop, speducationpop	New Jersey Department of Education. "User Friendly Budgets for 2013." 2013.http://www.state.nj.us/education/finance/fp/ufb/2012/01.html	Enrollment information under first table labeled "Advertised Enrollments"

Appendix 2: Data Means, Standard Deviations, Max and Min

Variable	Mean	Std. Dev.	Min	Max
pk12autism	0.0140629	0.0038287	0.0034	0.02248
superfund	0.7179	1.25	0	7
trafficvol	94120.02	75241.47	6779	338992
airpollution	102.93	9.593477	79	123
leadcount	0.01362	0.0094817	0.0036	0.0465
popdense	5100.404	8344.541	146.2	51810.1

Appendix 3: Tables and Figures

Table 1

Pearson Correlation Coefficients

Pearson Correlation:						
	pk12autism	**superfund**	**traffivol**	**airpollution**	**leadcount**	**popdense**
pk12autism	1.000					
superfund	-0.0219	1.000				
	(-.8493)					
trafficvol	**.2742***	-.0499	1.000			
	(.0151)	(.06647)				
airpollution	0.1744	-.0575	.2104	1.000		
	(.1266)	(.06171)	(.0645)			
leadcount	-0.2132	-0.0372	-0.1798	-0.0281	1.000	
	(.0609)	(.7463)	(.1152)	(.8071)		
popdense	**-0.259***	-0.0013	-0.0877	**0.4038***	.1198	1.000
	(.022)	(.9909)	(.4450)	**(.0002)**	(.2962)	
*= Significance at 95%						

Table 2

Initial Regression (Robust Results)

Log-Level Regression, all varaibles (robust results)				
F(5, 72)	5.07			
Prob > F	0.0005			
R-squared	0.2092			
Root MSE	0.29103			
lnpk12autism	Coef.	Robust Standard Error	t value	P>t
superfund	-0.0007013	.018528	-0.04	0.979
trafficvol	0.000000459	.0000003.99	1.15	0.327
airpollution	**0.008824**	**.0032422**	**2.72***	**0.028**
leadcount	-6.429456	6.404936	-1.00	.319
popdense	**-0.000013**	**.000000351**	**-3.70***	**0.000005**
constant	-5.104892	.33533557	-15.22	.000005
*=Significant at 95%				

Appendix 4: Full Data Set

Zip Code	K12total	K12SpecEd	K12Autism	Superfund	Trafficvol	Airquality	Lead count	Popdense
08037	3147	408	43	0	25822	93	0.0129	361.80
07621	3110	488	54	0	219210	123	0.0089	9306.50
07410	3827	825	82	3	199502	122	0.0089	6315.40
07601	4711	881	68	0	57169	115	0.0089	10290.00
07430	2844	408	57	0	126441	116	0.0089	1007.70
07652	3402	607	55	0	338992	90	0.0089	2516.00
07450	5080	629	69	0	18619	109	0.0089	4339.00
07661	1029	131	12	0	235844.5	116	0.0089	6116.30
07666	3459	670	69	0	285957	119	0.0089	6622.20
07670	3224	463	49	0	24718	121	0.0089	3148.60
08016	3579	516	61	2	78212	96	0.0044	1684.20
08053	3942	791	66	0	64851	96	0.0044	1555.10
08088	6158	1074	94	0	146668	102	0.0044	146.20
08055	2623	387	35	1	115526	99	0.0044	591.80
08057	3570	416	49	0	47628	99	0.0044	1410.60
08101	13241	2450	80	1	58503	93	0.0111	8669.60
08302	4929	399	17	0	97226	97	0.0465	4102.50
08360	8566	1286	107	2	75474	95	0.0465	887.50
07109	4142	555	63	0	34714	105	0.0304	10755.70
07003	5622	903	77	0	33615	103	0.0304	8920.50
07050	4135	701	39	2	14499	94	0.0304	13705.70
07039	5051	759	89	0	53454	105	0.0304	2132.80
07041	4363	567	50	0	19268	94	0.0304	2161.30
07042	5697	1002	107	1	42770	108	0.0304	5971.20
07110	3396	526	58	0	83435	106	0.0304	8384.10
07068	436	49	6	0	80083	107	0.0304	1644.40
07052	5793	1132	95	0	81709	103	0.0304	3836.00
08028	1933	320	32	0	31782	90	0.0101	2022.90
08085	1559	238	29	1	212700	96	0.0101	3568.40
07097	28961	3266	439	2	54928	116	0.0134	16736.60
07032	5291	709	58	3	160393	110	0.0134	4636.50
07047	7075	1073	71	0	169538	110	0.0134	11838.00
07087	9783	1195	102	1	29280	118	0.0134	51810.10
07093	6329	866	51	0	17880	120	0.0134	49341.70

(Continued)

Zip Code	K12total	K12SpecEd	K12Autism	Superfund	Trafficvol	Airquality	Lead count	Popdense
08822	2502	419	33	0	150949	92	0.0036	298.00
08512	4490	543	64	0	42188	103	0.0199	1737.60
08609	10545	1684	145	1	32186	92	0.0199	2240.20
08648	3521	476	52	0	40701	101	0.0199	1534.80
08550	8962	923	107	0	40506	86	0.0199	1349.80
08816	7615	898	158	1	148434	92	0.0076	2189.60
08818	12965	1438	211	5	11923	98	0.0076	3339.00
08902	5432	657	58	0	6779	101	0.0076	3396.20
08857	7961	1215	106	3	56440	103	0.0076	1717.70
08862	10378	866	73	2	19462	97	0.0076	10806.80
08854	6430	877	66	1	29128	103	0.0076	2975.50
08872	5190	925	91	4	180430	99	0.0076	2695.70
08852	8188	971	78	1	11964	96	0.0076	1068.10
07095	11875	1396	160	0	179060	104	0.0076	4290.00
07728	9830	1474	105	1	63104	95	0.0108	939.80
07730	2692	477	39	0	261736	117	0.0108	3659.40
07734	1354	260	28	0	206605	111	0.0108	9452.30
07746	4526	861	83	1	133324	117	0.0108	1323.70
07747	3521	394	57	0	162780	103	0.0108	3896.60
07748	8265	1448	116	0	10020	117	0.0108	1622.90
07712	3318	532	39	0	95417	116	0.0108	2509.10
07849	2960	471	41	0	141681	103	0.0052	544.70
07960	4403	707	91	0	177941	104	0.0052	1428.30
07828	4069	726	53	0	49354	93	0.0052	956.10
07869	4445	701	40	0	39502	91	0.0052	1235.90
07852	3418	541	58	0	72459	87	0.0052	1119.90
07882	2110	351	32	1	29327	79	0.0052	417.50
08723	7738	1668	174	1	52507	105	0.0092	2919.40
08527	8026	1178	114	1	53571	106	0.0092	552.70
08731	3719	790	75	0	16790	106	0.0092	332.00
08742	2518	374	37	0	56788	106	0.0092	5272.10
08753	14480	2141	221	0	87005	119	0.0092	2253.50
07011	10046	1316	103	2	113447	103	0.0219	7472.00
07501	23510	3666	165	0	151264	112	0.0219	17346.30
07470	7306	1324	109	0	95354	96	0.0219	2306.00
07920	4930	656	76	0	251489	93	0.0097	1113.60
08807	7356	1260	65	2	181862	98	0.0097	1387.90
08844	6113	1138	105	1	53011	98	0.0097	702.30
08502	4542	491	49	1	39133	98	0.0097	688.80
07871	3285	450	34	1	52605	99	0.0046	533.90
07205	2869	256	43	0	173081	102	0.0174	7784.00
07036	5233	770	67	7	92036	104	0.0174	3793.80
07901	3627	465	31	0	109774	102	0.0174	3578.90
07090	5326	920	67	0	31834	96	0.0174	4512.20

Table 3

Parsimonious Regression Results (Robust Results)

Final regression, variables *airpollution* and *popdense (robust results)*				
F(2, 75)	9.82			
Prob > F	0.0002			
R-squared	0.1558			
Root MSE	0.29462			
lnpk12autism	Coef.	Std. Err.	t	P>t
airpollution	**0.0104681**	**0.0034596**	**3.03***	**0.003**
popdense	**-0.000015**	**3.56E-06**	**-4.21***	**0**
constant	-5.308841	0.3622941	-14.65	0
*= Signicant at 95%				

Endnotes

[1] Another major consideration that may affect the accuracy of my results is the movement of families with children diagnosed with autism to other districts. The classification rates do not show how many of those children have moved to that district in the last few years, meaning the factors that contributed to the development of autism in the township the child grew up in may not be visible. While movement is an issue, it is doubtful that movement will affect the accuracy by a significant margin.