Effect of Vehicular Particulate Matter on the Lung Function of Asthmatic Children in Fresno, CA

Jamie Mikkelsen

Abstract Exposure to particulate matter (PM) is associated with adverse respiratory health effects. Vehicles traveling along a highway represent a significant source of fine particulates that contribute to the aggravation and possibly to the development of asthma in children. Residential history information and lung function data from 89 children involved in the Fresno Asthmatic Children's Environment Study were used to quantify the impact of PM exposure from vehicles on lung health. The forced expiratory flow volume in one second (FEV1) was collected for each child using a spirometer during office visits between November 2000 and December 2001. Individual-level demographic and socioeconomic data as well as the exact locations of the children's residences were gathered during home interviews. Residential address data were incorporated into a geographic information system to determine the distances of each residence to the closest highway in Fresno, CA. The distances to only highway 99 were also calculated. The categorical distances reported by the study participants were also used to estimate exposure to vehicular PM. Using three stepwise linear regression models, the effects of proximity to a vehicular source of PM on the mean FEV1 values were evaluated. After adjustment for sex, household income level, race, standing height, parental smoking, mother smoking during pregnancy, time lived in residence, and time of FEV1 test, the measures of absolute distances to the highways were found to be insignificant in predicting changes in mean FEV1 values. The regression model using self-reported distance variables indicated that children who lived one to three blocks from the source of vehicular PM experienced a 10% increased in mean FEV1 values, as compared to children who resided immediately next to the pollution source. These results indicate that living in an area with high traffic density may negatively affect the lung function of children with asthma.

Introduction

The number of childhood asthma cases in the United States has increased dramatically in recent years. Current estimates indicate that 4.4 million children in the United States under 18 years old suffer from the respiratory problem (Centers for Disease Control 1996). Asthma is defined by sporadic respiratory symptoms, such as wheezing and coughing, and airway hyperresponsiveness (Balmes 1993). The severity of asthma can range from mild symptoms to life-threatening episodes. Complex combinations of factors contribute to the onset of asthma. There is strong evidence from epidemiological studies, however, that identifies air pollution as an aggravator of respiratory problems in urban areas. Prolonged exposures to an inflammatory agent, like particulate matter (PM), can result in chronic bronchial problems (Taggart *et al*. 1996, Rosas *et al*. 1998, Cassino *et al*. 1999, English *et al*. 1999). Lipsett *et al* (1997) found a positive association between emergency room visits and ambient levels of PM less than 2.5 μm in diameter. Continued investigations of the respiratory health effects from PM exposure are necessary in order to predict the risk factors that may cause an asthmatic response (Stone 2000).

Research has confirmed the effects of air pollution on respiratory function of adults, however, current studies are focusing on the factors contributing to impaired lung function in children. Children are more susceptible to the damaging effects of air pollution for many reasons. Their higher levels of outdoor activity, as compared to adults, increases their exposure to harmful pollutants (Stone 2000). A Southern California study found children to have a greater response to air pollution than adults (McConnell *et al*. 1999). In addition, children's lungs are still developing which makes them more vulnerable to impairment (Bates 1995). Studies on children are particularly important because polluted childhood environments can lead to decreased adult lung function. Recently, a few studies have looked at the link between PM exposure and childhood asthma. A study in Switzerland found an increased relative risk of asthma incidence of 1.16 for a 20 $\mu g/m^3$ increase in exposure to total suspended PM (Braun-Fahrlander *et al* 1992). Children in one study were more likely to develop coughs and other respiratory symptoms as a result of prolonged exposure to suspended particulates (Schwartz *et al* 1994).

Proximity to industrial activity and roadways has been identified as a risk factor for the exacerbation of asthma (Stone 2000). Studies have shown a link between exposure to PM from vehicle exhaust and an increase in asthma symptoms in children. Research conducted in the United Kingdom found that children admitted to a hospital for respiratory problems were more likely to live within 500 meters of a main road with high traffic density (Edwards 1994). Another study found a positive relationship between self-reported asthmatic symptoms and traffic density in children in Germany (Duhme 1996). Recent studies indicate that children living near a vehicular source of PM experienced decreases in their lung functions (Brunekreef *et al* 1997 van Vliet *et al* 1997). However, some studies have not controlled for individual level confounders, such as socioeconomic factors or the time a child has lived near a source of PM, which could possibly confound the results.

The city of Fresno, California was an ideal study site for the analysis of the link between exposure to vehicular PM and lung function in children. There was a high incidence of asthma among the inhabitants of Fresno and the level of PM in the ambient air has consistently exceeded state and federal air quality standards; for the past 12 years, the highest annual geometric mean at the monitoring sites within Fresno County was above the State of California's annual standard for PM less than 10 μm in diameter (California Air Resources Board 1999). Highway 99, a freeway used heavily by trucks and passenger vehicles, runs through residential areas of Fresno. Three other freeways, highways 41, 168, and 180 traverse the city. Researchers for the Fresno Asthmatic Children's Environmental Study (FACES) initiated a five-year cohort study to identify the possible environmental factors that influence the natural history of asthma. The study began in November 2000 and includes an examination of childhood exposure to PM both in indoor and outdoor environments. In-office and home-based interviews were conducted at the onset of the research to assess the pulmonary function and general respiratory health of the children as well as to collect demographic and home characteristic data.

In this regression analysis, data from the FACES cohort study was used to investigate the long-term effect of living near a source of vehicular PM on the lung function of the asthmatic children in Fresno. This investigation used individual lung function tests, as opposed to hospital admissions data or self-reported symptoms, which were utilized in the above cited studies. The primary lung function outcome measure was forced expiratory flow in one second (FEV1) obtained during testing at the baseline office visit. The measured distance from the child's house to highways 99, 41, 168, or 180 served to estimate exposure to PM. In addition to investigating the effect of a calculated distance to a source of particulates, a regression model was fit using self-reported proximities in order to predict changes in the FEV1 values. Results from previous studies indicate that the FEV1 values for a child should be affected by proximity to a source of vehicular PM.

Methods

The data used for this study, including demographic variables, lung function tests, questionnaire data, and absolute distances to freeways were obtained from the researchers at UC Berkeley involved with the FACES project. Using these data and stepwise linear regression techniques, this study examined the effect of proximity to a source of vehicular PM on the lung function of asthmatic children.

The Recruitment for the FACES Study Children were recruited by the FACES staff through a variety of ways, including television and radio advertisements, physician referrals, and community health fairs. The children were been between the ages of 6 and 11 at the time of the baseline interview, had a medical diagnosis of asthma and lived within 10 km of First Street in Fresno, a US EPA Enhanced Monitoring Platform. All of the children required the use of asthma medication, visited an emergency room because of asthma related problems, or experienced asthma symptoms, such as cough, wheeze, or chest tightness in the previous 12 months prior to their inclusion in the study. If the parent did not speak English or Spanish or the child did not speak English, they were not eligible for the study. Children were excluded if they did not live in a primary residence for at least five nights of the week. Families who planned to move away from Fresno within 24 months of the baseline interview or who did not have access to a telephone were not eligible.

The FACES Baseline Interview The FACES researchers assessed the lung functions of the approved children during the baseline interviews. Tests were performed using a dry rolling seal volume spirometer (Morgan Scientific, Winchester, MA). A series of measures were obtained, including forced vital capacity (FVC) and FEV1 values. The results of the FEV1 tests were obtained from the FACES project and used for this analysis. This test provided the most information about airway hyperresponsiveness, and presented an accurate picture of the child's lung function (NHLBI 1995, Tager 2001, pers. comm.). For each child, eight values of FEV1 were obtained during the baseline visit. The results of each trial had been evaluated and graded "acceptable" by FACES researchers if the following conditions applied:

1. The peak expiratory flow time was reached in 120ms or less;

2. The child expired for 6 seconds or achieve a constant flow rate of less than 45mL/s in 2 seconds, and;
3. The volume of air that was back extrapolated was less than 150mL/s or 5% of the FVC.

Using the data provided, the average of the first three acceptable trials was calculated.

The child's parents provided the addresses of the child's current residences. A member of the FACES team geocoded the current address of each child using ETAK (ETAK, Tele Atlas North America, Inc, Menlo Park, CA). Arc/Info (ArcView 3.2, Environmental Systems Research Institute, Redland, CA) mapping software was then used to determine the proximity of the residences to the major freeways in Fresno, highways 41, 99, 168, and 180. Figure 1 illustrates the distribution of the current residences in the city of Fresno and their proximity to highway 99, the major freeway in the town. The results of the geocoding process were obtained and used in the regression models performed for this analysis. The parents of the participants in the baseline interview were also asked to indicate if their home was immediately next to, within one block of, between one and three blocks of, or more than four blocks away from a major roadway, intersection or freeway. The self-reported, categorical distances were obtained from the FACES project and used in one of the regression models.

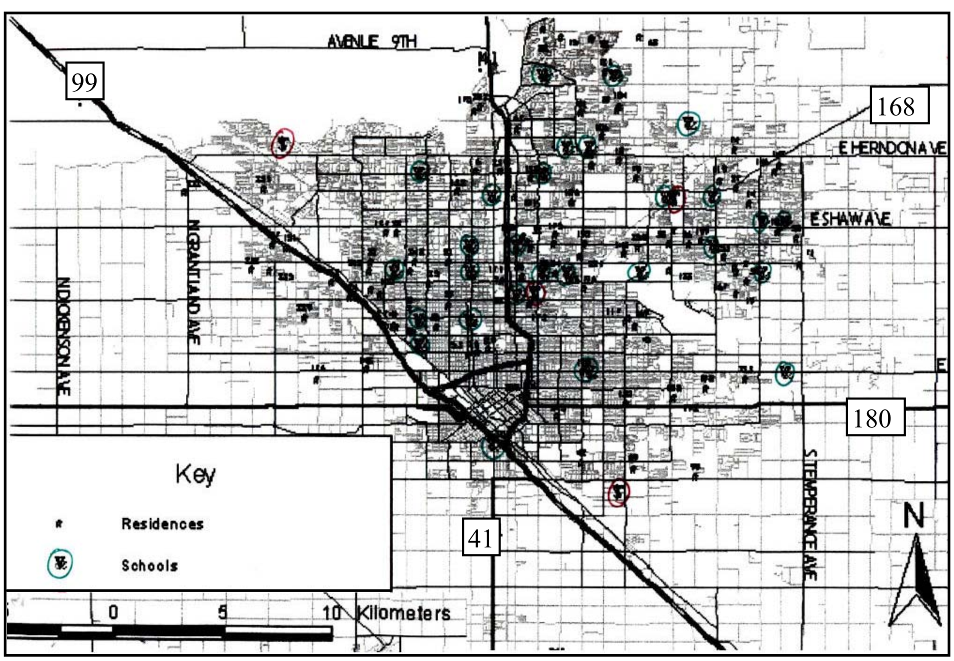

Fig 1: Distribution of Residences

Data Analysis Table 1 indicates all of the variables obtained from the FACES datasets that were incorporated into the stepwise regression models. All three of the models used a transformed mean FEV1 value in order to limit the loss of degrees of freedom in the regressions. The new variable was defined as

$$FEV\_height = 1000 * \{X/(H^3)\},$$

where X equaled the mean FEV1 value for each individual and H equaled the standing height for each child. Previous research has utilized this indicator to represent the combined effects of the child's weight, age, and height on his or her lung function (Tager 2002, pers. comm).

The first of the regression models looked at the effect of the absolute distance to highway 99 on the FEV_height variable. The second model investigated the effect of the vehicular PM from the highway closest to the child's home. The third analysis incorporated the self- reported, categorical distance variables to probe its relationship to lung function. All three analyses began with all of the variables listed in Table 1 but used different representations of proximity to vehicular PM. In most cases, variables were removed from the models if the p-values for the coefficients were greater than 0.10. After the models were run, the coefficient on the FEV_height variable was transformed back, using the mean height of 52.7 in, into a mean FEV1 value of the population for interpretation.

Variable	*Units*
FEV_height	L $s^{-1}in^{-3}$
Distance to highway 99	≤1000m or >1000m
Distance to closest highway (41, 99, 168, or 180)	≤250m or >250m
Self-reported distance to major roadway, freeway or intersection	Next to; within one block; between one and three blocks; more than four blocks away
Sex	Boy/Girl
Race	African American, Hispanic, White, Other
Household income	≤$40,000 or >$40,000
Time of day when FEV tests were performed	9-11am; 11am-4pm; 4pm+
Household smoker	Does a parent in the household smoke? Y/N
Maternal smoking during pregnancy	Did the mother smoke during pregnancy? Y/N
Time in current residence	≤2 years or >2 years

Table 1: Definitions of categorical and continuous variables

The literature suggests that dispersion patterns cause areas within 500 m of a pollution source to have the highest concentration of PM (Mortimer 2002, pers. comm.). Due to the small sample size, children who lived less than 1000 m from highway 99 were assigned a value of one. Another binomial variable was defined by the children who resided less than 250 m from the closest freeway. Four categories of race (African American, Hispanic, White and Other) were recoded as three binomial "dummy variables". Since a majority of the children were Hispanic, this category became the reference group for all the race variables. A female child was assigned a value of one in the binomial sex variable. A binomial "dummy variable" was created for the household income level, a marker for socioeconomic status and the 45 individuals with values above $40,000 became the reference group. To explore the effect of cigarette smoke, two additional binomial variables were created: one defined the presence of a household smoker and the other defined the presence of a mother who smoked during pregnancy. The time a child had lived in their current residence was incorporated as a binomial variable; the parameters are defined in Table 1. In addition, the severity of asthma is related to an individual's circadian rhythm and symptoms are worse in the early mornings (Tager 2002, pers. comm.). In an attempt to control for this issue, the time of day when the FEV1 tests were performed was placed in the regression models as three binomial variables. All analyses were completed using the STATA statistical package (STATA Corporation, College Station, TX).

Results

The characteristics of the study population are displayed in Table 2; note that predicted FEV1 values were calculated from the transformed FEV_height using a mean height of 52.7 in.

Covariate	*Mean*	*Sample size for variable* (***total sample size=89)***
FEV1	1.81 L/s	
Distance to 99	7000 m	≤1000m: 9
Distance to any highway (41, 99, 168, 180)	1800 m	≤250m: 11
Self-reported distance to major roadway, freeway, or intersection	Within one block	Immediately next to: 25 Within one block: 25 One to three blocks: 24 More than four blocks: 15
Sex		
Boys		56
Girls		33
Race		
African American		13
Hispanic		38
White		8
Other		30
Household income	$55,000	≤$40,000: 44
Time of day when FEV tests were performed		9-11am: 14 11am-4pm: 45 4pm+: 30
Household smoker		Yes: 17
Maternal smoking during pregnancy		Yes: 9
Time in current residence		Yes: 26

Table 2: Characteristics of study population

The first multivariate analysis looked at distance from highway 99 as the measure of vehicular PM. The distance to highway 99 was not found to have an effect on the lung function of the asthmatic children. No other variables, barring race, were significant and Appendix 1 provides the full regression results. The African American children demonstrated the greatest decrease in lung function and were found to have a change of -0.35 L/s (95% CI, -0.54 , -0.17) in mean FEV1 values relative to the reference group of Hispanic children.

The second multivariate analysis investigated the effect of the proximity to the closest freeway on the FEV_height values. The African American children again showed the lowest FEV_height value as compared to the Hispanic reference group (β=-0.0025, 95% CI, -0.0038, -0.0013). The coefficients for the sex, household income level, household smoker, maternal smoking during pregnancy, time lived in residence, time of day of FEV1 tests and absolute distance to the closest highway variables were not significant (Appendix 1).

The third regression model used the self-reported distances from a major freeway, intersection, or roadway as provided during the baseline interviews. Significant or near significant results were found for children living within 1 block or within 1 to 3 blocks, in comparison to children living immediately next to a freeway, intersection, or roadway. Based on the values of the coefficients, this model predicted a mean FEV1 value of 1.98 L/s (95% CI, 1.83-2.14) for all children living within one block from a major roadway, freeway, or intersection. This result corresponded to a 9% (95% CI, 0.9-18) overall increase in the mean FEV1 values, compared to the reference group of children who resided immediately next to the pollution source. Living between one and three blocks away demonstrated the largest effect; the mean FEV1 values increased by 10% (95% CI, 1.5-19) over the reference group, corresponding to a 0.186 L/s (95% CI, 1.84-2.16) increase in the mean FEV1 value. The children living more than four blocks from the PM source were predicted to have a mean FEV1 value that was 8% (95% CI, -2.5-18) greater than the reference group. Table 3 shows the standard errors, 95% confidence intervals, and p-values for the regression coefficients on the self-reported, categorical distance variables. The race of the child was also found to be a significant predictor of mean FEV1 values. The African American children were found to have the lowest FEV_height value (β=-0.0025, 95% CI, -0.004 , -0.001). The following variables were not found to be significant: sex, household income level, household smoker, maternal smoking during pregnancy, time lived in residence, and time of day of FEV1 tests (Appendix 1).

Variable	*Regression coefficient, β*	*Standard Error*	*95% CI*	*p-value*
Within 1 block of freeway, intersection, or roadway	0.00099	0.0005	-0.00007 , 0.0020	0.06
Between 1 and 3 block of freeway/intersection	0.00107	0.0005	0.00 , 0.0022	0.05
More than 4 blocks from freeway/intersection	0.00077	0.0006	-0.0005 , 0.0020	0.3

Table 3: Results of regression with self-reported distances

Discussion

This study did not detect an effect of living near a source of vehicular PM on lung function when absolute distances were used in the models. Evidence of a decrease in the lung function of the asthmatic children was found when self-reported, categorical distances were used as a surrogate for PM exposure. This analysis predicted a 10% increase in mean FEV1 values for the asthmatic children who lived within one to three blocks away from a major freeway, intersection or roadway, as compared to the children who resided immediately next to the source of vehicular PM. This result supports the hypothesis that the lung function of asthmatic children is affected by exposure to vehicular PM and agrees with previously published studies. There still exists, however, a discrepancy between the predictions of the regression models. The fact that the self-reported, categorical distances were based on proximity to a roadway or intersection, as well as to a freeway is a possible explanation for the differing results. The self-reported distance variable expanded the possible sources of PM. For instance, a child could have lived far from a highway but close to a busy intersection with high traffic density. The regression models that included only absolute proximities to highways would not have captured this additional exposure. However, the definition of a "major" roadway, freeway, or intersection may have varied among the respondents. The findings of this study indicate that exposure to vehicular PM may contribute to the decreased lung functions of asthmatic children. Also, all of the models found the African Americans to have the lowest mean FEV1 values as compared to the other ethnic groups. This result may be due to socioeconomic factors, other than household income, that caused African American families to live close to a source of vehicular PM.

The FEV1 tests and distance calculation methods were reliable but, as with any study, there existed limitations that could have affected the results. As stated before, asthma is a complex disease that is not well understood; many factors, including genetics and the environment affect the status of the disease in an individual. Ideally, more subjects would have lived closer to the four major highways since dispersion patterns reduce the levels of PM at distances greater than 500 m from a pollution source. The small sample size limited the investigations of the effects of confounders and produced results with little statistical power. The analyses looked at race, household income, and sex variables, and controlled for the presence of maternal and household smokers, the time lived in residence, the effect of the circadian rhythm on asthma severity and distance to a major freeway as a surrogate for PM exposure. Other factors, however, were omitted from the analysis due to time and feasibility. Wind speed and direction could have changed the exposure levels of PM from the vehicular sources. Indoor and outdoor levels of pollutants could also negatively affect the lung function of an asthmatic child. Also, the results may be confounded by the time a child has lived near a major highway. The small sample size prevented a detailed assessment of the potential confounding factors.

The results of this study indicate that exposure to PM from vehicular sources could be a concern for asthmatic children living near a major roadway, intersection, or freeway. Based on the limitations of this study, however, a more comprehensive exposure analysis is recommended. In addition to obtaining a larger sample size, further analyses could include levels of indoor or outdoor pollution and the distances of any previous residence from a major highway to rule out the potential confounding of results. Since children spend many hours in classes, an investigation of the location of schools to major sources of vehicular PM could be significant. Another analysis could include data from ambient PM monitors, instead of employing distance to a freeway as a surrogate for exposure. Additional research is warranted in order to further understand the relationship between exposure to vehicular PM and lung function in asthmatic children.

Acknowledgements

I am grateful to Kathleen Mortimer and Ira Tager from FACES for their help with this project. I'm also thankful for the support and contributions of John Latto, Justin Remais, Manish Desai, and Matt Orr.

References

Balmes, J. 1993. The Role of Ozone Exposure in the Epidemiology of Asthma. Environmental Health Perspectives **101**:219-224

Bates, D. 1995. The Effects of Air Pollution on Children. Environmental Health Perspectives **103**:49-53

Braun-Fahrlander, C., U. Ackermann-Liebrich, J. Schwartz, H.P. Gnehm, M. Rutishauser, and H. Wanner. 1992. Air Pollution and Respiratory Symptoms in Children. American Respiratory Discussion **145**:42-47

Brunekreef, B., N.A. Janssen, J. de Hartog, H. Harssema, M. Knape and P. van Vliet. 1997. Air Pollution from Truck Traffic and Lung Function in Children Living Near Motorways. Epidemiology **8**:298-303

California Environmental Protection Agency, Air Resources Board. 1999. PM10 Air Quality Data Summaries (1988-1997), Fresno County. http://www.arb.ca.gov/aqd/pm10/A2C10.htm

Cassino, C., K. Ito, I. Bader, C. Ciotoli, G. Thurston, and J. Reibman. 1999. Cigarette Smoking and Ozone-Associated Emergency Department Use for Asthma by Adults in New York City. American Journal of Respiratory and Critical Care Medicine **159**:1773-1779

Centers for Disease Control, National Center for Health Statistics, 1996 Home Survey Results http://www.cdc.gov/nchs/fastats/asthma.htm

Duhme, H., S. Weiland, U. Keil, B. Kraemer, M. Schmid, M. Stender, and L. Chambless. 1996. The Association between Self-Reported Symptoms of Asthma and Allergic Rhinitis and Self-Reported Traffic Density on Street of Residence in Adolescents. Epidemiology **7**:578-582

Edwards, J., S. Walters, and R. Griffiths. 1994. Hospital Admissions for Asthma in Preschool Children: Relationship to Major Roads in Bimingham, United Kingdom. Archives of Environmental Health **49**: 223-227

English, P., R. Neutra, R. Scalf, M. Sullivan, L. Waller, and L. Zhu. 1999. Examining Associations Between Childhood Asthma and Traffic Flow Using a Geographic Information System. Environmental Health Perspectives **107**:761-767

Lipsett, M., S. Hurley, and B. Ostro. 1997. Air Pollution and Emergency Room Visits for Asthma in Santa Clara County, California. Environmental Health Perspectives **105**:216-222

McConnell, R., K. Berhane, F. Gilliland, S. London, H. Vora, E. Avol, W. J. Gauderman, H. Margolis, F. Lurmann, D. Thomas and J. Peters. 1999. Air Pollution and Bronchitic Symptoms in Southern California Children with Asthma. Environmental Health Perspectives **107**:757-760

Mortimer, Kathleen. Researcher, Fresno Asthmatic Children's Environment Study, UC Berkeley School of Public Health. 2001, personal communication

National Institutes of Health, National Heart, Lung and Blood Institute. 1995. Global Initiatives for Asthma: A Global Strategy for Asthma Management and Prevention, NHLBI/WHO Workshop Report

Rosas, I. 1998. Analysis of the Relationships Between Environmental Factors and Asthma Emergency Admissions. Allergy **53**:394-401

Schwartz, J., D. Dockery, L. Neas, D. Wypij, J. Ware, J. Spengler, P. Koutrakis, F. Speizer, and B. Ferris. 1994. Acute Effects of Summer Air Pollution on Respiratory Symptom Reporting in Children. American Journal of Critical Care Medicine **150**:1234-42

Stone, V. 2000. Environmental Air Pollution. American Journal of Critical Care Medicine **162**: S44-S47

Tager, Ira. Principal Investigator, Fresno Asthmatic Children's Environment Study, UC Berkeley School of Public Health. 2001, personal communication

Taggart, S. C. 1996. Asthmatic Bronchial Hyperresponsiveness Varies with Ambient Levels of Summertime Air Pollution. European Respiratory Journal **9**:1146-54

van Vliet, P., M. Knape, J. de Hartog, N. Janssen, H. Harssema, and B. Brunekeef. 1997. Motor Vehicle Exhaust and Chronic Respiratory Symptoms in Children Living Near Freeways. Environmental Research **74**:122-132

Appendix 1: Regression Results

Variable	*Regression coefficient*	*Standard Error*	*95% CI*	*p-value*
Distance to 99	0.00023	0.0007	-0.00127 , 0.00173	0.76
Sex	-0.00052	0.0005	-0.00146 , 0.00042	0.27
African American	-0.00269	0.0007	-0.00399 , -0.00139	0.000
Other	0.00056	0.0008	-0.00105 , 0.00217	0.49
White	-0.00073	0.0005	-0.00178 , 0.00032	0.17
Income	0.00016	0.0005	-0.00082 , 0.00113	0.75
FEV1 test between 9 and 11am	0.00013	0.0006	-0.00098 , 0.00124	0.81
FEV1 test after 4pm	-0.00009	0.0005	-0.00113 , 0.00095	0.87
Household smoker	-0.00060	0.0006	-0.00178 , 0.00058	0.31
Mother smoked during pregnancy	-0.00028	0.0008	-0.00183 , 0.00127	0.72
Time in residence	0.00012	0.0005	-0.00082 , 0.00105	0.80

Table 1: Regression results using proximity to highway 99 only

Variable	*Regression coefficient*	*Standard Error*	*95% CI*	*p-value*
Distance to closest highway	0.00059	0.0008	-0.00098 , 0.00215	0.46
Sex	-0.00046	0.0005	-0.00140 , 0.00049	0.34
African American	-0.00250	0.0028	-0.00380 , 0.00130	0.000
Other	0.00058	0.0008	-0.00102 , 0.00217	0.48
White	-0.00070	0.0005	-0.00175 , 0.00030	0.19
Income	0.00009	0.0005	-0.00090 , 0.00102	0.86
FEV1 test between 9 and 11am	0.00017	0.0005	-0.00093 , 0.00122	0.75
FEV1 test after 4pm	8.36e-06	0.0005	-0.00180 , 0.00054	0.99
Household smoker	-0.00067	0.0006	-0.00186 , 0.00057	0.27
Mother smoked during pregnancy	-0.00019	0.0008	-0.00176 , 0.00137	0.80
Time in residence	0.00008	0.0004	-0.00085 , 0.00101	0.86

Table 2: Regression results using proximity to the closest freeway

Variable	*Regression coefficient*	*Standard Error*	*95% CI*	*p-value*
Within one block of freeway, intersection, or roadway	0.00099	0.0005	-0.00007 , 0.0020	0.06
Between one and three blocks	0.00107	0.0005	0.00 , 0.0022	0.05
More thank four blocks	0.00077	0.0006	-0.0005 , 0.0020	0.3
Sex	-0.00066	0.0004	-0.0016 , 0.00027	0.16
African American	-0.00263	0.0006	-0.00389 , -0.00136	0.000
Other	0.00053	0.0007	-0.00105 , 0.00210	0.51
White	-0.00077	0.0005	-0.00181 , 0.00028	0.15
Income	0.00024	0.0005	-0.00071 , 0.001214	0.63
FEV1 test between 9 and 11am	-0.00010	0.0005	-0.00119 , 0.00099	0.86
FEV1 test after 4pm	-0.00003	0.0005	-0.00186 , 0.00051	0.94
Household smoker	-0.00067	0.0008	-0.00167 , 0.00158	0.26
Mother smoked during pregnancy	-0.00004	0.0008	-0.00166 , 0.00158	0.96
Time in residence	-9.27e-06	0.0008	-0.00093 , 0.00091	0.98

Table 3: Regression results using self-reported distances