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Living Near Heavy Traffic Increases Asthma Severity

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Children and adults who suffer from asthma and live near heavy vehicular traffic are nearly three times more likely to visit the emergency department or be hospitalized for their condition than those who live near low traffic density. For adults with asthma, medium to high traffic exposure increases the likelihood of chronic symptoms by approximately 40% to 80%.

Moreover, living in areas of heavy traffic is a burden borne disproportionately by asthma sufferers who are ethnic/racial minorities or from low-income households. The issue is more pronounced among children than adults with asthma.

Asthma is one of the most common chronic respiratory disorders in the United States. According to the 2001 California Health Interview Survey (CHIS 2001), nearly 400,000 children (12.1% of total) and over 900,000 adults (10.2% of total) in the two largest counties of California—Los Angeles and San Diego—have been diagnosed with asthma at some point in their lives, with many of them suffering from severe asthma. Among children with asthma, approximately 10% suffer from daily or weekly symptoms and 11% have had an asthma-related emergency department (ED) visit or hospitalization in the year prior to the interview. Among adults with asthma, 23% report daily or weekly symptoms and 8% report an asthma-related ED visit or hospitalization.

Airway inflammation is a principal characteristic of asthma and is directly related to asthma severity as a function of acute and chronic airflow obstructions.[1] Air pollution can worsen asthma symptoms by causing inflammatory reactions in the lungs. For instance, ozone, a reactive gas that results primarily from the action of sunlight on hydrocarbons and nitrogen oxides emitted during fuel combustion, can act as a powerful respiratory irritant. In developed countries, traffic exhaust is one of the most important sources of outdoor air pollution. Truck, car, bus and other traffic emissions produce a complex mixture of toxic chemicals (e.g., benzene, particulate matter, and a variety of irritant gases, including nitrogen dioxide, sulfur dioxide, and ozone).[2] Between 1982 and 2001, Vehicle Miles Traveled (VMT) on California roadways increased 97% while the state population increased 40%[3], reflecting a potential increase in exposure to vehicle traffic emissions.

To examine the relationship between traffic-related air pollution and asthma severity, data from respondents of Los Angeles and San Diego County to the 2001 California Health Interview Survey were linked to traffic count data provided by the California

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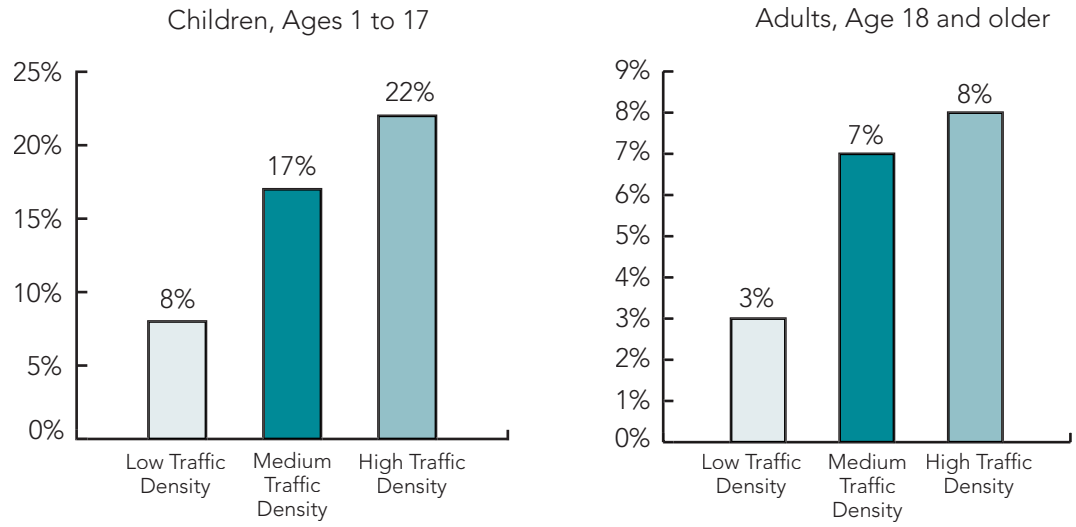
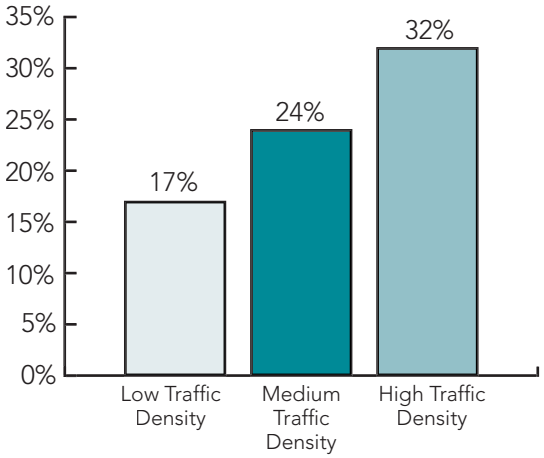
Exhibit 1 **Prevalence of Asthma-related ED Visits or Hospitalizations by Traffic Density**



Sources: 2001 California Health Interview Survey; California Department of Transportation.

Department of Transportation (Caltrans). This policy brief addresses whether individuals with asthma are more likely to experience daily or weekly symptoms, or have ED visits or hospitalizations for asthma, if exposed to high levels of traffic near their homes.

Exhibit 2 **Prevalence of Daily or Weekly Asthma Symptoms by Traffic Density (Adults, Age 18 and Older)**



Sources: 2001 California Health Interview Survey; California Department of Transportation.

Heavy Traffic Near Homes Associated with Increase in Severe Asthma

Traffic density was estimated based on the CHIS 2001 respondents' reported residential street and intersecting cross-street. Daily traffic-count data collected by Caltrans in 2000 along roads within 500 feet of the respondents' residential streets were aggregated to estimate residential traffic-density levels (see Data Sources and Methods for more details). The residential traffic-density values, measured as Vehicle Miles Traveled (VMT) per square mile, of the respondents were categorized into three levels: high traffic (daily VMT/mi^2 200,001), medium traffic (daily VMT/ mi^2 = 20,000-200,000), and low traffic exposure (daily VMT/mi^2 < 20,000). These cut-off points correspond roughly to the 20th percentile of the distribution in the population; i.e., those in the highest exposure group have traffic values in the top 20% of the population while those in the lowest exposure category represent the lowest 20% of traffic density in the population.

Emergency department visits or hospitalizations due to asthma are thought to be largely preventable, as they may reflect inadequate control of asthma through both

appropriate primary care and/or decreases in exposure to environmental triggers. Increasing exposure to traffic is associated with having an asthma-related ED visit or hospitalization in the year prior to the interview. Comparing the highest with the lowest category of traffic levels, both children and adults with asthma in the highest category are almost three times more likely to utilize these services than those in the lowest category (Exhibit 1). This may be due to children with an acute exacerbation, especially the younger ones, more likely to be taken to the ED or hospital by their parents.

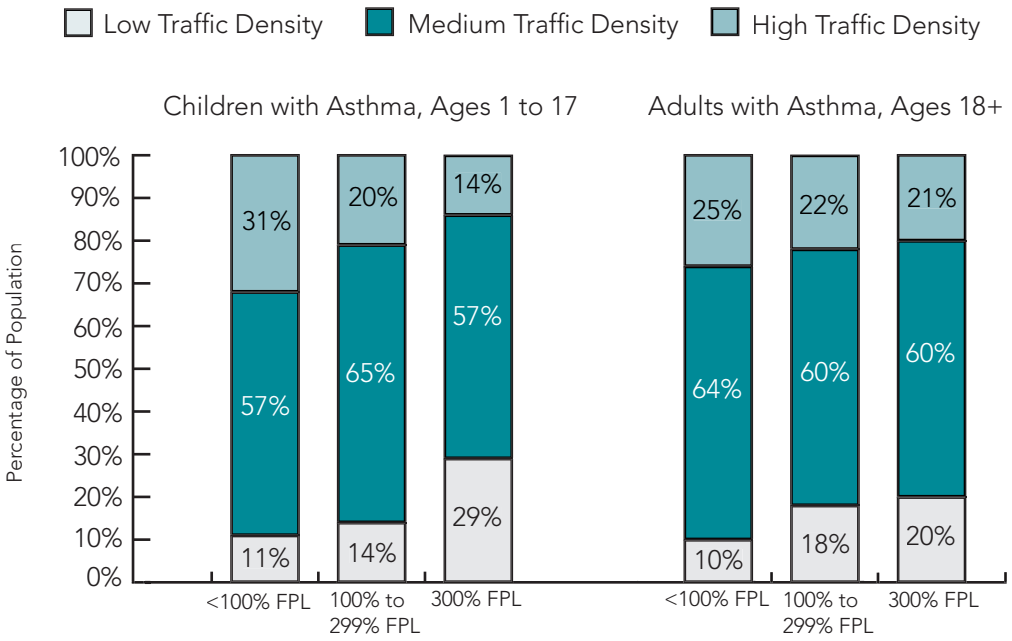
For adults but not children with asthma, the prevalence of daily or weekly symptoms is also associated with increasing exposure to traffic. Medium and high traffic exposure increases the likelihood of chronic symptoms by approximately 40% and 80%, respectively, compared with low traffic exposure (Exhibit 2). These estimates are adjusted for age, gender, race/ethnicity and household poverty level.

Low-Income and Racial/Ethnic Minority Groups Have Higher Prevalence and Exposures

Higher rates of severe asthma disproportionately affect low-income and racial/ethnic minority groups.[4] Individuals with asthma from low-income households (below 100% of the federal poverty level (FPL) are more likely to have daily or weekly symptoms, or an asthma-related ED visit or hospitalization. Likewise, Latinos and African Americans are more likely to utilize emergency services or hospitalizations for asthma, while daily or weekly symptoms are more commonly reported by the White population.

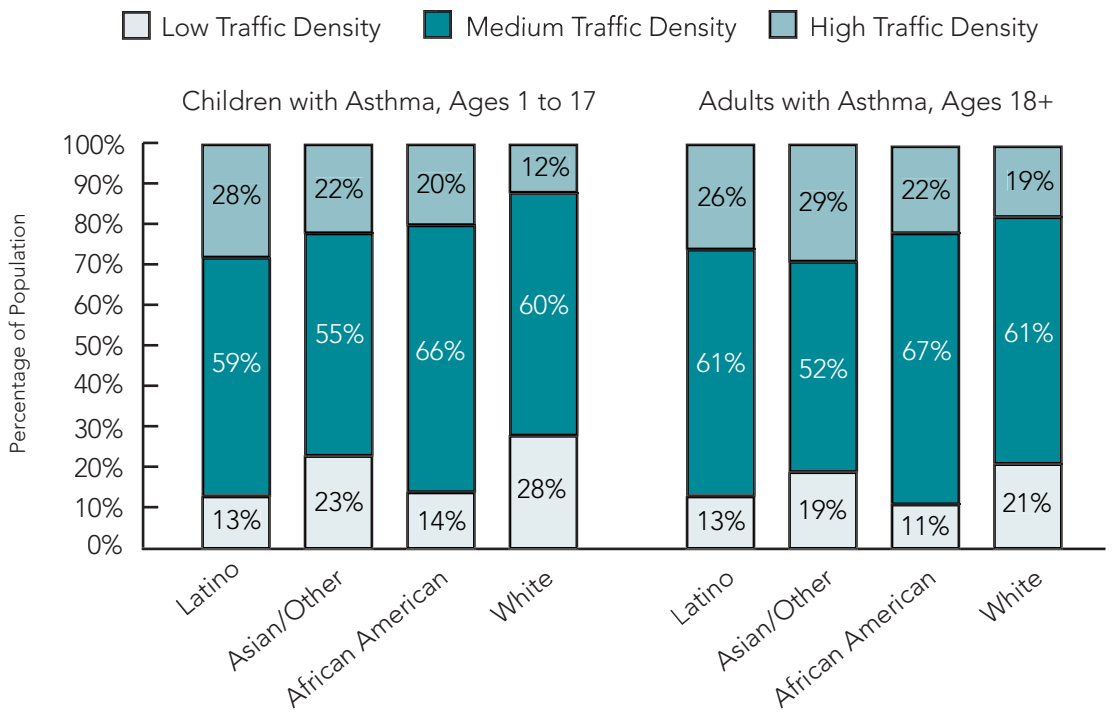
High-traffic levels near homes are more common among people with asthma who are racial/ethnic minorities or from low-income households. This may be due to limited housing choices, with affordable housing more likely to be located near streets with heavy traffic. This disparity is most pronounced among children with asthma, where those living in households below the federal poverty

Traffic Density by Federal Poverty Level Among Persons With Asthma **Exhibit 3**



Sources: 2001 California Health Interview Survey; California Department of Transportation.

Exhibit 4 **Traffic Density by Race/Ethnicity Among Persons With Asthma**



Sources: 2001 California Health Interview Survey; California Department of Transportation.

level are twice as likely to live near high-traffic areas as those from households at or above 300% FPL.[5] Adults with asthma from households below the federal poverty level are 10% more likely to have median- or high-residential traffic levels than those from households at or above 300% FPL (Exhibit 3).

Latino children with asthma are nearly two-and-a-half times more likely than White children to live near heavy traffic, while Asians/Others and African-American children are almost twice as likely. Among adults with asthma, racial/ethnic minorities are also more likely to be exposed to high traffic than Whites (Exhibit 4). The findings are consistent with previous studies.[6]

Policy Recommendations

This study adds to the body of evidence suggesting that further reduction of traffic-related air pollution is needed to reduce the burden of asthma, especially among low-income and racial/ethnic minority groups. While air quality improvements in the last few decades have been impressive, additional emission controls are needed to offset population growth and vehicle miles traveled in California. Currently, levels of ozone and particulate matter air pollution remain unhealthy in many parts of the country. Even in areas that are meeting the National Ambient Air Quality Standards, existing air quality levels may still adversely affect sensitive populations, such as those with asthma.[7] Control of motor vehicle emissions will be an important measure to help reduce the overall burden of asthma, especially in urban areas. Reduction of air pollution requires commitment from the government, industries and communities.

In addition to air pollution control measures, public and private efforts should also be made to reduce exposure to air pollution. New developments of schools, day care centers, houses, offices, or other facilities

such as government-subsidized housing, should consider proximity to busy roadways, especially freeways. The California Legislature passed SB351 in 2003 that prohibits the approval by the governing board of a school district for a school site that is within 500 feet from the edge of a freeway or other busy traffic corridor. Health-care providers should not only make sure that appropriate asthma medications are taken, but also advise their patients and families to be aware of outdoor air pollution effects on asthma. However, it is also important to increase awareness of indoor asthma triggers, such as dust mites, indoor allergens and chemicals; to prohibit smoking indoors; and to discourage children and adults from smoking. All these steps can help create asthmatic-friendly environments and reduce the overall burden of asthma on individuals, families and society.

Data Sources and Methods

The data related to asthma are from the 2001 California Health Interview Survey (CHIS 2001) collected during November 2000 and September 2001. CHIS 2001 is a two-stage, geographically stratified, random-digit-dial telephone survey of California adults, adolescents and children, and was conducted in 55,428 California households. The interviews were conducted in English, Spanish, Chinese (Mandarin and Cantonese dialects), Vietnamese, Korean and Khmer (Cambodian) to obtain information on demographic characteristics, health-related behaviors, health status and conditions, access to health care and insurance coverage.

We developed a traffic-density measure for each CHIS 2001 respondent based on their reported street of residence and nearest cross-street. Using these data, we identified each subject's "probable home street segment" and all roadways within a 500-foot buffer that had an Annual Average Daily Traffic (AADT) value from the Caltrans for the year 2000. Similar to previous studies, the traffic density value for each subject was estimated by first calculating the Vehicle Miles Traveled (VMT) for each road segment with a traffic count within the buffered area; VMT was estimated by multiplying the AADT by the road segment length.[8,9] Traffic Density was then calculated as the sum of the VMT for all road segments in the buffer divided by the area of the buffer. Subjects with no Caltrans-counted streets within their buffers (n = 155 in Los Angeles and San Diego) were included in the low-traffic referent category, as it was assumed these individuals had only small, residential streets near their homes.

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Notes

1 Delfino RJ. Epidemiologic evidence for asthma and exposure to air toxics: linkages between occupational, indoor, and community air pollution research. Environmental Health Perspectives 2002;110 Suppl 4: 573-89.

2 Trasande L, Thurston GD. The role of air pollution in asthma and other pediatric morbidities. The Journal of Allergy and Clinical Immunology 2005;115(4):689-99.

3 CARB. The California Almanac of Emissions and Air Quality. http://www.arb.ca.gov/aqd/almanac/almanac05/almanac05.htm. 2003.

4 Meng YY, Babey SH, Malcolm E, Brown ER, Chawla N. Asthma in California: Findings from the 2001 California Health Interview Survey: UCLA Center for Health Policy Research; 2003.

5 In 2001, the annual income at 100% of the Federal Poverty Level (FPL) was $9,039 for one person, $11,569 for a family of two, $14,128 for a family of three, and $18,104 for a family of four. The incomes at 300%+ FPL were three times these amounts, respectively (e.g. the annual income at 300%+ FPL was $27,117 or more for one person).

6 Gunier RB, Hertz A, Von Behren J, Reynolds P. Traffic density in California: socioeconomic and ethnic differences among potentially exposed children. Journal of Exposure Analysis and Environmental Epidemiology 2003;13(3):240-6.

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9 English P, Neutra R, Scalf R, Sullivan M, Waller L, Zhu L. Examining associations between childhood asthma and traffic flow using a geographic information system. Environmental Health Perspectives 1999;107(9):761-7.

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