

# Particle Pollution and Sudden Infant Death Syndrome in the United States

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# Particle Pollution and Sudden Infant Death Syndrome in the United States

## Summary

A recently published peer-reviewed study (Woodruff et al. 1997) found a statistically significant relationship between particulate air pollution in the United States and postneonatal infant mortality. Postneonatal mortality was defined as infant death that occurred between the age of 28 to 364 days. The study analyzed the relationship between PM10 levels and postneonatal mortality within a population of approximately 4 million infants born in 86 metropolitan areas in the United States between 1989 and 1991 (Woodruff et al. 1997).

Based on the risk factors derived by Woodruff and colleagues (1997), the Environmental Working Group and Physicians for Social Responsibility estimated the number of SIDS cases each year associated with airborne particle pollution (PM10). We estimate that about 500 SIDS cases each year in the United States are associated with airborne particle pollution.

Within the next two weeks, the EPA will finalize new regulations that will cut air pollution levels in half over the next ten years, including the particle air pollution associated with SIDS in the Woodruff study. EPA estimates that these microscopic airborne particles (PM10) penetrate deep into the lungs and cause 35,000 premature deaths in the United States each year. Influential members of Congress have threatened to overturn the new regulations, and polluting industries are waging an all-out fight to block the new health standards.

The relationship between SIDS cases and PM10 was used to predict SIDS mortality in metropolitan areas in the United States. Nearly one out of every five SIDS cases in the top twelve metro areas are associated with particle air pollution (PM10) (Table 1). The greater Los Angeles, New York, and Chicago metropolitan areas lead the nation in SIDS cases linked to airborne particle pollution with an estimated 44, 28 and 27 SIDS cases associated with microscopic airborne particles, so-called PM10, each year.

Airborne particle pollution (PM10) in just ten states is associated with more than 300 of the estimated 500 SIDS cases linked nationwide to PM10 each year. California tops the list with an estimated 93 SIDS cases associ-

**Table 1. Nearly one in every five SIDS cases in major metropolitan areas is associated with airborne particle pollution.**

Metropolitan Area	SIDS deaths 1994	SIDS deaths associated with PM10 1994	Percent of SIDS associated with PM10 1994
Los Angeles-Riverside-Orange County, CA	177	45	25
New York-Northern New Jersey-Long Island	180	29	16
Chicago-Gary-Kenosha, IL-IN-WI CMSA	144	27	19
Philadelphia-Wilmington-Atlantic City, PMSA	99	23	23
Detroit-Ann Arbor-Flint, MI CMSA	85	20	24
Houston-Galveston-Brazoria, TX CMSA	96	17	18
Phoenix-Mesa, AZ MSA	46	12	27
San Francisco-Oakland-San Jose, CA CMSA	100	11	11
Washington-Baltimore, DC-MD-VA-WV CMSA	80	11	14
Atlanta, GA MSA	63	11	17
Dallas-Fort Worth, TX CMSA	82	11	13
Cleveland-Akron, OH CMSA	45	10	22

Source: Environmental Working Group. Derived from Centers for Disease Control's "Wonder" database, and EPA's AIRS database using methods based on Woodruff et al. (1997) as described in the text.

ated with airborne toxic particles, followed by Texas and Illinois, with 37 and 32, respectively.

### SIDS and the Woodruff Study

SIDS is defined as the “sudden death of an infant under one year of age which remains unexplained after a thorough case investigation, including performance of a complete autopsy, examination of the death scene, and review of the clinical history” (Willinger et al. 1991).

While the cause of Sudden Infant Death Syndrome is still unknown, a triple-risk model is often used to describe the confluence of events that may lead to the sudden death of an infant (SIDS Alliance 1997). According to this model, all three elements must come together for SIDS to result.

The first element of the model, the *critical development period*, encompasses rapid growth phases during the infant’s first six months of life which may periodically destabilize the infant’s system. During this developmental period, changes occur in homeostatic controls, such as sleeping and waking, breathing, heart rate, blood pressure and temperature.

The second element, the *vulnerable infant*, represents an infant with an underlying defect or abnormality. In this model, normal babies do not die of SIDS; instead, there are pathophysiological reasons behind these seemingly sudden deaths, such as defects in regions of the brain that control respiration and heart rate during early life. Most vulnerable babies, however, appear perfectly healthy.

The third element involves *exogenous stressors*, outside or environmental challenges which a normal baby can overcome and survive, that an already vulnerable baby might not. Stressors such as second-hand exposure to tobacco smoke, prone sleep position, an upper respiratory infection, or air pollution (PM10) alone do not “cause” death for the infant, but can tip the balance against an infant’s chances of survival (Sidebar).

After controlling for maternal smoking, poverty, age of the mother at birth, temperature, and other potentially confounding factors, Woodruff and coworkers (1997) found a statistically significant relationship between PM10 levels and three categories of infant mortality: overall post-neonatal infant mortality, sudden infant death syndrome (SIDS) and infant respiratory related death. The link was the strongest for normal birth weight babies. Notably, no relationship was found for PM10 levels and infant death from other causes, which in effect provides a control for the study. Peer reviewed studies in the Czech Republic, Taiwan, and Brazil also have found a statistically significant relationship between particulate air pollution and infant mortality (Bobak 1992, Knobel 1995, Penna 1991).

### **The Clinton EPA Proposal**

On June 25, 1997, President Clinton recommended a major improvement in the decade-old health standard for particulate pollution, or microscopic soot, in the air we breathe. Referred to as PM10, this highly hazardous class of air pollutants can include various toxic metals such as lead, copper, nickel, zinc and cadmium, as well as fine aerosols formed from sulfur and nitrogen oxides and organic compounds such as phenols (EPA 1996a, EPA 1996b). According to the EPA’s most recent estimates (that do not include infant mortality) these tiny toxic particles in our air kill tens of thousands of people each year (EPA 1996a, EPA 1997).

The current EPA particulate standard, referred to as the PM10 standard, regulates particles smaller than 10 microns in diameter. A micron is one millionth of a meter, roughly one 70th the width of a human hair.

Current regulations target particles less than 10 microns in diameter because these small particles can penetrate into the deepest regions of the lungs (Bascom et al. 1996). More recent data show, however, that smaller particles, less than 2.5 microns in diameter (PM 2.5), present the greatest risk to human health (EPA 1996c).

The health standard endorsed by the President for extremely small airborne particles (PM 2.5) will cut PM2.5 pollution levels in half. Reductions in PM2.5 will produce parallel reductions in PM10. The EPA estimates that the new health standard in combination with ongoing efforts

## **Recommendations for Reducing the Risks for SIDS Steps Parents Can Take**

**Place your baby on its back to sleep.** The American Academy of Pediatrics recommends that healthy infants sleep on their backs or sides to reduce the risk for SIDS. This is considered to be most important during the first six months of age, when baby's risk of SIDS is greatest.

**Stop smoking around the baby.** Sudden Infant Death Syndrome is long associated with women who smoke during pregnancy. A new study at Duke University warns against use of nicotine patches during pregnancy as well. Findings from the National Center for Health Statistics now demonstrate that women who quit smoking during pregnancy, but resume after delivery, put their babies at risk for SIDS, too.

**Use firm bedding materials.** The U.S. Consumer Product Safety Commission has issued a series of advisories for parents regarding hazards posed to infants sleeping on top of bean-bag cushions, sheepskins, sofa cushions, adult pillows, and fluffy comforters. Waterbeds have also been identified as unsafe sleep surfaces for infants. Parents are advised to use a firm, flat mattress in a safety-approved crib for their baby's sleep.

**Avoid overheating, especially when your baby is ill.** SIDS is associated with the presence of colds and infections, although colds are not more common among babies who die of SIDS than babies in general. Now, research findings indicate that overheating— too much clothing, too heavy bedding, and too warm a room— may greatly increase the risk of SIDS for a baby who is ill.

**If possible, breastfeed your baby.** Studies by the National Institute of Health show that babies who died of SIDS were less likely to be breastfed. In fact, a more recent study at the University of California, San Diego found breast milk to be protective against SIDS among non-smokers but not among smokers. Parents should be advised to provide nicotine-free breast milk, if breastfeeding, and to stop smoking around your baby particularly while breastfeeding.

**Take good care of yourself and your baby.** Maintaining good prenatal care and constant communication with your health care professional about changes in your baby's behavior and health are of the utmost importance.

Excerpted from "What Every Parent Should Know: Facts about Sudden Infant Death Syndrome and Reducing the Risk for SIDS" The SIDS Alliance, 1314 Bedford Avenue, Suite 210, Baltimore, MD 21208. 410-653-8226, 800-221-SIDS, fax 410-653-8709

to reduce particulate forming emissions from electric power plants will save 35,000 lives each year (EPA 1996a, EPA 1997). These estimates do not include infant mortality that is associated with airborne PM10.

## Methodology

Infant mortality resulting from airborne particulate pollution (PM10) was estimated for counties, metropolitan statistical areas (MSAs), and the nation using the relationship developed by Woodruff and colleagues (1997). The estimates were restricted to geographic regions where both PM10 and SIDS data were available. This included 747 counties located within 205 MSAs, and 166 additional counties that were not in MSAs. MSA analyses were based on the average 1994 PM levels from all monitors within the MSA applied to total 1994 SIDS mortality data for the respective MSA (EPA AIRS 1994, CDC Wonder 1994).

Airborne PM10 levels for all monitors in the United States were acquired from EPA's Aerometric Information Retrieval System (AIRS) Database. Infant mortality statistics were acquired from the Centers for Disease Control through the use of the "CDC Wonder" database. SIDS occurrences between 28 days and 364 days were used (ICD-9 = 798.0).

We derived odds ratios for each county based on the results presented by Woodruff and coworkers (1997). The relative risk (RR) for infant mortality in an MSA or county is defined by a risk factor as follows:

$$RR = \text{EXP} [( \text{mean PM10 level} - \text{base case PM10 level} ) (\beta)]$$

Where:

RR= Relative risk

Base Case PM10 level = 11.9 (cleanest city in study)

$\beta$ = Regression coefficient:

$$\beta = \frac{\ln(\text{odds ratio for SIDS})}{(10\mu\text{g PM10})}$$

and:

odds ratio = for SIDS as 1.12 (Woodruff et al. 1997)

This model predicts the odds ratio for SIDS associated with variable levels of particulate pollution based on Woodruff et al. (1997). Mortality associated with particulate matter is determined by applying the relative risk factor to the total infant mortality or SIDS mortality as follows (Rothman 1986):

$$\text{SIDS cases associated with PM} = (\text{Total SIDS cases}) [(\text{RR}-1)/\text{RR}]$$

## Why These Estimates are Conservative

Our estimate of SIDS mortality associated with PM10 is an underestimate based on two factors:

- About 20 percent of all counties in the United States were excluded from the analysis because they lacked PM 10 data. Some 768 SIDS cases were reported in these counties. None of these SIDS cases were associated with PM10 although it is probable that some of these cases were linked to particle air pollution.
- We assume no PM-related death occurs below pollution level of  $11.9\mu\text{g}/\text{m}^3$ . This assumption is an artifact of the Woodruff study, where the cleanest city monitored had PM10 levels of  $11.9\mu\text{g}/\text{m}^3$ , but it is likely that some SIDS cases associated with PM10 occur at lower pollution levels.

## Results

Based on the methods described, about 500 of the 3800 SIDS cases in 1994 are associated with PM10 air pollution in the United States. This estimate does not include any air pollution related SIDS cases in counties that are not in an MSA and that have no pollution monitors. We assume, based on the cleanest MSA in the Woodruff study, that no particulate pollution related infant deaths occur at PM10 levels below  $11.9\mu\text{g}/\text{m}^3$ .

The relationship between SIDS cases and PM10 was used to predict SIDS mortality in metropolitan areas in the United States. Nearly 20 percent of all SIDS cases each year in the top twelve most polluted metro areas in the United States are associated with PM10 air pollution (Table 1). In the Los Angeles, New York, Chicago, Philadelphia, and Detroit greater metropolitan areas, from 20 to 44 SIDS cases annually, in each metro area are associated with airborne PM10.

Air pollution in just ten states accounts for more than 300 of the estimated 500 SIDS cases linked nationwide to PM10 each year. California tops the list with an estimated 93 SIDS cases associated with airborne toxic particles, followed by Texas and Illinois, with 37 and 32 respectively.

## Industry Misinformation Campaign

Major polluters, under the guise of their principal front group, Citizens For a Sound Economy (CSE), have orchestrated a multi-million dollar public relations campaign to discredit the EPA's efforts and stop any potential improvements in air quality standards.

Critics of the EPA proposal have raised a series of misleading criticisms about the Woodruff study. We address some of them here to clarify any misunderstandings that may arise from these statements.

**Polluter criticism #1:** Infants spend most of their time indoors so outdoor air pollution levels would not affect infant health.

**Response:** The level of particulates in indoor air, particularly in homes, is largely a function of outdoor air pollution levels (EPA 1996a). A major study by the California Air Resources Board confirmed that on average, indoor levels of diesel particulates in California were two thirds the outdoor levels (CARB 1997).

Further, if outdoor air quality were not relevant to indoor air quality then there is almost no chance that outdoor air pollution would correlate so strongly to infant death and SIDS. Woodruff et al. employed a control where mortality from other causes was compared to PM10 levels. No association was found. This significantly strengthens the conclusion that polluted outdoor air is linked to some percentage of SIDS cases. In addition, the study is consistent with others like it that demonstrate an association between infant mortality, adult mortality, and PM10.

**Polluter criticism #2:** The increased risk reported by Woodruff et al. is not significant.

**Response:** Using formal statistical techniques, the authors demonstrated *statistical significance*. With a study population of 4 million infants, an increased risk of 25 percent is statistically very strong. Further, the study authors controlled for maternal smoking, level of education, age of mother at birth, and other important potentially confounding factors. Most Americans would agree that such a loss of life is tragic; especially when it is avoidable.

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