

people in the area — “a small but significant percentage,” say the researchers, who describe their findings in the April *AMERICAN JOURNAL OF ORTHOPSYCHIATRY*.

The investigators conducted follow-up interviews with 46 abuse victims and a comparison group of 251 nonabused elderly.

Pillemer and Finkelhor defined maltreatment as one or more of the following: at least one act of physical violence toward the victim (ranging from throwing something at them to assault with a gun or knife) since they turned 65; withholding help important to daily life 10 or more times in the preceding year; and verbal aggression, including insults and threats, 10 or more times in the preceding year.

Spouses were responsible for 26 of the 46 abuse cases, the researchers note. Abuse victims were almost evenly split between men and women. Victims were no more disabled or dependent on their abusers than were comparison subjects on their relatives.

However, abusers were much more likely than relatives in the comparison group to have been arrested, hospitalized for a psychiatric disorder, involved in violent behavior outside the family or limited by a physical problem. In addition to relying on their victims for money, transportation and housing, abusers were more likely to have suffered a physical illness or the death of a relative in the previous year.

The high level of abusers' dependence on victims, seen most clearly in adult children who abused their parents, suggests the victims were also exploited for money and other possessions, the researchers say.

Their findings are consistent with a trend among family-violence researchers to deemphasize the characteristics of victims — whether children, women or the elderly — and concentrate on the psychological problems of abusers.

Revelations about elder abuse have important implications for treatment programs, the investigators maintain. Such programs generally aim to reduce caregiver stress by providing in-home assistance in the care of elderly persons and offering support groups.

But many abusers need psychological counseling, Pillemer and Finkelhor assert. Those who are dependent on their victims may also need help in finding employment and separate housing. Greater police involvement and legal assistance to victims would deter exploitation by abusers, they say. Furthermore, emergency shelters for elder abuse victims, similar to those provided to younger battered women, would provide temporary refuge from abusive situations.

“The view that the elderly cause their own abuse by becoming frail and dependent should be discarded,” the researchers conclude.

— B. Bower

Smallest aerosol pollutants linked to disease

In August 1986, labor disputes shut down the Geneva steel plant west of Orem, Utah. Thirteen months later, the mill resumed operations under a new owner. It also resumed belching huge quantities of particulates — dust-sized aerosol pollutants — from its coking ovens and open-hearth furnaces. Almost at once, people living nearby began commenting on a decline in air quality — and in the health of their children.

Now, a researcher at Brigham Young University in Provo, Utah, has confirmed that respiratory health among area residents improved during the plant's shutdown. And for the first time, his study links a region's increased levels of the smallest particulates — 10 microns and smaller — with increased rates of children's hospitalization for bronchitis, asthma, pneumonia and pleurisy.

The Environmental Protection Agency made aerosols 10 microns and smaller (PM_{10}) its new gauge of hazardous air particulates in July 1987. Previously, the agency measured and set limits only on “total suspended particulates” — the total dust wafting in air.

The State of Utah, however, had begun continuous PM_{10} monitoring in the Orem area two years earlier. So by mid-1988, Brigham Young environmental economist C. Arden Pope III had roughly three years' worth of data to analyze, including more than a year's data preceding Geneva's shutdown. That's important, he notes in the May *AMERICAN JOURNAL OF PUBLIC HEALTH*, because the steel mill emits approximately 82 percent of the area's industrial PM_{10} emissions when it's operating. Even after accounting for other, largely seasonal sources, such as household wood stoves, Pope found that Geneva's emissions represent 47 to 80 percent of the area's PM_{10} total.

His analysis shows that PM_{10} levels in the area climb in the fall and peak in the winter. While mean PM_{10} concentrations in the fall of 1985 were 35 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) of air — just 13 percent higher than a year later, when the steel mill was shut down — fall hospitalizations for Utah County children with bronchitis and asthma were more than twice as high in 1985 as they were in the fall of 1986. In fall 1987, after the plant reopened, hospitalization of children with bronchitis and asthma exceeded even the 1985 level. Adult hospitalizations for these diseases showed no similar increase that fall.

In the winter of 1985-86, mean PM_{10} levels were $90 \mu\text{g}/\text{m}^3$ — 75 percent higher than the next winter's mean. Hospitalizations of children with bronchitis and asthma in the 1985-86 winter season were more than three times as numerous and admissions for pneumonia and pleurisy almost 2.5 times as numerous as in the

following winter, when the mill was closed. Winter increases also showed up in adult hospitalizations for bronchitis and asthma. Pope says PM_{10} levels can explain 30 percent of the variability between years in the adult hospitalizations.

Pope acknowledges that in a study like this — identifying correlations only — “there's no way to establish absolute cause and effect.” However, he told *SCIENCE NEWS*, “this study does find some very damning correlations.”

Pope's analysis is “a landmark study,” says Douglas W. Dockery of the Harvard School of Public Health in Boston. In epidemiology, he explains, “you look for unique situations where there is a natural experiment going on.” Geneva's shutdown provided such an experiment, he says, enabling Pope to identify a strong relationship between small particulates and respiratory disease.

Dockery recently found a similar association in his study of 5,422 children aged 10 to 12 from six U.S. cities: Portage, Wis.; Watertown, Mass.; Topeka, Kan.; St. Louis, Mo.; Kingston, Tenn.; and Steubenville, Ohio. Of the seven measures of air pollution he analyzed — including total suspended particulates, ozone, nitrogen oxides and sulfur dioxide — only particulates 15 microns and smaller (PM_{15}) served as a strong predictor of respiratory disease.

Dockery's study shows that children living in the “dirtiest” city — steel town Steubenville, with an average annual PM_{15} level of $58.8 \mu\text{g}/\text{m}^3$ — run more than double the bronchitis risk of children in the “cleanest” city, Portage, with its average annual PM_{15} level of $20.1 \mu\text{g}/\text{m}^3$. Children with asthma and persistent wheezing represented the majority of the excess bronchitis cases in the more polluted communities, Dockery and his colleagues report in the *MARCH AMERICAN REVIEW OF RESPIRATORY DISEASE*.

The Brigham Young and Harvard studies are the first to focus on the smallest particulates and to confirm what researchers have long suspected — that these aerosols are the most important in terms of respiratory-disease risk. Pope focused on acute effects of exposure, while Dockery's group focused on long-term effects.

Both analyses yield evidence that EPA's current PM_{10} standard is not sufficient to protect children's health. For instance, even though Orem-area PM_{10} levels never exceeded EPA's 24-hour standard of $150 \mu\text{g}/\text{m}^3$ in fall months, twice as many local children were hospitalized for bronchitis and asthma in years when the plant was operating compared with the year when it wasn't. Similarly, Dockery found “health effects occurring at levels below the current annual average PM_{10} standard” of $50 \mu\text{g}/\text{m}^3$.

— J. Raloff