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# MISCLASSIFIED SMOKING STATUS AND LUNG CANCER IN NON-SMOKERS FROM ENVIRONMENTAL TOBACCO SMOKE

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The lung cancer risk estimates for exposure to environmental tobacco smoke remain controversial. The major unresolved issue is the extent of misclassification of smokers as non-smokers and of the bias thereby introduced. We studied misclassification rates in two large cohorts using information on smoking habits obtained several years apart.

**Methods:** Cohort I included Swedish twins born 1886-1925 who answered questionnaires in 1961 and in 1967 (1970). Cohort II was a random stratified population sample of subjects born 1894-1945 who responded to postal surveys of smoking habits in 1963 and 1969. Subjects reporting on the second occasion that they never had smoked despite having reported current or former smoking on the first occasion were considered misclassified. The lung cancer mortality in never smokers, misclassified smokers, former smokers and smokers was followed through 1987 for cohort I.

**Results:** In the twin cohort 5.0% of male and 4.5% of female ever smokers reported in the second questionnaire that they had never smoked. They constituted 11.1% and 1.4% of reported non-smokers in men and women respectively. Cohort II yielded very similar results. Smoking habits were more moderate among the misclassified than among other smokers and they were largely former smokers. The relative risk for lung cancer in the misclassified men was 2.4 (C.I. 0.5-11.3), compared to 4.3 (C.I. 2.0-9.6) in former smokers. No deaths occurred among misclassified women.

**Conclusion:** Our findings on smoking misclassification rates in two large Swedish cohorts concur with results of other investigators. Though misclassification of smokers as non-smokers exists, our results indicate that it does not chiefly concern current or heavy smokers, nor is it sizeable enough to explain the lung cancer risk related to ETS exposure.

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# THE EFFECTS OF AIR POLLUTION ON THE SEVERITY OF HAYFEVER SYMPTOMS IN A RURAL POPULATION IN THE UK.

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A three year study on the effects of ambient air pollution on the severity of hayfever symptoms in London concluded that symptoms were worse on days of high O<sub>3</sub> concentration. However O<sub>3</sub> concentrations are generally lower in London than in many rural areas of southern Britain.

Therefore the study was repeated in the summer of 1993 at a rural location 90 km west of London. A panel of both hayfever sufferers and controls, recorded the severity of a number of symptoms on a daily basis during the hayfever season. All volunteers were employees at a government laboratory for which pollution, pollen, and meteorological monitoring data was available.

The control population did not suffer from symptoms that could be explained by either pollen or pollution variables. The regression model based on pollen levels explained a significant proportion of temporal variation in symptom severity in the hayfever group. Effects of pollutants in modifying the relationship between pollen and symptom severity will be considered in context of previous urban studies.

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# ESTIMATION OF LONG-TERM OZONE EXPOSURES

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While there is a great deal of interest in determining the human health effects of long-term ozone exposures, epidemiologic studies addressing this issue are hampered by the lack of reliable methods for estimating prior lifetime air pollution exposures of study subjects. We are developing methods for using the US nationwide air pollution monitoring network (more than 500 monitoring stations) for this purpose. We have obtained these data in digital form from the "AIRS" system maintained by the U.S. Environmental Protection Agency. Using hourly ozone data as inputs, we computed the following daily summary statistics: the daily 1-hour maximum; the daily 8-hour maximum; the averages from 10 am to 6 pm and from 10 am to 10 pm; and the sum of hourly concentrations above 60 ppb. These summaries were then averaged (or summed), where appropriate within months and compared. We found that all these summaries except the sum of hourly concentrations above 60 ppb were highly correlated with each other. These monthly summaries were also used as input to a spatial interpolation model (kriging), which enabled generation of point estimates and associated standard errors at locations not directly monitored. The reliability of the model prediction was evaluated by comparing long-term average model prediction to actual concentrations at selected sites. This study represents the first attempt to comprehensively analyze and depict spatial patterns of ozone concentrations across the U.S. for use as input to epidemiology studies and provides valuable information on the utility of existing fixed-site monitoring data for long-term exposure estimation.

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# ACUTE EFFECTS OF SUMMERTIME HAZE ON PEAK FLOW IN EXERCISING ADULTS

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Previous studies of exercising subjects have shown acute lung function effects of photochemical oxidant pollution. A recent health study conducted at Governors Island, NY measured peak flow (PEFR) and respiratory symptoms before and after jogging in the presence of summer haze air pollution. Governors Island is located in the New York harbor and serves as a U.S. Coast Guard facility. Twenty-one volunteers (18 male; 3 female) were recruited from personnel who lived and/or worked on the island. Subjects ran an average of 3 times per week for approximately 13 weeks from 6/7/92 to 9/6/92. Each jogger typically performed a run between 1 and 3 miles long and was allowed to choose his/her own exercise level while attempting to maintain a similar heart rate across all runs. Before and after each run, subjects performed three blows into a mini-Wright peak flow meter and recorded these data, along with any symptoms, on a weekly log sheet. For validation, force expiratory maneuvers were carried out before and after runs on two separate days for each subject during the summer. Air pollution concentrations were measured on-site using a specially equipped van on loan from U.S. E.P.A. The pollutants measured included 1/2 hour average ozone (O<sub>3</sub>), nitrogen dioxide (NO<sub>2</sub>), and sulfur dioxide (SO<sub>2</sub>), and 24-hour average acid aerosol (H<sup>+</sup>), and fine sulfate (SO<sub>4</sub>) mass. Data were analyzed by regressing daily changes in PEFR on O<sub>3</sub> and H<sup>+</sup> concentrations for each subject individually and for all subjects combined. We also examined the relationship between baseline PEFR (i.e., PEFR measured before each run) on same-day and previous-days pollution. A comparison of these results with those of past studies will be reported.

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# A CROSS-SECTIONAL ANALYSIS OF THE EFFECTS OF PM10 ON 1990 U.S. MORTALITY

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Recent time-series analyses have indicated that there is an association between particulate matter less than 10 µm in aerodynamic diameter (PM10) and increased human mortality. An alternative method to assess the relationship between particulate air pollution and health is to analyze the differences in the annual mortality rates and the corresponding pollution levels across metropolitan areas. Past such cross-sectional mortality studies have produced correlations between air pollution and mortality ranging from non-significant to extremely significant. One of the most consistently significant relationships across all studies has been that between sulfate (SO<sub>4</sub>) air pollution and total mortality. In the most recent of these (for 1980), Ozkaynak and Thurston (1987) reported that the strongest particulate matter associations were found with measures of the fine mass and sulfates, but not with total suspended particulate matter (TSP). Cross-sectional analyses methods have not yet been applied to assess the human mortality effects of PM10.

During the 1980's, the data for particulate matter available for application to such cross-sectional studies have been greatly improved, with the advent of the routine measurement of PM10 throughout the U.S. In this study, we have developed and analyzed an extensive database of the 1990 U.S. vital statistics and ambient air pollution data for 117 metropolitan statistical areas. Multiple regression techniques were used to test for and examine relationships between 1990 particle pollution levels and total mortality rates in the United States. Other pollutant predictors considered in this analysis were SO<sub>4</sub>, SO<sub>2</sub>, NO<sub>2</sub>, O<sub>3</sub> and TSP. Additionally, population and socio-economic variables such as mean age, population density, and percentage of the population: over 65, with 4 or more years of college, living below poverty level and that is non-white, were also included in the regression model. Comparisons are made between recent U.S. time series results for PM10 and the cross-sectional PM10 results from this work, and conclusions are drawn regarding the mortality effects of PM10 in the U.S.

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# WORLDWIDE DIFFERENCES IN AIR POLLUTION

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A review has been completed to determine which countries contribute most to the release of pollutants into the atmosphere and to identify countries where the relative burden of air pollution is greatest. To identify such countries, data on emissions and on current levels of pollutants were compared for both developed and developing countries.

Despite stricter environmental control than in other parts of the world, Europe is the largest contributor to the release of SO<sub>2</sub> and NO<sub>x</sub> into the atmosphere (43.8% and 36.7% of global emissions in 1979). However, during the 1970's Asia and South America have had the biggest increase in such emissions (52.9% and 41.4% respectively for SO<sub>2</sub>).

The predominant trend in urban levels worldwide was downward in the period from 1973 to 1980. However, 29.6% of monitored cities had annual averages of SO<sub>2</sub> above WHO guidelines between 1980-84. Highest levels were found in China, Iran, Korea and Mexico. For particulate matter, roughly 60% of monitored cities had annual averages above guidelines. Highest levels were found in China, India and most cities of Latin America. Insufficient comparative data exists for NO<sub>x</sub>, but data suggests a slightly increasing trend in most cities.

Reasons for differences amongst regions include topography, demography, meteorology, the level and rate of industrialization and socio-economic development. Attention should be focused on developing countries where air pollution levels have deteriorated. These countries, have experienced not only the greatest increase in urbanization (110% against only 6.9% for more developed countries) but also the greatest increase in number of vehicles (138% for S. America and 64% for Europe during 1970's).

This rapid and disorganized growth in less developed countries (frequently combined with an absence of environmental policies, results in huge populations exposed to the hazardous effects of air pollution. However, to date, unlike developed countries, few studies on environmental pollution and respiratory diseases have been undertaken in these countries.