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APPENDIX AVAILABLE ON REQUEST

Special Report

Reanalysis of the Harvard Six Cities Study and the American Cancer Society Study of Particulate Air Pollution and Mortality

Part II: Sensitivity Analyses

Appendix B. Occupational Exposures

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UNIVERSITY OF OTTAWA

Faculty of Medicine **Faculty of Health Sciences**

Re-analysis of the Harvard Six-Cities Study and the American Cancer Society Study of Air Pollution and Mortality, Phase II: Sensitivity Analysis

Appendix A, B, C, D, E, F, G, H, and I

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OCCUPATIONAL CONFOUNDING

There are various classes of potential confounders in epidemiological studies of chronic disease. Age and sex are basic biologic-demographic covariates that must always be taken into account. Macrolevel sociodemographic covariates of interest include: ethnicity, race, social class, and area of residence. Social class is a complex multidimensional construct, often operationalized by such components as educational attainment, income, or occupation. Another set of potential confounders consists of microlevel covariates representing specific exposures and personal habits, the most important of which is cigarette smoking, but also includes dietary consumption of specific foods or nutrients, physical activity, occupational exposures and others. Occupational exposure in this context differs from the use of occupation as an indicator of social class.

The relevance of collecting information and controlling for confounding depends on the nature of the disease and exposure factors under study, and on the feasibility of collecting information on relevant exposures. In the two studies on air pollution and mortality of present interest, geographic variables were not considered as confounders by the Original Investigators, although this possibility is explored in our reanalysis. Race was not an important issue because very few subjects were non-white. Information on ethnic origin was not collected by the Original Investigators. In both studies, educational attainment was obtained from study subjects and was used in some analyses as a potential confounder and in others as a potential effect modifier. Other indicators of social class have been obtained at an ecologic level and will be evaluated as potential confounders.

Occupational exposure is an important potential confounder in these studies because it is plausible that individuals who live in areas of high pollution tend to work in more polluted workplaces than subjects who live in clean areas. It is plausible that subjects who work in polluted workplaces suffer higher risks of some fatal chronic diseases than subjects who work in clean workplaces. Indeed, there is substantial evidence that occupational exposures cause a number of potentially fatal diseases. For the present studies, the primary focus of concern is on three categories of "cause of death" and we will limit our discussion to these three: lung cancer, nonmalignant respiratory disease and cardiovascular disease. We also consider death from any cause, as did the Original Investigators.

There are a number of occupational exposures which, under certain conditions, increase the risk of lung cancer (Siemiatycki 1991; Coultas 1994; Boffetta et al 1995; Blot and Fraumeni 1996). Some of the main occupational exposures and circumstances that are recognized as being risk factors for lung cancer are: arsenic (among smelter workers, and arsenical pesticide manufacturers and applicators); asbestos (among insulators and textile workers, asbestos product manufacturers, some construction workers, and asbestos miners); chloromethyl ethers; chromium (in chromate production and chromate pigment use); coke carbonization emissions (among coke oven workers and gas retort workers); nickel (among nickel production workers); and sulfuric acid mist. Further, in the following occupations and industries, excess risks of lung cancer have been demonstrated, but the responsible agents have not been pinpointed with any certainty: aluminum refining (possibly PAHs); foundry workers (possibly PAHs); painters; printers (possibly oil mists); and truck drivers (possibly diesel particulates). Finally, there are several other occupational circumstances which are suspected of being risk factors for lung cancer. As a rule, the occupations in which excess risk of lung cancer has been found are occupations with perceptible amounts of respirable dusts and fumes in the working environment. These are generally "blue-collar" jobs.

Nonmalignant respiratory diseases have also been linked to some occupational risk factors (Saric 1992; Oxman et al 1993; Christiani and Wegman 1995; Sullivan et al 1995; Schwartz and Peterson 1998). Examples include: asthma among grain-dust workers, polyurethane industry workers, and animal handlers; hypersensitivity pneumonitis among agricultural workers; fibrosis among miners; chronic bronchitis among workers exposed to various organic and inorganic dusts; chronic obstructive pulmonary disease among painters and miners; and granulomatous disease in workers exposed to beryllium-containing metal alloys. Less is known about occupational causes of nonmalignant respiratory disease than about lung cancer; like lung cancer, however, it is thought that respirable dusts and fumes might also contribute to nonmalignant pulmonary outcomes.

Cardiovascular disease (CVD) has not been clearly shown to be related to chemical exposures in the workplace, although there is some evidence in this regard (Thériault 1995; Steenland 1996; Sjögren 1997). There is limited evidence that carbon monoxide and carbon disulfide exposure might be risk factors for CVD. The proportion of CVD that is plausibly linked to chemical or physical agents in the workplace is much less than the corresponding proportions for lung cancer and respiratory disease. On the other hand, there is some evidence that some psychosocial characteristics of work may be risk factors for CVD. There have been suggestions (Karasek et al 1981) that workers with limited control of their working conditions and high demands on the part of their superiors are subject to levels of stress which place them at risk. If these are high-risk jobs for CVD, they are not clearly linked to the degree of pollution in the job environment.

Ideally, it would have been desirable for each study to have data on potential occupational confounders for each of the three major causes of death evaluated. Unfortunately, this was not possible for two reasons. First, although our knowledge of occupational risk factors is quite advanced for lung cancer, it is less so for nonmalignant respiratory disease, and much less so for CVD. Second, the data collected in the two studies regarding occupation were quite limited. The Six Cities Study included a history of jobs held from time of leaving school until the beginning of follow-up, as well as for the 3- and 6-year follow-ups. The only information which we have in coded form, however, is the occupation and industry information from the baseline interview at the time of enrollment. The occupational and industrial titles provided by respondents were coded to the 1970 US Census Occupational and the Industrial Classification Systems respectively. In the ACS Study, questions were asked at the baseline interview regarding current or last occupation and the occupation of longest duration. An ad hoc system to code occupations only (ignoring industries) was developed by the ACS investigators. Although the Six Cities Study coding system had 442 occupational categories, the ACS Study coding system had only 68. The ACS coding system was thus much less specific than that used in the Six Cities Study. Nevertheless, the Original Investigators in the ACS Study made an attempt to retain distinct categories for occupations thought to be at risk of cancer, most of which were blue-collar occupations.

In addition, respondents in both studies were asked whether they were exposed to certain substances. In the Six Cities Study, respondents were asked about exposure to unspecified dusts, fumes and gases. In the ACS Study, there was a list of six substances (ie, asbestos, diesel engine exhaust, coal or stone dusts, tar, formaldehyde and chemicals/acids/solvents) for which self-reported exposures were ascertained. The original analyses in both studies included the self-reports of dusts and fumes in the covariate sets; specifically, they used simple dichotomous variables for exposure (or not) to any of the substances reported. Recent research has shown, however, that self-reports of occupational exposure in community-based studies are of uncertain validity (Bond et al 1988; Ahlborg 1990; Fritschi et al 1996; Calvert et al 1997; McGuire et al 1998). This is in contrast with self-reports of job titles which appear to be quite accurate (Baumgarten et al 1983; Bond et al 1988; Bourbonnais et al 1988; Rona and Mosbech 1989). The Original Investigators also used the coded occupations to create a simple white-collar/blue-collar variable.

It was not clear to the Reanalysis Team that the self-reports of dusts and fumes and the simple white-collar/blue-collar variable provided effective control for occupational confounding. The Reanalysis Team believed it would be possible to provide greater control of occupational confounding by examining the available information on occupation and industry in more detail.

INDICES OF OCCUPATIONAL EXPOSURE

We developed a strategy that elucidates the potential for confounding of the air pollution-mortality relations reported by the Original Investigators. For this purpose, we distinguished lung cancer from the other causes of death because so much more is known about potential confounders for that disease than about the others, and because both studies explicitly presented results for lung cancer. We set out to earmark those study subjects whose occupations could be considered one which is known or suspected to be at risk of lung cancer, and to develop an indicator variable to that effect. Further, in addition to identifying specific high-risk jobs, we created a variable that we refer to as a "dirtiness" index that describes the degree of dusts, gases and fumes in subjects' jobs. Conceptually, this is somewhat like categorizing subjects as white- or blue-collar workers, but with greater validity and precision than was provided either by the self-reports of study subjects regarding exposure to dusts and fumes, or by the Original Investigators' translation of job codes into a blue-collar/white-collar index. The creation of these new exposure indices was carried out by a research team that has had extensive and long-standing experience in assessing occupational exposure in the context of community-based studies (Gérin et al 1985; Siemiatycki et al 1991).

These two new variables—a binary indicator of exposure to occupations at risk of lung cancer and a semiquantitative index of job dirtiness— allowed us to carry out a number of informative sensitivity analyses. First of all, the inclusion of these two indices allowed us to control for possible confounding of the air pollution-lung cancer association more effectively than was done in the original analyses, and elucidate whether the observed relations with lung cancer may have been due to uncontrolled confounding by occupational exposures. These results will also be indirectly informative about the possible confounding of the associations with nonmalignant respiratory disease and CVD. On the prima facie hypothesis that there is likely to be stronger confounding by occupational exposures for lung cancer than for the other diseases, the degree of confounding bias for lung cancer can be assumed to represent an upper limit of that for the other causes.

Second, by including the dirtiness index in our analyses of nonmalignant respiratory disease and CVD, it is possible to control for that component of occupational hazards which is correlated with the degree of non-specific workplace pollution. It is legitimate to question whether such an index is closer to an index of occupational exposure, or to an indicator of social class. This index can also be conceptualized as a variable which englobes and integrates all occupational exposures in the workplace, and which may include pollutants that are pathogenic. But it can also be conceptualized as one which captures an aspect of social class that is correlated with, but distinct from, educational attainment (the other social class variable used by the Original Investigators). Thus the dirtiness index includes attributes of both occupation and social class.

DEVELOPMENT OF OCCUPATION/EXPOSURE INDICES

Attribution of the Dirtiness Index

The dirtiness index was developed for use in a large case-control study of occupational cancer in Montreal (Siemiatycki et al 1987a). This index was developed primarily to facilitate control for confounding by unmeasured occupational exposures, the same purpose for which it is used in the present application. The index has been used for this purpose in specific analyses (Siemiatycki et al 1987b; Siemiatycki et al 1988a), and it has been used in a methodological investigation of the correlation between degree of occupational exposure and smoking habits (Siemiatycki et al 1988b).

A team of occupational hygienists and chemists who had been working for a decade on assessing specific exposures of workers developed a correspondence system for estimating the amount of dusts, gases and fumes that might be present in each four-digit job category in the 1971 Canadian Dictionary of Occupational Titles (Manpower & Immigration 1971). Each job code was scored from 0 to 6 (very clean to very dirty). The score made no judgment about the potential carcinogenicity or toxicity of the occupational exposures present; it only served to discriminate relatively clean from relatively dirty occupations. This was not done with reference to the idiosyncrasies of any particular worker's workplace; rather, it depicted a representative workplace environment over time and across industries and companies.

To ensure consistency while assigning the scores, the chemists developed a grid to assist them. This grid is presented in Table B.1. This index only takes into account chemical exposures, ignoring exposures to ionizing or non-ionizing radiation. For the present reanalysis, the same team of occupational hygienists and chemists took each code in the two occupational coding systems, found the closest match to the Canadian coding system, and used the corresponding dirtiness score. The dirtiness scores for each code in the ACS Study and the Six Cities Study are given in Tables B.2 and B.3.

We adapted this scheme to the ACS and to the Six Cities Study. For each of the 68 job categories in the ACS Study, and each of the 442 occupation codes in the 1970 US Census Classification system (which was used to classify jobs in the Six Cities Study), we used the same criteria that we had earlier used to attribute a dirtiness score to the job codes in the Canadian system.

With the resulting correspondences between job codes and dirtiness scores, we linked to the two datafiles to attribute exposure to each individual in the two studies. For the Six Cities Study, there was only one job code on file for each study subject—namely the one held at the time of the baseline interview—and the score in the correspondence system for that occupation became the individual's score. The Original Investigators in the ACS Study had coded different subsets of current occupation, last occupation, and longest occupation, and indicated how long the person had worked in these different occupations. In the ACS Study, we therefore computed an average of the scores, weighted by the duration of employment in the jobs held. Thus in the Six Cities Study, this variable takes integer values between 0 and 6 whereas in the ACS Study, this variable is nearly continuous in the range 0 to 6.

Exposure to Recognized Lung Carcinogens

Simonato and Sarracci (1983)published lists of occupations and industries known (list A) and suspected (list B) to be associated with lung cancer. For some of these at-risk jobs, the causative agent was known and for others, the causative agent was yet unknown. Boffetta and collegues (1995) updated these lists based on the International Agency for Research on Cancer's evaluation of occupational exposures (International Agency for Research on Cancer 1972–1999). Some at-risk jobs required specification of an occupation and an industry, whereas some applied to an entire occupation group, irrespective of the industry. In order to more precisely define the at-risk jobs, and to enhance the comparability between studies using these lists, Ahrens and Merletti (1998) classified them using the Standard Classification of Occupations (ISCO) and the International Standard Industrial Classification (ISIC).

Tables B.4 through B.9 show the data used to attribute exposure to occupations at risk of lung cancer in the two studies. For the sake of transparency, we distinguish here between the so-called A list and B list (ie, known vs. suspected risk factors) although in the analyses, we have combined these groups of occupations. Tables B.4 and B.5 show the at-risk occupations, assigned by Ahrens and Merletti (1998) to the ISCO 1968 and ISIC 1971 codes. Tables B.6 and B.7 show our translation of Tables B.4 and B.5 into the ACS coding system. Similarly, tables B.8 and B.9 show our translation of Tables B.4 and B.5 into the Six Cities Study coding system. These tables include notes to explain the coding and the decisions we made. In general, if we believed that exposure to a lung carcinogen would be concentrated in a small subset of the workers who share a common code, we did not attribute the exposure to that code, thereby protecting the specificity of the attribution.

Ahrens and Merletti found it convenient to define a set of occupation codes as "blue-collar". This blanket code was used in those situations where the ISIC industry code seemed to represent an at-risk industry rather specifically, but did not include office clerks and other "white-collar" jobs which were not considered to be exposed to any carcinogens in the workplace. The "blue-collar" group defined by Ahrens and Merletti was comprised of the following ISCO codes: 5-5* (all subgroups within 5-5) / 5-6* (all subgroups within 5-6) / 5-81 (firefighter) / 6-28 (farm machinery operator) /6-31 (logger) / 7-* (all subgroups within 7) / 8-* (all subgroups within 8) / 9-* (all subgroups within 9). To be consistent with the Ahrens and Merletti procedure, we defined an equivalent "blue-collar" group for the US Bureau of the

Census (1970) occupations codes used in the Six Cities Study, which included codes 401 to 785 inclusively (except for 425: decorators and window dressers), plus 706, 902, 903 and 961. Decorators and window dressers were omitted from the "blue-collar" group because Ahrens and Merletti had not included them in their grouping; in the ISCO classification system, however, they appeared in a group of predominantly white-collar workers (16250: "display artists" is part of 162: "commercial artists and designers") whereas in the US Bureau of the Census, they appear with predominantly "blue-collar" workers (425 is part of "craftsmen and kindred workers"). Following Ahrens and Merletti, we did not include farmers and farm laborers (US Census codes 801–824) in the "blue-collar" category, but added them separately when needed.

Using the Ahrens and Merletti interpretation of at-risk occupations as a guideline, we translated these into the occupation/industry classification systems used in the ACS and Six Cities Studies. Since the ACS Study has only occupation codes, it was often difficult to find a good fit between the occupation and industry combination and the ACS coding system. The occupation and industry codes used in the Six Cities Study allowed for a much better specification of at-risk jobs.

APPLICATION OF OCCUPATIONAL EXPOSURE INDICES

The ACS Study

Table B.10 shows (separately for the "fine particle cohort" and the "sulfate cohort") the distribution of the occupational dirtiness index by several characteristics of study subjects, including the pollution level of the subject's place of residence. Over half of all subjects were in the lowest occupational dirtiness category. The following population subgroups had much higher dirtiness levels than their respective complimentary subgroups: males, subjects with less than high school education, and subjects who self-reported that they had exposure to dusts and fumes. Smokers had slightly higher dirtiness scores than non-smokers. Most importantly, there was no clear relation between the occupational dirtiness scores and the pollution levels of the towns of residence.

Table B.11 shows the percentage of subjects who worked in an occupation which has been shown or which is suspected to be at elevated risk of lung cancer, according to various characteristics. The percentage of subjects with such exposure was 2.7% in both cohorts. The patterns by subgroup were similar to those of the dirtiness index. Again, there was no evidence of increasing occupational exposure with increasing environmental pollution.

Table B.12 shows the relation between the dirtiness score in three aggregated categories and mortality from all causes of death, cardiopulmonary causes and lung cancer. This analysis is based on a Cox proportional-hazards model with the same covariates as were included in the original model of the ACS Study, excluding air pollution. These results provide little evidence of any independent effect of the occupational dirtiness score on mortality. When we carried out an analysis of mortality by individual dirtiness categories, there were some numerically elevated risks in the highest category (score 6), although these did not attain statistical significance.

The RR due to exposure to occupational lung carcinogens, as determined by our occupational lung carcinogens variable, was 1.23 (95% CI: 1.00–1.51) in the fine particulate cohort, and 1.19 (95% CI: 1.02–1.39) in the sulfate cohort based on the original model with 1-year age stratification. These results confirm the utility of the lung carcinogen index as an indicator of lung cancer risk.

The Six Cities Study

Table B.13 shows the distribution of the occupational dirtiness index by several characteristics of study subjects, including the subject's city of residence at the time of enrollment. Nearly 40% of subjects were in the lowest occupational dirtiness category. The following population subgroups had much higher dirtiness levels than their respective complimentary subgroups: males, subjects with less than high school education, and subjects who self-reported that they had exposure to dusts and fumes. Smokers had slightly higher dirtiness scores than nonsmokers. Most importantly, subjects in Topeka and Watertown, among the least-polluted towns, had somewhat lower occupational dirtiness scores than other subjects, and subjects in Steubenville were most likely have had high dirtiness jobs.

Table B.14 shows the percentage of subjects who worked in an occupation which has been shown, or which is suspected to be at elevated risk of lung cancer, according to various characteristics. The percentage of subjects with such exposure was 7.5%. The patterns by subgroup were similar to those of the dirtiness index. There was no evidence of increasing occupational exposure to carcinogens with increasing environmental pollution.

Table B.15 shows the relation between the dirtiness score in three aggregated categories and mortality from all causes of death, cardiopulmonary causes and lung cancer. This analysis is based on a Cox proportional-hazards model with the same covariates as were included in the original model used by the Original Investigators, excluding air pollution. As in the ACS Study, there is little evidence of any independent effect of the occupational dirtiness score on mortality. When we carried out an analysis of mortality by individual dirtiness categories, there were some elevated mortality risk ratios in the highest category (score 6), though these modest excess risks did not attain statistical significance.

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Table B.1. Operational Meaning of Each Dirtiness Score from 0 to 6

Dirtiness Score	Assessment
0	Generally no exposures, maybe the odd job with low number of exposures at low-level* (i.e. concentration** low, frequency** low or medium)
1	1 or 2 low-level* exposures (concentration low, frequency low or medium)
2	3-6 low-level* exposures (concentration low, frequency low or medium)
3	More than 6 low-level* exposures (concentration low, frequency low or medium) AND/OR 1-3 medium-level* (i.e. concentration medium, frequency low or medium; concentration low, frequency high).
4	4-5 medium-level exposures (i.e. concentration medium, frequency low or medium; concentration low, frequency high), AND probably also some low-level* exposures, but this is somewhat irrelevant at this point
5	More than 5 medium-level *exposures (i.e. concentration medium, frequency low or medium; concentration low, frequency high) AND/OR 1 or 2 high-level exposures (i.e. concentration medium, frequency high; concentration high, frequency medium or high) AND probably some low-level* exposures, but this is irrelevant at this point
6	More than 3 high-level* exposures (i.e. concentration medium, frequency high; concentration high, frequency medium or high) AND probably some low- and medium-level* exposures, but this is somewhat irrelevant at this point

* Exposure level = takes into consideration both the intensity (i.e. concentration) and the frequency of the exposure.
** The concentration and frequency levels mentioned in this grid refer to the coding system used by Siemiatycki et al. in their case-control study of occupational cancer. (Siemiatycki, J., Nadon L., Lakhani R., Bégin D., Gérin M., Exposure Assessment. In: Risk Factors for Cancer in the Workplace. Ed. J. Siemiatycki, CRC Press, Boca Raton, 1991, pp. 45-114.)

Table B.2 Dirtiness Score for Each Occupation Code in the ACS Study

ACS Occupation Code	ACS Occupation	Dirtiness Score	Note
0	Unemployed	0	
1	Teacher Professor Dean Principal Librarian School superintendent School administrator	2	Vocational teachers would have a 4 and fine arts teachers usually have some exposures (score=1) but most teachers are unexposed
2	Manager Director Owner	0	
3	Cashier Clerk Sales Retail Store	0	
4	Carpenter Furniture maker Lumber Logger Sawmill worker Saw filer Wood cutter Wood worker	4	Furniture makers and carpenters are more exposed because of paints, varnishes, adhesives etc. We would have assigned 6 for furniture makers and carpenters and 3 for others so we've averaged this out to 4
5	Electrician	3	
6	Foreman	3	Difficult one because not specific enough. In our previous dirtiness classification based on the 1971 Canadian Dictionary of Occupations, the various foremen were scored between 2 and 5 so we've used 3, which is the average
7	Machinist	5	

Table B.2 Dirtiness Score for Each Occupation Code in the ACS Study

ACS Occupation Code	ACS Occupation	Dirtiness Score	Note
8	Auto mechanic Repair Service station Gas station attendant	5	
9	Painter	6	We assumed most were construction or industrial painters, artists would have been coded lower, i.e. score=3
10	Plumber	4	
11	Assembler	4	This code is very vague (we have 16 different 4-igit CCDO codes for assemblers but most seem to have been coded 4)
12	Welder	6	
13	Truck driver Bus driver Cab/taxi driver Delivery man Routeman	1	
14	Construction	5	Covers a wide range of occupations (an industry actually) but from what we could see in the dirtiness index for the first 4 digits of the CCDO, most were attributed a score of 5
15	Rancher Fisherman Farmer (farm hand, farm laborer)	4	
16	Janitor Handyman Custodian Maintenance man	4	

Table B.2 Dirtiness Score for Each Occupation Code in the ACS Study

ACS Occupation Code	ACS Occupation	Dirtiness Score	Note
17	Police Detective FBI Guard Watchman Nightwatchman	2	
18	Legal profession Lawyer/attorney Law clerk Judge	0	
19	Clergy Rabbi Minister Priest	0	
20	Miner	6	
21	Housewife	0	Housewives actually may actually have exposures but since they occur at home and not in the workplace, we have disregarded them
22	Office worker Secretary Typist Receptionist Clerical worker	0	
23	Accountant Bookkeeper	0	
24	Nurse RN	2	
25	Doctor Ophthalmologist Physician Veterinarian GP	1	

Table B.2 Dirtiness Score for Each Occupation Code in the ACS Study

ACS Occupation Code	ACS Occupation	Dirtiness Score	Note
26	Hospital worker Nurse's aide Orderly Porter Paramedic	3	Probably 3 since we believe they are more exposed than nurses and doctors
27	Beautician Cosmetologist Barber	3	
28	Textile worker Sewer Seamstress Stitcher Upholsterer	4	
29	Cook Chef Butcher Baker Food service Food preparation	2	
30	Waiter Waitress	1	
31	Maid Domestic	2	
32	Retired	0	
33	LPN	2	
34	CRT operator PBX operator VID operator Programmer Data entry operator	0	

Table B.2 Dirtiness Score for Each Occupation Code in the ACS Study

ACS Occupation Code	ACS Occupation	Dirtiness Score	Note
35	Warehouse worker Factory worker (unspecified)	4	This group is too broad; exposures depend on what the factory is making or what is in the warehouse. Thus, we could only make a guess on this one
36	Banking: Bank appraiser, Loan officer, Teller, Underwriter	0	
37	Dentist	3	
38	Postal worker, Mail carrier	0	
39	Pharmacist, Mortician, Chemist, Funeral director	4	
40	Firemen	3	Heavy exposures in their workplace but generally wear protective equipment
41	Engineer (unspecified)	2	Exposures depend on the type of engineer. On average, in our previous dirtiness index (based on the first four digits of the 1970 CCDO) we assigned a 2
42	Real estate Insurance Stockbroker	0	
43	Disabled	0	
44	Executive President, Vice President	0	
45	Telephone operator	0	
46	Social worker, Therapist, Counselor	0	
47	Radio Technician Dental/M.D./x-ray Technician Laboratory technician	3	Exposures depend on type of technician; on average in our previous index (based on the first four digits of the 1970 CCDO), we assigned 3
48	Steel mill worker	6	

Table B.2 Dirtiness Score for Each Occupation Code in the ACS Study			
ACS Occupation Code	ACS Occupation	Dirtiness Score	Note
49	Child care worker, Day care worker, Aide (teacher, school, library, day care)	0	
50	Civil servant Government worker	0	
51	Photographer Printer Lithographer	5	Photographers would have been assigned 4, if they had not been in the same category as printers and lithographers
52	Writer, Editor, Publisher, Advertising Copy writer, Newspaper person	0	
53	Shipyard worker	5	
54	Architect	0	
55	Railroad worker	3	
56	Military	2	Difficult to code since it depends on what job the serviceman performed
57	Laborer	6	Depends on what type of work the laborer was doing but generally these unskilled workers are in very dirty jobs
58	Heavy equipment operator	5	
60	Dry cleaner	4	
61	Laundry worker	3	
62	Florist Gardener	4	Gardeners are very exposed (5) but florists less (3); we've averaged them out
63	Pilot	1	
64	Oil field worker Refinery worker	4	
65	Pipefitter	5	
66	Musician	0	

Table B.2 Dirtiness Score for Each Occupation Code in the ACS Study

ACS Occupation Code	ACS Occupation	Dirtiness Score	Note
67	Dockworker Tugboat worker Maritime employee	4	
97	Other	0	
99	None given	0	