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Occupational risk factors of lung cancer in São Paulo, Brazil

by Victor Wünsch-Filho, MD,[1] José E Moncau, MPH,[2] Dario Mirabelli, MD,[3] Paolo Boffetta, MD[4]

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Objectives This study estimated the risk of occupational exposure for lung cancer in the metropolitan region of São Paulo, the largest urbanized and industrialized area in Brazil.

Methods In this hospital-based case-referent study of 398 cases and 860 referents, the cases were matched to referents according to age, gender, and hospital and personally interviewed for information on lifetime job history, smoking habits, passive smoking exposure, cancer in relatives, socioeconomic status, and migratory history. The analysis concerned industrial titles and occupational categories. With the use of a job-exposure matrix, exposure to asbestos, polynuclear aromatic hydrocarbons, arsenic, dust, nickel and chromium was assessed.

Results For the men in the 56 industrial and 122 occupational categories examined, an excess risk of lung cancer was found in the machinery industry [odds ratio (OR) 1.62, 95% confidence interval (95% CI) 1.02—2.55). In pottery manufacturing the risk (OR 2.21, 95% CI 1.00—4.87) was increased for workers exposed ≥10 years (OR 6.43, 95% CI 1.12—37.01). Textile workers employed for ≥10 years with a latency of ≥40 years had an elevated risk (OR 21.93, 95% CI 1.96—245.0). In the analysis using the job-exposure matrix no risk was detected for the specific lung cancer carcinogens examined. For the women, no significantly elevated risk was observed.

Conclusions The results of this study revealed risks of lung cancer for men in the machinery industry and for pottery and textile workers with long-term exposure.

Key words case-referent study, epidemiology, job-exposure matrix, lung cancer.

After cardiovascular diseases, cancer is the second greatest cause of death among the Brazilian population above 40 years of age, and lung cancer represents the first neoplastic cause of death among men (1). The incidence of lung cancer is increasing in the country (2), and this growth has been associated with the increase in the prevalence of smoking (3). The incidence is higher in the southeast and southern states, the more urbanized and industrialized regions of the country (4, 5). In the city of São Paulo, data from the late 1970s showed an annual age-standardized lung cancer incidence rate of 36.5/100 000 for the male population (6). More recent figures are not available, but the incidence is likely to have increased.

Tobacco smoking is the major cause of lung cancer worldwide (7). Its role has been confirmed in the only study of lung cancer conducted so far in Brazil (8). In addition, several occupational factors have been shown to contribute to the development of this cancer (9). The role of occupational factors on lung cancer varies greatly between countries and time periods (10). It is well documented that specific chemical substances and physical agents, including asbestos, polynuclear aromatic hydrocarbons (PAH), arsenic, dust, nickel and chromium, and occupations involving exposures to these agents increase the risk (11). In addition, several industrial branches involving complex chemical mixtures have been associated with an elevated risk of lung cancer (11).

The majority of studies on occupational factors for lung cancer have been carried out on workers from developed countries with old and well structured industrial processes, but the nature and magnitude of occupational lung cancer have been scarcely explored in developing countries (12—14). Our objective was to try to explore this relationship in Brazil through a hospital-based case-referent study in the metropolitan region of São Paulo.

1 Faculdade de Saúde Pública. Universidade de São Paulo. São Paulo, Brazil.
2 Universidade Federal de São Paulo. São Paulo, Brazil.
3 Agenzia Regionale per la Protezione del Piemonte, Grugliasco, Italy.
4 International Agency for Research on Cancer, Lyon, France.

Reprint requests to: Victor Wünsch-Filho, Departmento de Epidemiologia, Faculdade de Saúde Pública, Universidade de São Paulo, Av Dr Arnaldo, 715, 01246—904, São Paulo, SP, Brazil.

Subjects and methods

The metropolitan region in question is comprised of 37 municipalities and about 15.2 million people. It is the largest industrialized area in Brazil (15). The labor force includes about 7 million people, of whom 29.7% work in industry, 16.5% are employed in commerce, 43.8% do service work, and 10% are in other activities (16).

Data were collected in 14 hospitals from July 1990 to June 1991. The cases and referents were interviewed with the aid of a standard questionnaire with structured sections to obtain detailed information on tobacco smoking, passive smoking in childhood and adult life, cancer in the family, socioeconomic status, migration, medical history, and each job held for at least 6 months.

The cases available had been newly diagnosed as lung cancer, according to the International Classification of Diseases (ICD), ninth revision (17), from January 1989 to June 1991. The diagnosis was assessed from hospital records and only those confirmed by histology or cytology were accepted. Eligible cases with a definite diagnosis other than lung cancer were reclassified as referents if the diagnosis was among those retained for referents. Only residents living in the same metropolitan region as the cases for at least 6 months were included. Information was taken from 83.9% of the patients. For the subjects too ill to answer the questionnaire, proxy information was sought from next-of-kin: 9.3% from a child, 4.5% from a spouse, and the rest from other relatives or people in close contact with the patient.

The cases and referents were matched for age (±3 years), gender, and hospital. For each eligible referent, the diagnosis abstracted from medical records was coded according to the ICD. Patients with chronic obstructive respiratory diseases and smoking-related cancers (bladder, larynx, esophagus, oral cavity, pharynx, pancreas, kidney and renal pelvis) were excluded. Altogether 89.9% of the referents were interviewed in person, while children, spouses and other next-of-kin contributed to 4.1%, 2.4% and 3.6% of the interviews, respectively.

Altogether 1258 persons were retained in the analysis: 398 cases and 860 referents. Selected characteristics of the cases and referents are shown in table 1. The case-referent ratio was 1.7 for the men (307 cases and 546 referents) and 3.4 for the women (91 cases and 314 referents). For the male cases the average age was 62.5 years, and for the female cases it was 60.8 years. The corresponding values for the referents were 60.5 and 62.2 years. The job turnover during a lifetime was higher for the men (average of 4.4 jobs among the cases and 3.9 among the referents) than for the women (2.5 and 2.3, respectively).

The International Standard Industrial Classification of All Economic Activities (ISIC) (18) was used to classify industry and the International Standard Classification of Occupations (ISCO) (19) was used for occupations. The cases and referents were classified into 56 industrial and 122 occupational categories. Only categories including at least 10 men employed (overall prevalence of exposure 1.17%) or 6 women (overall prevalence of exposure 1.48%) were included in the analysis. A 10 years' time lag of employment was considered to examine exposure duration, and 40 years since the first exposure was established as the cut point for latency. The calculations were made by summing the exposure periods from the first employment to the time of the lung cancer diagnosis.

A job-exposure matrix (JEM) was developed for assessing the specific lung carcinogens. Each subject's job history was used to set up a data base of all combinations of industrial activity and occupational titles ever held by any interviewee. An industrial hygienist and an occupational epidemiologist assessed, for every combination, the probability and intensity of exposure to asbestos, PAH, arsenic, dust, nickel, and chromium. The assessment was scored blindly according to the following scale: *no exposure* (exposure similar to the general population's), *definite low exposure* (exposure higher than the general population's, but at levels experienced by some groups), *possibly high exposure* (job may add significant exposure, but information about job not completely available), *definite high exposure* (exposure definitely higher than that of the general population and information about job exposure reliable).

The analysis was conducted separately for the men and women. Odds ratios (OR) and 95% confidence intervals

Table 1. Selected characteristics of the cases and referents by gender.

Characteristic	Men		Women	
	Cases (N=307)	Referents (N=546)	Cases (N=91)	Referents (N=314)
Age[a]				
<50 years	30	86	12	38
50—59 years	87	171	28	74
60—69 years	110	169	34	128
≥70 years	80	120	17	74
Hystological type of tumor				
Squamous cell carcinoma	138	—	29	—
Adenocarcinoma	76	—	33	—
Small-cell carcinoma	43	—	14	—
Large-cell carcinoma	13	—	2	—
Undifferentiated[b]	37	—	13	—
Diagnosis of referents[c]				
Infectious and parasitic diseases (ICD — 001—139)	—	113	—	26
Nontobacco related neoplasms (ICD — 140—239)	—	51	—	65
Endocrine, nutritional and metabolic diseases and immune disorders (ICD — 240—279)	—	22	—	30
Diseases of circulatory system (ICD — 390—459)	—	137	—	78
Diseases of digestive system (ICD — 520—579)	—	58	—	40
Other diagnosis	—	165	—	75

[a] Age range: 36—90 cases; 33—90 referents.
[b] It includes all tumors diagnosed by cytology.
[c] Code of the International Classification of Diseases in parentheses.

(95% CI) were calculated as approximations of relative risk (20). The risk of lung cancer was estimated by comparing subjects ever employed in a particular industrial or occupational category or ever exposed to an agent included in the job-exposure matrix with those never employed or exposed. Each subject could be counted as exposed in more than 1 industry or occupation and to more than 1 carcinogen. Potential confounders were controlled by unconditional logistic regression modeling (20). Statistical significance was assessed by the maximum likelihood ratio test (21).

Results

The proportion of squamous-cell lung cancer was higher for the men, and adenocarcinoma was predominant among the women. Only 34 (8.5%) cases did not have the diagnosis established by histology. Cases confirmed by cytology were assumed to be of an undifferentiated type.

Almost three-fourths of the selected referents had a diagnosis included in the 5 main ICD code groups: diseases of the circulatory system (25.0%), infectious and parasitic diseases (16.2%), nontobacco-related neoplasms (13.5%), diseases of the digestive system (11.4%), and endocrine, nutritional and metabolic diseases and immune disorders (6.0%). The remaining had diseases classified into other ICD groups, for example, bone fractures, rheumatoid arthritis, skin diseases, and complications of labor or delivery. The men had a higher proportion of infectious diseases (20.7%) and a lower proportion of neoplasms (9.3%) than the women (8.3% and 20.7%, respectively).

Table 2 presents the risk of lung cancer from tobacco smoking. A step-gradient effect was observed for the men according to the number of pack-years.

Results for the men in 23 industries, when controlled for age, cigarette smoking, family history of cancer, migration, and socioeconomic status are shown in table 3. Only machinery showed a significantly elevated risk of lung cancer. Two other industries (pottery and nonmetallic mineral manufacturing) showed (nonsignificant) risks higher than 1.5. In the analysis for exposure duration (≥10 years) and latency (≥40 years) the risk increased in the pottery and nonmetallic mineral industry, but it did not change in the machinery industry. None of the 21 occupational categories examined showed a significantly increased risk of lung cancer (table 4).

With respect to histological type, the finance category revealed an increased risk of adenocarcinoma (OR 2.25, 95% CI 1.15—2.66). Other industrial categories at increased risk of adenocarcinoma were wood, furniture, printing, chemicals and plastics, basic metal, machinery, and energy (all at P>0.05).

We conducted an analysis for the men after excluding the cases and referents with information collected through proxy interviews. In general this approach increased, but not significantly, the relative risks of the earlier analysis including proxy interviews. However for pottery and textile workers the risks increased: pottery workers: ever employed OR 2.54 & 95% CI 1.09—5.88, employed ≥10 years OR 13.78 & 95% CI 1.49—127.43, employed ≥10 years and ≥40 years of latency OR 14.13 & 95% CI 1.54—129.97; textile workers: ever employed OR 1.00 & 95% CI 0.43—2.34, employed ≥10 years OR 7.70 & 95% CI 1.01—58.42, employed ≥10 years and ≥40 years of latency OR 21.93 & 95% CI 1.96—245.0.

The results of the analysis using the job-exposure matrix for the male workers are shown in table 5. When the level and duration of exposure were taken into consideration, no increased risks were found for asbestos, PAH, arsenic, dust, nickel, or chromium, but in the analysis with a ≥40-year latency the risks for these agents were somewhat high.

For the women, elevated risks of lung cancer, based on small numbers, were found for 2 industrial categories, leather (OR 2.93, 95% CI 0.74—11.56) and finance (OR 1.91, 95% CI 0.63—13.40) and 2 occupational categories, laundresses (OR 2.88, 95% CI 0.48—16.98) and hairdressers (OR 4.26, 95% CI 0.66—27.21). The analysis using the job-exposure matrix for the women was strongly hampered by the small number of exposed subjects.

Discussion

Out of 56 industrial and 122 occupational categories, only the categories of machine industry and pottery industry and textile worker occupation (excluding proxy interviews and including employment for ≥10 years and latency for ≥40 years) showed significantly elevated risks of lung cancer for the men. No significant risk was observed for the women.

Our study confirms tobacco smoking as an important risk factor of lung cancer for both men and women. This result is in the same direction as that of other studies from many countries (7), but the risk level is lower than those reported in Colombia (22). A possible explanation is our reference selection. One-quarter of our referents had a circulatory disease, and the proportion of smokers was probably higher in this group than in the general population and the effect therefore underestimated. When the referents with this ICD diagnosis were excluded, the effect of smoking increased for those smoking ≥61 pack-years: men OR 9.34 & 95% CI 4.76—18.33; women OR 4.79 & 95% CI 1.34—17.03. The effect of controlling for cigarette smoking on the relative risks of the industrial and occupational categories and carcinogens assessed with the aid of the job-exposure matrix showed a trend towards elevated risks among the men (table 6).

When the occupational risks, the main objective of this study, were focused upon, the results for the pottery industry were particularly interesting. There was a borderline significant excess risk that increased for workers exposed for

Table 2. Tobacco smoking and socioeconomic status and risk of lung cancer. (OR = odds ratio, 95% CI = 95% confidence interval)

	Men				Women			
	Cases (N)	Referents (N)	OR	95% CI	Cases (N)	Referents (N)	OR	95% CI
Cigarette smoking[a]								
Never smokers[b]	14	99	1.00	·	29	208	1.00	·
Ever smokers	290	441	4.75	2.66—8.50	60	98	4.43	2.62—7.47
Current smokers	189	234	6.59	3.59—12.1	42	51	5.98	3.25—11.0
Ex-smokers[c]	100	200	3.28	1.77—6.07	17	36	3.51	1.74—7.10
Cigarette consumption in pack-years[d,e]								
≤20	14	24	1.35	0.66—2.76	26	48	3.95	2.05—7.62
21—40	68	120	4.20	2.18—8.09	14	12	8.98	3.58—22.5
41—60	85	86	6.90	3.65—13.0	11	11	7.39	2.87—19.0
≥60	105	94	7.74	4.12—14.6	5	10	3.60	1.14—11.4
Socioeconomic status[f,g]								
Level 1 (lowest level)[b]	49	99	1.00	·	24	68	1.00	·
Level 2	96	160	1.05	0.75—1.46	27	94	0.81	0.45—1.46
Level 3	84	161	0.86	0.62—1.21	18	80	0.76	0.40—1.45
Level 4 (highest level)	34	45	1.34	0.79—2.29	10	10	3.75	1.36—10.3

[a] Odds ratio adjusted by age; pure cigar and pipe smokers excluded from the analysis.
[b] Reference category.
[c] More than 1 year since cessation of smoking.
[d] Odds ratio adjusted by age.
[e] Reference category: never smokers.
[f] Based on a combination of income per capita and level of education.
[g] Odds ratio adjusted by age and smoking.

Table 3. Employment in selected industries and risk of lung cancer among the men. (OR = odds ratio, 95% CI = 95% confidence interval)

Industry[a, b]	Ever employed[c]				Employed ≥10 years[c]				Employed ≥10 years and ≥40 years of latency[c]			
	Cases (N)	Referents (N)	Adjusted OR[d]	95% CI	Cases (N)	Referents (N)	Adjusted OR[d]	95% CI	Cases (N)	Referents (N)	Adjusted OR[d]	95% CI
Agriculture (1)	104	236	0.72	0.50—1.04	73	161	0.81	0.55—1.19	66	139	0.81	0.54—1.21
Food and tobacco (31)	35	67	0.90	0.56—1.44	9	19	0.72	0.31—1.70	8	15	0.77	0.30—1.93
Textile (321)	20	42	0.98	0.54—1.79	10	11	1.62	0.62—4.26	9	9	1.67	0.60—4.68
Leather (323)	7	15	1.30	0.48—3.49	2	3	1.12	0.17—7.60	2	1	3.31	0.24—45.2
Shoes (324)	5	17	0.44	0.15—1.27	1	4	0.35	0.03—3.65	1	4	0.36	0.03—3.77
Wood (331)	18	23	1.41	0.71—2.81	6	7	1.18	0.37—3.79	6	6	1.34	0.40—4.51
Furniture (332)	11	14	1.44	0.59—3.49	3	4	1.38	0.25—7.47	3	3	1.68	0.28—10.2
Printing (342)	9	15	1.14	0.45—2.90	3	5	0.86	0.18—4.20	3	5	0.90	0.18—4.36
Chemicals and plastics (35 excluding 355)	26	40	1.22	0.70—2.14	9	13	1.25	0.49—3.18	9	10	1.44	0.54—3.81
Pottery (361)	16	15	2.21	1.00—4.87	6	2	6.43	1.12—37.0	6	2	6.51	1.14—37.2
Other nonmetallic mineral (362—369)	14	16	1.65	0.75—3.64	4	2	5.32	0.88—32.1	2	2	2.85	0.34—23.8
Basic metal (37)	34	54	1.34	0.82—2.20	12	7	1.67	0.73—3.79	7	9	2.02	0.67—6.11
Metal products (381)	38	60	1.28	0.79—2.05	8	18	0.90	0.37—2.23	6	14	0.78	0.28—2.16
Machinery (382—384)	48	60	1.62	1.02—2.55	16	18	1.50	0.71—3.18	14	13	1.73	0.74—4.04
Other manufacturing (other 3)	34	49	1.21	0.73—2.01	16	19	1.35	0.64—2.84	14	13	1.68	0.72—3.94
Energy (4)	11	14	1.27	0.54—3.02	7	6	1.98	0.61—6.40	7	6	1.96	0.61—6.33
Construction (5)	67	154	0.74	0.51—1.07	46	91	0.91	0.60—1.40	38	70	0.92	0.58—1.47
Trade (61—62)	8	19	0.67	0.27—1.63	5	10	0.76	0.24—2.40	5	6	1.12	0.31—4.01
Restaurants hotels (63)	7	13	0.97	0.36—2.63	2	2	2.57	0.30—21.8	2	1	7.03	0.52—94.3
Transport (7)	57	106	0.98	0.66—1.46	31	54	1.01	0.60—1.68	26	41	0.97	0.55—1.71
Finance business (8)	35	51	1.12	0.68—1.86	14	27	0.77	0.37—1.56	9	21	0.55	0.24—1.27
Social services (91—94)	73	149	0.82	0.57—1.17	39	86	0.70	0.44—1.10	28	70	0.58	0.35—0.97
Personal services (95)	14	22	1.29	0.62—2.70	4	13	0.63	0.19—2.09	4	12	0.76	0.23—2.55

[a] Categories with at least 10 subjects employed.
[b] Code of the International Standard Industrial Classification of All Economic Activities in parentheses.
[c] *Reference category: never employed.*
[d] Odds ratio adjusted for age, cigarette smoking, cancer in family, migratory history, and socioeconomic status.

Table 4. Employment in selected occupations and risk of lung cancer among the men. (OR = odds ratio, 95% CI = 95% confidence interval)

Occupation[a, b]	Ever employed[c]				Employed ≥10 years[c]				Employed ≥10 years and ≥40 years of latency[c]			
	Cases (N)	Referents (N)	Adjusted OR[d]	95% CI	Cases (N)	Referents (N)	Adjusted OR[d]	95% CI	Cases (N)	Referents (N)	Adjusted OR[d]	95% CI
Professionals, administrative, clerical and managerial (1—3)	74	117	1.02	0.69—1.50	33	57	0.84	0.49—1.43	25	39	0.88	0.48—1.60
Sales workers (3)	64	116	1.01	0.68—1.49	31	65	0.68	0.41—1.12	27	48	0.71	0.41—1.23
Cooks (531)	1	10	0.17	0.02—1.43	1	1	1.20	0.07—20.0	—	—	.	.
Waiters (532)	5	13	0.52	0.17—1.55	1	5	0.33	0.03—4.19	1	4	0.45	0.04—5.21
Launders (560)	2	8	0.65	0.13—3.32	1	4	1.25	0.06—26.9	1	4	1.25	0.06—26.9
Other services workers (other 5)	54	95	1.19	0.79—1.79	19	36	1.04	0.47—2.31	16	28	1.43	0.58—3.50
Agricultural workers (6)	100	234	0.69	0.48—1.00	69	162	0.86	0.48—1.52	63	140	0.89	0.49—1.63
Textile workers (75)	12	25	1.03	0.48—2.22	6	5	3.38	0.12—95.1	6	3	6.76	0.32—141.6
Tailors and related workers (79)	3	12	0.38	0.10—1.44	2	9	1.50	0.12—18.4	2	8	2.00	0.17—24.1
Shoemakers (801)	6	13	0.84	0.30—2.39	1	5	0.14	0.01—1.57	1	5	0.14	0.01—1.57
Wood workers (73—81)	15	21	1.22	0.59—2.54	10	12	0.89	0.14—5.69	9	11	0.72	0.12—4.33
Toolmakers (83)	169	324	0.88	0.62—1.25	120	221	1.19	0.75—1.86	97	169	1.13	0.71—1.79
Machinery filters (84)	159	303	0.87	0.62—1.23	109	203	1.11	0.70—1.76	91	156	1.17	0.72—1.88
Electrical workers (85)	156	295	0.90	0.64—1.26	104	192	1.06	0.67—1.67	86	147	1.09	0.68—1.75
Plumbers and welders (87)	147	283	0.89	0.63—1.24	98	175	1.16	0.73—1.85	81	134	1.17	0.72—1.92
Printers (92)	136	275	0.80	0.57—1.12	91	167	1.20	0.75—1.94	74	127	1.20	0.73—1.99
Painters (8)	128	259	0.77	0.56—1.08	82	147	1.29	0.79—2.11	70	116	1.28	0.77—2.15
Construction workers (95)	93	170	0.97	0.69—1.37	47	76	1.14	0.62—2.09	39	59	1.14	0.60—2.17
Dockers (971)	5	6	1.25	0.36—4.42	—	1	.	.	—	—	.	.
Drivers (98)	36	61	1.00	0.62—1.61	27	40	1.75	0.56—5.48	23	32	1.34	0.43—4.15
Other production workers (other 7, 8, 9)	28	41	1.37	0.79—2.35	17	28	0.51	0.10—2.44	14	19	0.60	0.12—2.91

Categories with at least 10 subjects employed.
[b] Code of the International Standard Classification of Occupations (ISCO), revised 2nd edition, in parentheses.
[c] Reference category: never employed.
[d] Odds ratio adjusted for age, cigarette smoking, cancer in family, migratory history, and socioeconomic status.

≥10 years. Crystalline silica in the form of quartz and crystobolite is carcinogenic to humans (23) and in the pottery industry such exposures occur at high levels (24). Several other potential lung carcinogens are present in pottery and ceramic manufacturing also, for example, talc dust and metals, including antimony, chromium, copper, iron, and titanium (25).

The analysis excluding the proxy interviews detected an expressively increased risk for textile workers exposed for ≥10 years and with ≥40 years of latency. Results of other lung cancer studies for textile workers do not agree; The difference possibly reflects variations in industrial processes and exposure profiles to carcinogens. The textile manufacturing industry entails potential exposure to several chemicals (dyes, solvents, oils, formaldehyde, resins, fumigants, and flame retardants) and organic dust (26).

We interpret the results of the job-exposure matrix as being affected by nondifferential misclassification with respect to the assessment of exposure. The high sensitivity and low specificity of our matrix could be due to data collecting deficiencies with respect to the specific agents examined. The matrix classified about 44% of all the male cases and referents as ever exposed to arsenic, 66% to asbestos, 67% to PAH, and 74% to dust. These figures probably represent an overestimate of exposure in the male population source of the cases and referents.

Other biases may have affected our study also. For example, 398 incident lung cancer cases in 1 year is only a part of the overall figure, estimated to be 1000 new cases[5] for the metropolitan region used in this study, and we could not exclude the possibility that selection through hospitals might have introduced some bias.

It has been assumed that the levels of carcinogenic exposure are higher in work settings in developing countries than in developed countries (27), and higher risks of cancer can

5 Data from the Mortality Information Program of the city of São Paulo revealed 1211 deaths from lung cancer (ICD code 162) between 1 July 1990 and 30 June 1991; 842 of the decedents were men. Considering the high death fatality rate after the diagnosis, we can conclude that a minimum of 1000 new cases of lung cancer occurred during the study period in the metropolitan region of São Paulo (including São Paulo county and 36 other municipalities).

Table 5. Exposure to asbestos, polycyclic aromatic hydrocarbons (PAH), arsenic, dust, nickel and chromium as estimated via a job-exposure matrix and risk of lung cancer among the men.[a] (OR = odds ratio, 95% CI = 95% confidence interval)

Exposure	Ever[b]				Ever with ≥10 years of duration[b]				Ever with ≥10 years of duration and ≥40 years of latency[b]			
	Cases (N)	Referents (N)	OR[c]	95% CI	Cases (N)	Referents (N)	OR[c]	95% CI	Cases (N)	Referents (N)	OR[c]	95% CI
Any exposure												
Asbestos	158	345	0.80	0.51—1.24	147	308	1.02	0.68—1.53	124	238	1.12	0.75—1.67
PAH	161	346	0.95	0.60—1.48	147	311	1.08	0.72—1.62	125	239	1.18	0.79—1.76
Arsenic	98	234	0.83	0.57—1.21	84	183	1.08	0.73—1.58	79	156	1.16	0.78—1.72
Dust	184	382	1.02	0.58—1.81	171	352	1.13	0.70—1.83	145	271	1.30	0.83—2.05
Nickel	19	43	0.91	0.50—1.67	14	22	1.31	0.62—2.75	10	15	1.44	0.59—3.50
Chromium	76	169	0.99	0.68—1.45	60	120	1.19	0.79—1.78	46	91	1.16	0.74—1.82
Possibly high exposure												
Asbestos	144	297	1.03	0.68—1.54	134	269	1.13	0.77—1.67	114	120	1.23	0.83—1.82
PAH	144	304	1.07	0.71—1.60	132	278	1.13	0.76—1.66	113	214	1.23	0.83—1.82
Arsenic	98	231	0.84	0.58—1.23	84	181	1.09	0.74—1.61	79	155	1.16	0.78—1.73
Dust	168	331	1.46	0.93—2.31	157	312	1.34	0.88—2.06	136	244	1.48	0.97—2.26
Nickel	19	43	0.91	0.50—1.67	14	22	1.31	0.62—2.75	10	15	1.44	0.59—3.50
Chromium	76	168	1.00	0.69—1.46	60	119	1.20	0.80—1.79	46	90	1.17	0.75—1.84
Definite high exposure												
Asbestos	13	28	0.83	0.40—1.73	12	26	0.85	0.40—1.79	11	22	0.87	0.39—1.91
PAH	48	98	1.02	0.66—1.56	45	95	0.99	0.64—1.52	34	66	1.02	0.63—1.66
Arsenic	.	.	.	—	.	.	.	—	.	.	.	—
Dust	140	292	1.11	0.74—1.66	132	278	1.09	0.73—1.62	118	222	1.26	0.84—1.89
Nickel	4	9	1.13	0.32—3.99	3	6	1.43	0.32—6.36	1	3	1.37	0.13—14.0
Chromium	4	12	0.98	0.29—3.32	3	9	1.14	0.28—4.68	1	5	0.99	0.11—9.09

[a] Excluding proxy interviews.
[b] Reference category: never exposed.
[c] Odds ratio adjusted by age, cigarette smoking, cancer in family and migration history, and socioeconomic status.

Table 6. Smoking effect of estimated relative risk of the men.[a] (OR = odds ratio, 95% CI = 95% confidence interval, PAH = polycyclic aromatic hydrocarbons)

Exposure[b]	Cases	Referents	No smoking adjustment		With smoking adjustment	
			OR[c]	95% CI	OR[c]	95% CI
Asbestos	158	345	0.73	0.49—1.09	0.80	0.51—1.24
PAH	161	346	0.84	0.56—1.27	0.95	0.60—1.48
Arsenic	98	234	0.71	0.50—1.00	0.83	0.57—1.21
Dust	184	382	0.85	0.51—1.44	1.02	0.58—1.81
Nickel	19	43	0.93	0.52—1.65	0.91	0.50—1.67
Chromium	76	169	0.99	0.68—1.45	0.89	0.63—1.27
Pottery industry (ISIC 361)	14	13	2.38	1.10—5.16	2.54	1.09—5.88
Machinery industry (ISIC 382—4)	40	58	1.51	0.96—2.37	1.61	0.99—2.61
Textile workers (ISCO 75)	9	23	0.88	0.40—1.96	1.00	0.43—2.34

[a] Excluding proxy interviews.
[b] Ever-never exposed (reference category: never exposed); code of the International Standard Industrial Classification of All Economic Activities (ISIC) or the *International Standard Classification of Occupations (ISCO) in parentheses.*
[c] Odds ratio adjusted by age, cigarette smoking, cancer in family, migration history, and socioeconomic status.

be observed in industries and occupations of developing countries. We were unable to detect such differences clearly. Exposure to carcinogens may be higher in work settings of developing countries, but the latency may not yet be long enough to reveal its effect in epidemiologic studies. There are no time-pattern series of well-known cancer-related industries in São Paulo, and there is no indirect approach that can be used to throw more light on this problem. However, the very high risks of lung cancer among the textile and pottery workers exposed ≥10 years and with ≥40 years of latency are a strong expression of the exposure to carcinogens in these industries, the oldest in Brazil.

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