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Bladder cancer in the textile industry

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Objectives This study examined the occupations and industries at high risk for bladder cancer in an area where the textile industry is plentiful and the incidence of the disease is very high.

Methods A case-referent study concerning 218 incident bladder cancer cases diagnosed during 1993—1995 in the county of Vallès Occidental, Barcelona, was carried out. A reference group (N=344) was selected from municipal lists matched to the cases by age, gender, and area of residence. All the subjects were personally interviewed, and a complete occupational history was abstracted together with other sociodemographic and life-style factors. All odds ratios (OR) and 95% confidence intervals (95% CI) were adjusted for age, gender, and smoking.

Results No overall excess risk was found for ever having worked in the textile industry (OR 1.13, 95% CI 0.79—1.63) nor for specific sectors of this industry (ie cotton, wool, silk). An excess risk was observed for spinners and winders employed for more than 20 years (OR 3.28, 95% CI 1.08—9.97) and for machine setters employed between 1960 and 1974 (OR 4.26, 95% CI 1.09—16.7).

Conclusions The results of this study do not support the findings of some earlier studies for an increased bladder cancer risk in the textile industry. However, some elevated risks were observed among the workers with the highest exposures.

Key terms case-referent study, epidemiology, occupation, population-based, risk factors.

Bladder cancer is common in industrialized countries (1, 2). The main identified etiologic factors are tobacco smoking and occupation (3—5). It has been estimated that between 1% and 20% of bladder cancer cases can be attributed to occupation (6—8).

Several studies have found an association between bladder cancer and employment in the textile industry (9—15). For specific textile occupations and activities, such as dyeing and printing, the association is well established, and exposure to napthylamines, known carcin-

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ogens since the first half of this century (16, 17), has been identified. For other occupations, available data are nonconclusive (9—22) and thus deserve further attention (23). One of the limitations of most community-based studies conducted so far is that the prevalence of exposure in the textile industry has been relatively low, and therefore no detailed analysis of occupations and processes within this industry has been possible.

In Spain, incidence and mortality from bladder cancer are high, and increasing rates have been observed for several decades (24, 25). The county of Vallès Occidental is a highly industrialized and urbanized area of about 600 000 inhabitants in the province of Barcelona. Recent data show that the incidence of bladder cancer in this county (44.1 per 100 000 men) is among the highest reported for men (26). Its industrial frame is mainly manufacturing. The textile industry has been very prevalent, employing more than 40% of the population ever employed in this industry, and it mainly concentrates on wool and cotton products. A population-based case-referent study was conducted with the objective of investigating the risk of bladder cancer in more detail in the textile industry.

Subjects and methods

The study base was the county of Vallès Occidental. The cases were defined as all persons living in that area with a histopathologically confirmed first diagnosis of malignant tumor of the urinary bladder, coded as ICD-188 in the 9th revision of the International Classification of Diseases, between 1 October 1993 and 31 May 1995. They were selected through the hospitals of the county and through 11 other hospitals, mainly from the city of Barcelona, where some cases of the county were diagnosed or treated.

The reference group was a population-based sample of living persons without any kind of known benign or malignant tumor of the urinary tract, and their area of residence belonged within the county of Vallès Occidental at the time of selection. Two referents per case were randomly selected using municipal-based census lists. The exclusion criteria were the same as for the cases. The referents were individually matched to the case series by gender, age (5-year groups) and municipal area of residence.

An active search of cases was carried out by establishing specific strategies of detection for each hospital. An exhaustive detection was ensured by enlisting the participation of 1 person from the urology, oncology, pathology or admissions department in each hospital. A co-ordinator supervised complete and efficient case detection in all the centers. Completeness was periodically validated from the information systems (admission lists, pathology records, etc) of all the centers. For the selection of referents, a participant was also assigned in each town hall, and a random selection strategy was established for each one. Once a case was detected and included in the study, 2 referents were randomly selected from the census list, according to the gender and age of the case.

The cases and referents were interviewed by means of a standardized questionnaire (27). It included demographic data, complete occupational history, lifetime tobacco consumption, history of urinary tract infections, and coffee consumption. Only jobs held for at least 6 months were included. For each job, the year the job began and finished, the subject's occupation, a description of tasks performed, the type of activity of the company, its size, name and address, and the main products manufactured or services provided were recorded. To reinforce the recall of suspected occupations, specific questions were included, and exposure in several occupations and sectors within the textile industry was also specifically asked. Interviews were carried out by 3 trained interviewers either at home, at an office of the coordinating center, or during admission to a hospital or a visit to an outpatient clinic. Each occupation was coded using the Spanish National Classification of Occupations (CNO, 1979), which is an adaptation of the 1968 version of the International Standard Classification of Occupations (ISCO) of the International Labour Office. The work activities of companies were coded using the Spanish Classification of Economic Activities of 1993. For the textile industry, some other ad-hoc codes were also used for a small fraction of persons when the company had several subtextile activities and the occupation was nonspecific so that a specific activity code could not be assigned (eg, a blue-collar worker in a spinning and weaving factory). Under such circumstances, a code summarizing the combination of different industrial activities within this industry was devised. Codification was carried out by an expert (DT) in hygiene, who was blind as to the case-referent status.

Altogether of 277 cases and 491 referents were detected. Of them, 220 (79.4%) cases and 349 (71.1%) referents were interviewed. Of the 57 cases and 142 referents that could not be interviewed, 11 cases and 68 referents could not be traced, 12 cases and 8 referents had serious difficulties, due to poor health, to respond to the questionnaire, 23 cases and 62 referents refused to participate, 10 cases and 3 referents died before the interview could be carried out, and 1 case and 1 referent could not be interviewed for other reasons. After the interview, 2 other cases were excluded because a previous diagnosis of bladder cancer was determined during the interview or the case did not meet the diagnostic criteria once additional clinical information was available, and 5

Table 1. Description of the case subjects and the referents.

	Subjects (N=218)		Referents (N=344)	
	N	%	N	%
Age (years)				
<35	2	0.9	6	1.8
36—55	32	14.7	38	11.0
56—75	134	61.5	230	66.9
≥76	43	20.4	63	18.3
Missing	7	3.2	7	2.0
Gender				
Male	196	89.9	314	91.3
Female	22	10.1	30	8.7
Marital status				
Single	2	0.9	13	3.8
Married	183	83.9	285	82.8
Widow	29	13.3	37	10.8
Divorced	3	1.4	6	1.7
Missing	1	0.5	3	0.9
Educational level				
Some primary education	106	48.8	156	45.7
Elementary education	77	35.5	129	37.8
High school	25	11.5	37	10.9
Higher education	9	4.1	19	5.6
Missing	1	0.5	3	0.9
Smoking status				
Ever smoked[a]	185	84.9	241	70.1
Pack-years[b]				
0	38	17.4	109	31.7
>0—15	17	7.8	64	18.6
15—34	56	25.7	76	22.1
35—54	62	28.4	57	16.6
≥55	45	20.6	38	11.0

[a] Any kind of tobacco (cigarettes, cigars, pipe).
[b] It refers only to ever cigarette smokers; thus 3 case subjects and 5 referents who never smoked cigarettes, but had only other forms of tobacco use (cigars, pipe) were excluded from this analysis. In addition, 2 case subjects and 1 referent who had ever smoked cigarettes but had missing information about the number of smoked cigarettes per day were excluded.

Table 2. Association between the occupational groups in the textile industry and bladder cancer. (95% CI = 95% confidence interval)

Occupational group[a]	Case subjects	Referents[b]	Odds ratio[c]	95% CI
Never textile (-)	143	231	1	·
All textile occupations (75/79)	75	113	1.03	0.70—1.51
Textile workers (75)	67	106	0.99	0.67—1.47
Tailors, dressmakers and related workers (79)	11	12	1.36	0.52—3.56
Fiber preparers (751)	9	24	0.57	0.25—1.30
Spinners and winders (752)	21	30	0.99	0.53—1.87
Machine setters and others (753/841.50/849.45)	11	8	2.02	0.74—5.51
Weavers and knitters (754/755)	24	41	0.96	0.53—1.76
Dyers and finishers (756)	16	30	0.81	0.41—1.59
Other textile workers (757/758/759)	6	4	2.33	0.62—8.76

[a] Code of the CNO-1979 in parentheses.
[b] The reference group were those who had never had a textile occupation.
[c] Nonconditional logistic regression, adjusted by tobacco consumption, age and gender.

referents were also excluded because they had a current or previous diagnosis of bladder cancer. Finally, 218 cases and 344 referents were included in the analysis. The majority of histological types of cases were transitional-cell carcinomas (93.6%). The rest were squamous-cell carcinomas (0.9%), adenocarcinomas (4.1%), and other types (1.4%). All the interviews were complete and were carried out at the person's home for 117 (53.7%) cases and 254 (73.8%) referents. The mean duration of the interview was similar for the cases and referents (46.7 versus 44.4 minutes), as was the average number of different jobs ever held (3.9 versus 4.6 jobs). The cases and referents were similar regarding age, gender, marital status, and educational level, but smoking was more frequent among the cases than among the reference series and cumulative cigarette consumption was also higher for the cases (table 1).

Analysis

Odds ratios (OR) and their 95% confidence intervals (95% CI) were calculated. Unconditional logistic regression was used, using the SAS (statistical analysis system) for windows. All the analyses were adjusted for age, gender, and smoking (ever versus never smoker). All the jobs were analyzed according to occupation and industrial activity. For the textile industry analysis, unexposed workers were defined as those who had never had a textile occupation or had never worked in a textile industrial activity.

The following three temporal variables were used in the analysis: (i) the period of work, defining 3 different periods [before 1960, 1960—1974, and after 1974, according to big changes that occurred in the textile industry of Catalonia at those times (28) and that could well have affected the work conditions], (ii) duration of exposure (<10 years, 10—19 years and ≥20 years), and (iii) age at first exposure (<50 years and ≥50 years).

Results

Table 2 shows the analyses for occupations in the textile and dressmaker sector. A proportion of 30.7% of the cases and 30.8% of the referents had ever been textile workers, and 5.0% and 3.5%, respectively, had ever been tailors or dressmakers. The prevalence of specific textile occupations among the referents was high, for example, 7% for fiber preparers and 11.3% for spinners and winders. There was no association observed for most occupations, apart from machine setters and other textile workers who had a nonstatistically significant increased risk.

Table 3 shows the analysis for industrial activities for the textile and dressmaker industries. The prevalence of

the textile industry in the sample was 42.2% among the cases and 39.2% among the referents, and for the clothing industry the corresponding figure was 3.2% for both the cases and referents. For the 3 main sectors of the textile industry (preparing fibers and spinning, weaving, dyeing and finishing) the prevalences ranged between 13% and 17% among the reference series. No increased risks were found for the textile industry, although a non-statistically significant increased risk was observed for the sector of preparing fibers and spinning, involving either cotton or wool materials. Elevated risks were also found for the cotton sector on the whole and for its weaving section, but none of them reached statistical significance.

A statistically significant increased risk was observed for spinners and winders with a duration of >20 years (OR 3.28, 95% CI 1.08—9.97) and for persons exposed in the preparation of fibers and spinning before 1960 (OR 1.82, 95% CI 1.07—3.10). An increasing trend with duration and period of exposure was suggested for machine setters, and a statistically significant increased risk was found for those employed between 1960 and 1974 (OR 4.26, 95% CI 1.09—16.7).

For those younger than 50 years of age and those older than 50 years, we compared the risk for textile occupations and main industrial activities for those first employed in each occupation. Although none of the risks were statistically significant, they tended to be higher for those who started at a younger age.

Finally, compared to never smokers, and after adjustment for age and gender, ever smokers showed an elevated risk of bladder cancer (OR 4.31, 95% CI 2.38—7.79).

Table 3. Association between textile industrial activities and bladder cancer. (95% CI = 95% confidence interval)

Group of industrial activity[a]	Case subjects	Referents[b]	Odds ratio[c]	95% CI
Never textile industry (-)	117	199	1	.
All textiles (17/18)	101	145	1.13	0.79—1.63
Textile (17)	92	135	1.14	0.78—1.64
Made-up of textile goods (18)	7	11	0.86	0.28—2.69
Preparing fibers and spinning (17.1)	46	59	1.41	0.88—2.28
Weaving (17.2[d])	28	49	0.95	0.54—1.66
Dyeing and finishing (17.3[d])	27	44	0.98	0.56—1.71
Cotton (17.110 / 17.210[d])	22	26	1.36	0.71—2.60
Wool (17.120 / 17.130[d])	48	78	1.11	0.71—1.74
Silk (17.150)	7	9	0.96	0.29—3.14
Knitting mills (17.6)	3	7	0.52	0.10—2.78
Others (17.160 / 17.170)	3	6	0.53	0.10—2.83
Cotton preparing and spinning (17.110[d])	13	15	1.29	0.57—2.93
Cotton weaving (17.210[d])	12	14	1.45	0.62—3.40
Cotton dyeing and finishing (17.113[d])	1	2	0.70	0.06—8.45
Wool preparing and spinning (17.120[d])	37	46	1.57	0.93—2.64
Wool weaving (17.220[d])	13	38	0.58	0.29—1.17
Wool dyeing and finishing (17.128[e])	2	3	1.31	0.20—8.41
Silk preparing and spinning (17.150[d])	1	3	0.79	0.08—8.01
Silk weaving (17.240[d])	3	6	0.23	0.03—2.09

[a] Code of the CNAE-93 in parentheses.
[b] The reference group comprised those who had never worked in a textile industrial activity.
[c] Nonconditional logistic regression, adjusted by tobacco consumption, age and gender.
[d] Ad-hoc codes were also used.
[e] Ad-hoc code.

Discussion

Several studies have found an association between the textile industry and bladder cancer, particularly among weavers (9, 12, 18). The risk of bladder cancer associated with dyeing was established several decades ago, and aromatic amines have been identified as carcinogens for these workers. The results of the present study showed only a small elevated risk. This finding can be explained by the types of textile exposures found in Vallès Occidental, in comparison with other areas, and also by the improvements that have been made in work conditions across time. The county concentrates mainly on wool-based products, and the dyeing of cotton products is rather uncommon. A study carried out in a nearby area (12) found an increased risk of bladder cancer in association with dyeing and weaving. The textile industry in that area, however, mostly involved cotton products, and the dyeing of such cotton goods was very common. Other studies have found an increased risk for cotton textile workers (19) but not for workers dyeing woolen goods (29). It is possible that different substances and exposures in cotton and wool textiles can explain our results. For example, azoic materials, known bladder carcinogens, were mainly used in the dyeing of cotton textiles but not for wools. In addition, in the study by Gonzalez et al (12), small industries in which poor safety measures were common predominated. Conversely, in Vallès Occidental bigger factories predominate, in which more safety measures are expected.

Work conditions have changed across time. The studies published were mostly carried out in the 1970s or early 1980s, and, if it is assumed that the mean latency period for bladder cancer is 20 years, cases attributable to occupational risks would have mostly been exposed in the 1950s and 1960s at the latest. Since then, work conditions have improved significantly, and in Spain important changes have occurred in the industry from the 1960s on, especially after 1975 (28). Our series corresponds to cases that would have been exposed mainly in the 1970s, and the time frame could explain the lack of positive results. Other also recent studies carried out in other

countries have not found elevated risks for occupations previously associated with bladder cancer (20).

A risk associated with exposure to spinning over a long period of time and during earlier periods was shown by our data, which suggest that exposure changes and improvements in work conditions in general (such as better hygienic standards) could have had an impact on the risk of bladder cancer. Spinners have previously been found to have increased risks of cancers other than those of the bladder (3). Relevant exposure, such as oils and fibers, in contact with the skin or the respiratory tract occurs during spinning. Certain kinds of oils are known to cause cancer in humans (30).

Previous studies have reported an elevated risk for machine operators (10, 18, 31) because of possible exposure to cutting oils and other substances that contain aromatic amines and nitrosamines (30). We found increased risks for machine setters, especially those exposed from 1960 on. Although machines and ambient air in textile mills are much cleaner now than earlier, the handling of oily materials for machine maintenance has probably not changed much.

The risk of bladder cancer in relation to the age at which exposure began has been a subject of debate. Previous studies found a higher risk for young workers at first employment (31, 32), whereas others found a more elevated risk for those older (17). Our series supports the hypothesis that first employment in the textile industry at a younger age tends to involve a more elevated risk.

In conclusion, an overall association between bladder cancer risk and work in the textile industry was not found in our study. Only the subgroup of machine setters exposed in the past and spinning exposed during long periods were significantly associated with a higher risk of bladder cancer.

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