

Pet birds and risk of lung cancer in Sweden: a case-control study

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Abstract

Objective—To investigate the association between keeping birds and the risk of lung cancer in Sweden.

Design—Case-control study based on cases of lung cancer and community controls. Interviews were performed by two nurses specially trained for this project.

Setting—Three major referral hospitals located in southwest Sweden.

Subjects—All patients aged 75 and under with newly diagnosed lung cancer and of Scandinavian birth who lived in one of 26 municipalities in Gothenburg and Bohus county or Älvsborg county. Potential control subjects matched on county of residence, sex, and closest date of birth were selected from population registries. In the context of a larger case-control study, information on pet birds was obtained from 380 patients with lung cancer (252 men) and 696 controls (433 men).

Main outcome measures—Odds ratios for lung cancer in relation to whether or not pet birds were kept and the duration of keeping pet birds.

Results—The adjusted odds ratio for ever versus never exposed to pet birds at home was 0.94 (95% confidence interval 0.64 to 1.39) for men and 1.10 (0.64 to 1.90) for women. There was no evidence of a trend for increased risk of lung cancer with duration of bird ownership.

Conclusion—Bird keeping does not seem to confer any excess risk of lung cancer to Swedish men or women.

Introduction

Contact with birds has been associated with cancer in three case-control studies in European populations.¹⁻³ The original study from the Netherlands was carried out by Holst *et al* in 1988.¹ After adjustment for smoking (as a binary variable of smoker *v* non-smoker) the relative risk of lung cancer from exposure to any bird in the five to 14 years before diagnosis was estimated to be 6.7 (95% confidence interval 2.2 to 20.0) on the basis of data from 49 patients with lung cancer and 98 randomly selected population based controls. In a hospital based case-control study of 143 patients with lung cancer, 143 controls with heart disease, and 143 controls with orthopaedic conditions Gardiner *et al* found no significant association between household exposure to pet birds and lung cancer overall (relative risk 1.29 (0.79 to 2.12)). They did, however, find a significant risk of lung cancer associated with keeping pigeons (3.9; 1.2 to 12.6).² In an even larger study of the aetiology of lung cancer Kohlmeier *et al* observed an increased risk of lung cancer of 2.14 (1.35 to 3.40) among people in West Berlin exposed to pet birds.³ The adjusted odds ratio increased to 3.19 (1.48 to 8.21) among those with longest (>10 years) exposure.

As keeping birds is fairly common in Sweden, a relative risk of the magnitude reported in any of these earlier studies could have a substantial impact on the nation's public health. We therefore included questions concerning bird ownership in our population based case-control study of lung cancer conducted in the city of Gothenburg and counties of Bohus and Älvsborg in southwest Sweden.

Subjects and methods

STUDY POPULATION AND SELECTION OF CASES AND CONTROLS

The study comprised patients 75 years and under of Scandinavian birth who lived in one of 26 municipalities in Gothenburg and Bohus county and Älvsborg county in southwest Sweden at the time of the study. The municipalities were selected to represent the area from which patients with suspected lung cancer were referred to the pulmonary units at the regional hospitals.

Procedures were established to identify suspected cases of lung cancer at three hospitals in the region. These hospitals cover more than 90% of such cases in the Gothenburg area and 75% in the county of Älvsborg. Patients who were referred to one of these hospitals with suspected lung cancer (on the basis of lung x ray findings) were invited to participate in the study.

The project was described as a research project aimed at studying the relation between environmental factors and lung disease. Patients who were willing to participate in the project were immediately contacted and an appointment for an interview was made. For each patient who had suspected lung cancer the next person in the respective county who was of the same sex and closest in birth date in the regional population registry was identified as a control. If the person was an immigrant an alternative control was selected.

Of the 731 men and 475 women with suspected cancer, 645 (88%) and 390 (82%), respectively, were interviewed. Of the 171 patients (14%) who were not interviewed, 77 had agreed to participate but were too ill to undergo interview, nine were not asked on the grounds of mental illness, and 85 declined. Among the 733 men and 476 women who were approached as controls, 159 (22%) and 134 (28%), respectively, were not interviewed: 79 (7%) declined because of ill health, 106 (9%) refused without indicating a reason, and 108 (9%) did not answer the letter or telephone call.

The suspected cases and controls were matched with the regional cancer registry. They were classified as cases of lung cancer (ICD-7 (international classification of diseases, seventh revision), code 162.1) only if they had a complete notification in the registry (that is, a report from the clinician as well as the pathologist).

Of the 645 men and 390 women with suspected cancer who we interviewed, 355 (55%) and 178 (46%), respectively, were later diagnosed as having primary lung cancer. The patients who did not receive this diagnosis were excluded from the analysis and not used as controls.

QUESTIONNAIRE

The questionnaire included questions on smoking, environmental tobacco smoke, occupational exposure, conditions in the residential area (local air pollution), and dietary habits.⁴ Questions on pet birds were added to the questionnaire in February 1990. Information on pet birds was obtained from 685 men (252 diagnosed cases and 433 controls) and 391 women (128 diagnosed cases and 263 controls).

The section on pet birds contained questions on exposure to pet birds in the home for a period of at least six months. If there was such exposure, follow up questions were asked about the length of contact, the calen-

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Table 1—Characteristics of men and women with lung cancer and population controls regarding potential confounding factors for lung cancer. Figures are numbers (percentage) of subjects

Characteristic	Men		Women	
	Cases (n = 252)	Controls (n = 433)	Cases (n = 128)	Controls (n = 263)
Age at interview (years):				
<50	14 (5.6)	34 (7.8)	18 (14.1)	30 (11.4)
50–59	55 (21.8)	89 (20.6)	19 (14.8)	58 (22.1)
60–69	109 (43.3)	182 (42.0)	53 (41.4)	104 (39.5)
≥70	74 (29.4)	128 (29.6)	38 (29.7)	71 (27.0)
Smoking history:				
Never smoked	12 (4.8)	140 (32.3)	18 (14.1)	154 (58.6)
Former smoker	57 (22.6)	170 (39.3)	14 (10.9)	40 (15.2)
Smoker	183 (72.6)	123 (28.4)	96 (75.0)	69 (26.2)
Smoking duration (years):				
1–19	8 (3.3)	77 (26.3)	5 (4.5)	24 (22.0)
20–29	20 (8.3)	52 (17.7)	12 (10.9)	29 (26.6)
30–39	47 (19.6)	58 (19.8)	29 (26.4)	26 (23.9)
40–49	90 (37.5)	73 (24.9)	44 (40.0)	20 (18.3)
≥50	75 (31.3)	33 (11.3)	20 (18.2)	10 (9.2)
No of cigarettes smoked/day:				
1–9	27 (10.8)	82 (28.0)	13 (11.8)	37 (33.9)
10–19	91 (37.9)	106 (36.2)	63 (57.3)	50 (45.9)
20–29	88 (36.7)	77 (26.3)	28 (25.5)	15 (13.8)
≥30	35 (14.6)	28 (9.6)	6 (5.5)	7 (6.4)
Marital status:				
Married	188 (74.6)	344 (79.4)	74 (57.8)	181 (68.8)
Widowed	16 (6.3)	23 (5.3)	22 (17.2)	45 (17.1)
Divorced	25 (9.9)	25 (5.8)	23 (18.0)	19 (7.2)
Never married	23 (9.1)	41 (9.5)	9 (7.0)	18 (6.8)
Socioeconomic job classification:				
Higher civil servants and executives	23 (9.1)	60 (13.9)	4 (3.1)	10 (3.8)
Farmers	1 (0.4)	13 (3.0)		
Housewives		2 (0.2)		15 (5.7)
Self employed	24 (9.5)	44 (10.2)	2 (2.3)	7 (2.7)
Intermediate non-manual employees	33 (13.1)	86 (19.9)	17 (13.3)	34 (12.9)
Assistant non-manual employees	39 (15.5)	60 (13.9)	30 (23.4)	78 (29.7)
Skilled workers	71 (28.2)	95 (21.9)	12 (9.4)	15 (5.7)
Unskilled and semiskilled workers	61 (24.2)	75 (17.3)	60 (46.9)	104 (39.5)

dar period of this contact, and kinds of birds. Of those who reported having been exposed to pet birds, 96% had their first exposure more than five years before the interview. There were no questions on where in the house the birds were kept nor the number of birds.

INTERVIEWS

The patients were interviewed within a few days after referral to the department. Two nurses specially trained for the project administered all interviews at the hospitals. Interviews were generally conducted before the diagnosis was established and before the patient's condition had become so serious that an interview could not be carried out.

The interview took about 45 minutes to complete, and the two nurses alternated between interviewing controls and suspected cases to avoid subjective bias. Interviews with controls usually took place at the department or at their homes within four to eight weeks of the patient's interview. The recruitment of patients started in January 1989 and ended in June 1994.

STATISTICAL ANALYSIS

For estimation of odds ratios, logistic regression models were fitted to the data with the EGRET software package for unconditional maximum likelihood estimation of the regression parameters.⁵ In all analyses adjustments were made for age, number of cigarettes a day, duration of smoking (years), number of years since quitting smoking (continuous variables), marital status (four classes), and socioeconomic job classification. One gram of pipe tobacco was considered to be equal to one cigarette. Those who had stopped smoking in the four years before the interview were classified as smokers.

Adjustments were also made for consumption of vegetables, fruit, and milk. The choice of adjustments was made on the basis of previous results from the study on men.⁴

Results

Table 1 gives details of the cases and controls. Differences between cases and controls were seen for smoking, marital status, socioeconomic job classification, smoking duration, number of cigarettes smoked, and intake of vegetables, fruits, and milk (not shown in table).

The odds ratio adjusted for age for current smoking (20 cigarettes a day) compared with never smoking was 32.4 (14.5 to 72.3) for men and 43.3 (12.6 to 148.8) for women. The adjusted odds ratio for ever versus never exposed to pet birds at home was 0.94 (0.64 to 1.39) for men and 1.10 (0.64 to 1.90) for women. Current smokers (men and women) had an odds ratio of 1.08 (0.69 to 1.68), former smokers 1.30 (0.73 to 2.30), and never smokers 0.32 (0.11 to 0.89) after adjustment for sex. Table 2 shows the adjusted odds ratio for lung cancer by duration of exposure to pet birds among 252 men and 128 women with lung cancer and 433 and 263 controls. No evidence for a trend of increasing risk of lung cancer with duration of bird ownership was observed for the men or women in this study.

We had information on type of pet bird for 98% of the exposed men and 97% of the exposed women. Table 3 shows the odds ratios for exposure to parakeets (budgerigars), canaries, parrots, and other birds. Parakeets were the most common birds, and the odds ratios were close to 1.0 for men and women. The difference between the crude and adjusted odds ratio for "other birds" was due mainly to the number of years the subjects had smoked.

Discussion

The overall results from this case-control study of exposure to pet birds in southwest Sweden does not provide strong support for the proposed aetiological link between bird keeping and the risk of lung cancer. An even larger study, which examined both pet ownership and exposure to farm fowl in Missouri, United States, also provided no additional epidemiological support for this hypothesis.⁶

Table 2—Exposure to pet birds among men and women with lung cancer and controls

Duration of exposure (years)	Men				Women			
	No (%) of cases (n = 252)	No (%) of controls (n = 433)	Crude odds ratio (95% confidence interval)	Adjusted odds ratio* (95% confidence interval)	No (%) of cases (n = 128)	No (%) of controls (n = 263)	Crude odds ratio (95% confidence interval)	Adjusted odds ratio* (95% confidence interval)
0	144 (57)	256 (59)	1.0	1.0	67 (52)	145 (55)	1.0	1.0
1–2	36 (14)	69 (16)	0.93 (0.59 to 1.46)	0.73 (0.43 to 1.27)	19 (15)	34 (13)	1.21 (0.64 to 2.28)	1.30 (0.58 to 2.89)
3–9	43 (17)	73 (17)	1.05 (0.68 to 1.61)	1.01 (0.60 to 1.72)	32 (25)	56 (21)	1.24 (0.73 to 2.08)	1.11 (0.57 to 2.17)
≥10	29 (12)	35 (8)	1.47 (0.86 to 2.51)	1.21 (0.63 to 2.32)	10 (8)	28 (11)	0.77 (0.36 to 1.68)	0.94 (0.35 to 2.54)

*Adjusted for vegetable index, fruit index, milk consumption, age, number of cigarettes/day, number of years smoked, number of years since quitting, marital status, and socioeconomic job classification.

Table 3—Odds ratios (95% confidence intervals) for lung cancer according to exposure to different types of pet birds

Type of pet bird	Men				Women			
	Cases	Controls	Crude odds ratio (95% confidence interval)	Adjusted odds ratio* (95% confidence interval)	Cases	Controls	Crude odds ratio (95% confidence interval)	Adjusted odds ratio* (95% confidence interval)
Never exposed to pet birds	144	256	1.0	1.0	67	145	1.0	1.0
Parakeet (budgerigar)	80	133	1.07 (0.76 to 1.51)	0.89 (0.58 to 1.37)	53	92	1.25 (0.80 to 1.95)	1.24 (0.70 to 2.21)
Canary	10	29	0.61 (0.29 to 1.29)	0.80 (0.33 to 1.95)	6	22	0.59 (0.23 to 1.52)	0.83 (0.26 to 2.62)
Parrot	10	18	0.99 (0.44 to 2.20)	0.64 (0.24 to 1.71)	4	7	1.24 (0.35 to 4.37)	0.90 (0.18 to 4.48)
Other birds	16	12	2.37 (1.09 to 5.15)	1.94 (0.70 to 5.37)	3	9	0.72 (0.19 to 2.75)	0.55 (0.12 to 2.42)

*Adjusted for vegetable index, fruit index, milk consumption, age, number of cigarettes/day, number of years smoked, number of years since quitting, marital status, and socioeconomic job classification.

Presumably the epidemiological inconsistency between the two recent studies and the three earlier studies may be explained by a true difference in risk experienced by Swedes and Missouri women on one hand and Dutch, German, and British bird owners on the other. For instance, only two people in our study (both cases) reported exposure to pigeons, which previously has been associated with an increased risk.² Alternatively, as has been suggested by several authors, the aetiological association purported by the earlier studies or by extension the study result(s) reported here may be the result of methodological artefact.⁷⁻⁹

A consistent positive association from studies of diverse methodological design is usually considered a strength in support of a purported aetiological association. Potential weaknesses affecting each of the positive case-control studies, however, leave open the possibility that methodological artefact may play a part in creating a spurious association. Although residual confounding from heavier cigarette exposure among bird keepers has been discussed,^{7 10 11} the excess risk of lung cancer associated with the lower socioeconomic categories is not necessarily completely accounted for by differences in smoking behaviour. Incidence in non-malignant respiratory disease,¹² environmental exposure to tobacco smoke,¹³ air pollution,^{14 15} occupational carcinogens,¹⁶ and diets low in fresh fruits and vegetables and high in animal fat^{17 18} have been identified as potential risk factors for lung cancer. We suspect the incidence of many of these exposures are more common in the lower socioeconomic categories. In the research of Gardiner and Lee pigeon keepers, who were the only group with a significant excess risk of lung cancer, were much more likely to belong to social grade D.¹⁰ In the study by Holst *et al* 78% of the cases and only 67% of the controls belonged to the lower socioeconomic category.¹ Data on socioeconomic category were not presented by Kohlmeier *et al*.^{3 11}

Certainly, the mere possibility of confounding does not mean that confounding is necessarily responsible for the positive associations observed in the Netherlands, Germany, and Britain. Although our own study has several strengths—namely, its size, its detailed histories on smoking and diet, and its information on

duration of pet ownership—it is limited by the absence of intensity of exposure data. Our questionnaire did not collect information on the numbers of birds owned or the amount of contact with them. The Swedish data may be missing a positive association between intense contact with birds and an excess risk of lung cancer. This possibility is somewhat diminished by the Missouri data, which found no association with intensity of exposure nor any other measure of exposure.⁶ If, however, intensity of exposure is greater among European men than Missouri women intensity of exposure may need further study.

Bird ownership is a widespread practice in many areas of the world and the possibility of its association with a highly fatal disease such as lung cancer is a serious potential public health problem that needs further investigation. In light of the inconsistent epidemiological data, however, a more specific hypothesis needs to be proposed before the next scientific or public health step can be taken.

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Key messages

- Three previous studies found an association between keeping pet birds and an excess risk of lung cancer
- A population based case-control study of lung cancer in southwest Sweden was conducted with questions about duration of pet bird ownership and types of birds owned
- No evidence of a trend for increased risk of lung cancer was observed with duration of ownership of birds
- Bird keeping does not seem to confer any excess risk of lung cancer in Sweden