Passive smoking and diet in the etiology of lung cancer among non-smokers

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A case-control study was undertaken in Athens to explore the role of passive smoking and diet in the causation of lung cancer, by histologic type, in non-smoking women. Among 160 women with lung cancer admitted to one of seven major hospitals in Greater Athens between 1987 and 1989, 154 were interviewed in person; of those interviewed, 91 were life-long non-smokers. Among 160 identified controls with fractures or other orthopedic conditions, 145 were interviewed in person; of those interviewed, 120 were life-long non-smokers. Marriage of a non-smoking woman to a smoker was associated with a relative risk for lung cancer of 2.1 (95% confidence interval [CI] 1.1 - 4.1); number of cigarettes smoked daily by the husband and years of exposure to husband's smoking were positively, but not significantly, related to lung cancer risk. There was no evidence of any association with exposure to smoking of other household members, and the association with exposure to passive smoking at work was small and not statistically significant. Dietary data collected through a semi-quantitative food-frequency questionnaire indicated that high consumption of fruits was inversely related to the risk of lung cancer (the relative risk between extreme quartiles was 0.27 (CI 0.10 - 0.74)). Neither vegetables nor any other food group had an additional protective effect; furthermore, the apparent protective effect of vegetables was not due to carotenoid vitamin A content and was only partly explained in terms of vitamin C. The associations of lung cancer risk with passive smoking and reduced fruit intake were independent and did not confound each other. Passive smoking was associated with an increase of the risk of all histologic types of cancer, although the elevation was more modest for adenocarcinoma.

Key words: Lung cancer, passive smoking, diet, air pollution, vitamin A, vitamin C, carotene.

Introduction

The association between involuntary exposure to tobacco smoke and lung cancer was first reported in 1981; by the end of 1989 more than 20 epidemiologic studies had examined this issue. In about one-third of these studies there were statistically significant positive associations between passive smoking and lung cancer risk, whereas in another third there were positive but statistically non-significant relationships, and in the remaining third the associations were minimal or non-existent. Overall the association between passive smoking and lung cancer is highly significant and, for practical purposes, chance can be excluded as a possible explanation. On the basis of biologic plausibility and epidemiologic evidence, causality appears the most likely explanation of the empirical association, but this view has not been uniformly accepted. It has been suggested that the association may reflect misclassification of ex-smokers among non-smokers (ex-smokers are at increased risk of lung cancer and are more likely to be married to smokers relative to life-long non-smokers), or to confounding effect(s) of unspecified factor(s). One such factor could be nutrition (e.g., nutrition poor in carotenoid sources of vitamin A) since passive smokers may be less health-conscious than non-exposed persons. The present study was undertaken to examine the role of diet and passive smoking in the causation of lung cancer in non-smokers, by histologic type. Special emphasis was given to the exclusion of ex-smokers from any analysis concerning lifelong non-smokers.

Materials and methods

All women hospitalized during an 18-month period (1987 - 89) in seven hospitals of the Greater Athens area...
with a definite diagnosis of lung cancer formed the case series. The hospitals included all three cancer hospitals in this area, the only hospital for chest diseases in Athens, and the three largest university general hospitals. Women were included when there was a positive histologic or cytologic examination or when bronchoscopy was considered diagnostic of primary bronchogenic carcinoma. A total of 160 cases were identified. Controls were 160 women hospitalized in the orthopedic departments of the same hospitals or the nearby hospital for orthopedic disorders, to which most accident cases from Greater Athens and the surrounding area are admitted. Controls were randomly selected from those admitted within a week after the identification of a corresponding case and had to be 35 years of age or over. Among the control women, 102 had fractures and the remaining 58 had other traumatic or orthopedic conditions.

All cases and controls were interviewed in person in the hospital wards, as soon as a definite diagnosis was established, by one of five interviewers who each interviewed the same proportion of cases and controls. There were no refusals among cases but six were too ill to be interviewed. Among controls, 12 were in a condition that did not permit interview, and three refused to participate. In the interviews, patients were asked to indicate in detail their lifelong smoking histories, their exposure to passive smoking—from their husbands, from other household members and at work—as well as a number of other demographic, socioeconomic, and medical characteristics. Subjects were also asked to estimate the average frequency of consumption (per month, per week, or per day), before the onset of the present disease, of 47 food items or beverage categories. These items were selected from an extensive list of 120 items, using the criterion that the selected items should cover, collectively, more than 80% of the intake of each of the energy-generating nutrients as well as of vitamin A. This criterion was established on information from control groups in a number of case-control studies undertaken in Athens to explore the role of diet in the causation of cancer at various sites.

Lifetime exposure to air pollution was controlled in the analysis on the basis of information about the lifelong residential and employment addresses of all subjects. The areas of residence and work were divided into five categories according to their estimated outdoor air-pollution levels. For the Greater Athens area, air-pollution levels by borough were calculated on the basis of the mean yearly measurements (1983–85) of smoke and NO$_2$, as recorded in 14 monitoring stations dispersed throughout the area. A line for zero air pollution was established on information from control groups in a number of case-control studies undertaken in Athens to explore the role of diet in the causation of cancer at various sites.

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Exposure to the smoking of household members other than the husband was assessed by multiplying the years a woman lived in each of her homes throughout her life, with the number of smokers in the corresponding home (excluding the husband) and by summing these product terms. Subsequently, all women were distributed into four groups: one containing those who had never been