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‘Lung cancer and tobacco consumption’: technical evaluation of the 1943 paper by Schairer and Schoeniger published in Nazi Germany

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INTRODUCTION

Ideological rather than technical considerations have dominated the discussion over whether or not scientists in Nazi Germany used up-to-date epidemiological methods to investigate the relation of tobacco to lung cancer. To the question ‘could something good have emanated from this evil regime?’ some historians¹ and epidemiologists² have responded affirmatively, suggesting that because of an obsession with racial purity and health, the Nazis had been ahead of their time in terms of research on the effect of tobacco and health. Strangely, however, little attention has been given to the technical quality of this material, in terms of design and analytic methods, and to how it compared with pre-1945 epidemiological research. A telling fact is that the first of the two papers reporting associations between tobacco and lung cancer published during the Third Reich, by Mueller, which appeared in 1939, remained unavailable as a primary document for people who do not read German until selected portions were translated into English for the first time in 2012.³

As I did for Mueller’s 1939 paper,³ I proceed here with a technical evaluation of the second, and more recent, tobacco and lung cancer paper published in Nazi Germany. The paper entitled ‘Lung Cancer and Tobacco Consumption’⁴ was submitted, in German, to the *Zeitung fuer Krebsforschung* (Journal of Cancer Research) on 27 August 1943 and published in issue 4 of volume 54 in 1943. It was translated into English in 2001.⁵ I have used for this purpose all the primary material that, to my knowledge, is currently available.

ANALYSIS

The paper

In brief, in 1942, the authors sent a questionnaire about smoking habits to the relatives of 195 patients who had been diagnosed with lung cancer between 1930 and 1941 in Jena, Thuringia, a Central-Eastern region of Germany. Additionally, the survey was sent to the relatives of 555 patients who had died from cancer of the tongue, oesophagus, stomach,

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rectum and prostate ‘to assess the possible influence of smoking on other types of cancer.’ They sent another questionnaire to 700 ‘normal’ men, residents of Jena, ‘aged 53 and 54 years.’ This age group was chosen because the average age at death of the lung cancer cases was 53.9 years. Of the 1450 questionnaires sent out in total, 38.6% were deemed usable (‘brauchbare’), including 93 male and 16 female lung cancer cases. Results indicated that lung cancer patients were more likely to be ‘moderate,’ ‘heavy’ or ‘very heavy’ smokers compared with patients with other cancers, in particular gastric cancer. Lung cancer patients also smoked more than normal men (table 1). Of the 108 female cancer patients, all but three (two stomach and one colon cancer patients) were non-smokers.

The stated objective of Schairer and Schoeniger’s study was ‘to demonstrate the general validity’ (‘um ihre allgemeine Gueltigkeit zu erweisen’) of another study with a similar title published in 1939 by Mueller.⁶ The results of the two studies were deemed consistent, but, as I show in table 2, their analyses were based upon two very different categorisations of smoking. Amounts smoked were different, and the smoking categories of Mueller’s study⁶ comprised cigarette, pipe and cigar smoking, while those of Schairer and Schoeniger’s study⁴ did not mention pipe smoking.

The authors

Schairer and Schoeniger worked in the Wissenschaftliches Institut zur Bekämpfung der Tabakgefahren (Scientific Institute for the Control of Tobacco Hazards), created in 1941 and led by SS Karl Astel, a sympathiser of the German groups publishing racist antitobacco propaganda such as the journal *Reine Luft* (Pure Air) (pp 497–8⁷). Eberhard Schairer (1907–1996) had ‘applied to join the Nazi Party in 1937’ and was doctor of the Sturm Abteilung (or brown shirts) (p 214¹). Erich Schoeniger (1917–?), Schairer’s advisee, participated in the military campaign against France in the army and then completed his MD from the University of Jena.⁸

Lingering issues

If we remove the Nazi context and simply evaluate how convincing the paper could be in 1943, a number of previously unaddressed issues arise.

First, how did the authors identify the 700 men residing in Jena, specifically aged 53 or 54 years, including their addresses, and send them a questionnaire? What were the characteristics of the 270 respondents compared with those who did not? The paper⁴ is silent about this.

Second, could Schairer and Schoeniger have compared their results with those of Mueller using exactly the same categories of smoking Mueller had used? Would the results still have been consistent between the two studies?

Third, what did Schairer and Schoeniger do with the pipe smokers? From Mueller’s paper⁶ we can expect pipe smoking, alone or in combination with other forms of tobacco use, to have represented a substantial fraction of the tobacco exposure at that time. Yet, pipe smoking is not included in the smoking categories used by Schairer and Schoeniger.⁴ Is there an additional source of information that would allow us to determine where all the pipe smokers have gone?

Perhaps it may be argued that this was 1943 and epidemiological designs were not as rigorous during that time as they are today, and therefore it is unfair to scrutinise this paper as I do. If this is true, then how does Schairer and Schoeniger’s report compare with those of case-control studies published around the same time? Was the dearth of detail about the selection and comparability of the groups, and about the analytical methods, common in the

epidemiological publications of the 1930s and 1940s? Are the weaknesses in Schairer and Schoeniger's report⁴ typical of epidemiological work then?

Besides the 1943 article, the typewritten dissertation that the younger of the two authors, Schoeniger, defended orally on 25 May 1944,⁸ is probably the only still available additional source of information about the study. I therefore used both the paper⁴ and the dissertation⁸ to address the questions mentioned above. I also compared the Methods sections of Schairer and Schoeniger's paper⁴ with that of six case-control studies published before 1945.

The dissertation

The dissertation is a 27 page, typewritten document in A4 format. The cover page says that this doctoral dissertation, submitted at the School of Medicine of the University Friedrich Schiller of Jena, came out of the Pathology Institute of Jena (former Deputy Director Professor Dr E Schairer) and the Scientific Institute for the Control of Tobacco Hazards (Director, State Council, Professor Dr Astel). The oral evaluation took place on 25 May 1944. The first expert was Dr Schairer and the second Dr Timm. The Dean was Dr Kihn. A first section (pp 1–11) is about the rise of lung cancer and its possible causes, including occupational and tobacco exposures. Section II (pp 12–20) is about the 'research on the tobacco consumption of people who died from bronchial carcinoma.' Section III is a two-page appendix about the gender differences in lung cancer mortality. Then follow a one-page summary and acknowledgment to Schairer; a one-page biography of Schoeniger; and a list of 25 references, 19 of which are from the *Zeitschrift fuer Krebsforschung* and two in English.⁸

Elusiveness of the population control group

The dissertation⁸ provides no additional information or data breakdown about the population sample. The junior Schoeniger acknowledges the senior Schairer for 'taking care of the survey in the population which in the current wartime is not carried out without difficulties' ('fuer die Uebernahme der Rundfrage in der Bevoelkerung, die in der jetzigen Kriegszeit nicht ohne Schwierigkeiten durchzufuehren ist').⁸ Precisely because of these difficulties, the non-description of this component of the study design is baffling (and unusual for its time as I discuss below). Schairer had apparently no previous experience with population studies. How did he obtain the list of names and addresses of all men aged 53–54-years-old? Did he retrieve them from the 1939 Jena census? We can no longer determine how many men in that age range lived in Jena during that time, as the census archives have since been destroyed and the only information left is the total population size of 74 248 inhabitants in 1939 (Statistical Unit of the City of Jena, 2011, personal communication).

Comparison with Mueller's study

In 1939, Mueller published a paper on smoking and lung cancer in the same journal and with almost the same title as Schairer and Schoeniger's.³⁶ He compared 86 male lung cancer cases with an also ill-defined group of 'healthy men, of the same age,' from Cologne, Germany. His lung cancer series had 10 female cases who were all non-smokers. Schairer and Schoeniger's declared intention was to 'validate'⁴ Mueller's finding. Indeed, they used a questionnaire for the cases (provided in the dissertation, see box 1) which is almost identical to that used by Mueller.³⁶ As Mueller, they do not provide the questionnaire sent to the non-cancer group. Yet, Schoeniger decided against using Mueller's categories because they seemed 'too wide' to him, particularly for the moderate smokers (p 14⁸). Table 2 shows the two categorisations side-by-side. They are quite different. For example, for Mueller,⁶ an 'extreme' smoker could have smoked daily 10–15 cigars, more than 35 cigarettes or more than 50 g of pipe tobacco; while for Schairer and Schoeniger, a 'very heavy' smoker had smoked daily either more than four cigars or more than 20 cigarettes. Schairer and

Schoeniger used lower thresholds for heavy smoking than Mueller and did not consider pipe tobacco as an exposure.

Since both studies had utilised the same questionnaire, an exact comparison between them would have been possible, at least when comparing the cases of cancer. Unfortunately, the dissertation does not indicate if this was attempted nor does it discuss the implications of comparing studies with differing smoking categories.

How consistent would the reported associations have been, had both studies used the same smoking categories? The dissertation does not provide adequate data to reanalyse Schairer and Schoeniger's study⁴ using Mueller's categories.⁶ However, because Mueller⁶ described the smoking habits of each of his 86 cases of lung cancer, it is possible to reanalyse the smoking habits of Mueller's lung cancer cases⁶ using Schairer and Schoeniger categories.⁴ Table 2 shows that only 47 out of the 66 lung cancer patients with information on amount smoked can be classified using Mueller's categories. Of the 19 losses, eight were pipe smokers only, and 11 fell between categories because amounts were reported did not fit in Schairer and Schoeniger's categories (eg, 0.7 or 2.5 cigars/day, 5.5 cigarettes/day). Schairer and Schoeniger's categories⁴ yield 59.6% of 'very heavy' smokers among Mueller's lung cancer patients instead of the 29.1% Mueller reported.⁶ Thus, it appears that it is only after using categories that generated very different distributions of smoking among the cases—with a much higher proportion of heavy smokers—that Schairer and Schoeniger⁴ were able to conclude that their results were consistent with those of Mueller.⁶ Unfortunately, we do not have the data to reanalyse Mueller's 'healthy' group the same way and assess the impact of the different smoking categories on the tobacco–lung cancer association.

Omission of the pipe smokers

As can be seen in table 2, the smoking categories used by Schairer and Schoeniger⁴ do not mention pipe smokers. This is a serious omission, as pipe smoking was very prevalent in the 1930s and 1940s. About half of Mueller's cases smoked pipes, 9.3% were pipe smokers only and 43% (37/86) of cases were allocated to a specific smoking category because of their pipe smoking habit.⁶ Pipe smokers must have represented a substantial fraction of the Jena samples too, yet neither the paper⁴ nor the dissertation⁸ state that pipe smokers were excluded. Schairer and Schoeniger⁴ have completely failed to mention how they dealt with pipe tobacco. Therefore, pipe smokers must be buried in the analysis, misclassified as cigarette smokers or non-smokers. Here again, even using Mueller's lung cancer data, the differential impact of this error on the compared groups is impossible to assess.

Effect of the war on smoking habits

The dissertation does not provide a copy of the questionnaire sent to the normal men of Jena aged 53–54, but it reveals that it asked whether respondents had 'changed their tobacco consumption before and after the beginning of the war.'⁸ However, in their discussion, instead of checking their data, Schairer and Schoeniger⁴ only speculate about whether the large differences observed in smoking habits between the cancer and the normal cases could be due to the fact that men in Jena had stopped smoking or smoked less because of the war. This was a particularly relevant question because of the timing of the data collection. The study must have been carried out somewhere between the end of the case accrual at the Pathological Institute of Jena—either end of 1941⁴ or March 1942 (p 12⁸); paper⁴ and dissertation⁸ are inconsistent—and August 1943, date at which the paper⁴ was submitted for publication. This corresponds to the period the German Sixth Army was immobilised and then defeated in Stalingrad, USSR. Tobacco had already been severely taxed since 1939, but when the Nazi leadership declared 'total war' in 1942, after the debacle before Moscow, tobacco became even harder to get, and was allocated preferentially to soldiers (pp 428–9⁹).

There are therefore good reasons to expect that Jena men who had not been sent to some war front had been constrained by the consequences of the war to reduce their tobacco consumption. If this were so, it would most likely also have biased the associations towards a case having smoked more than the normal sample.

How was the study performed?

How did Schairer and Schoeniger perform their study?⁴ The available documents suggest that Schoeniger was in charge of the cancer series. He must have collected the data, probably sending the questionnaire to the relatives. He analysed the data (the dissertation provides the age distribution of the male and female lung cancer data, which was not in the paper) and decided himself (the dissertation⁸ is explicit about that) to use different smoking categories than those used by Mueller.⁶ Being inexperienced with the data analysis process, he must have overlooked or ignored information about pipe smoking.

The question of the population survey is much more problematic, as Schoeniger seems to have had no command over the population survey data. His dissertation strictly reproduces the paper content. How did Schairer proceed? Had he access to the 1939 census of Jena to identify all the men aged 53–54 years, he could have performed and analysed the population survey on its own, and plugged the results in Schoeniger's analysis of the case series. This interpretation, however, leaves many questions unanswered. Why did not Schairer provide more information about the population survey? Why is there no trace of the population questionnaire? How was it worded to match the content of the case questionnaire? How did Schairer know that the questionnaire to his normal cases was similar to that Mueller had used for his healthy men? How could he, when he prepared the data for Schoeniger or supervised the dissertation, not have noticed that pipe smokers were not included, even though they must have represented a substantial fraction of the smokers then?

Thus, however we look at the study, it is primarily a series of cancer cases. The population sample, which would have been its most original component, is mysterious and elusive.

Comparison with pre-1945 epidemiological studies

How did the design of the 1943 study⁴ compare with epidemiological studies of its time? Let us focus here on pre-1945 case-controls studies, the closest eligible epidemiological study design, since Schairer and Schoeniger had cancer–cancer and cancer–non-cancer comparisons. Between 1926 and 1940, that is, 3–17 years before the publication of Schairer and Schoeniger,⁴ I know of six reports published with designs that we can only refer to and analyse as 'case-control' studies.^{10–15} These studies were qualitatively different from anything that to my knowledge has been done earlier.¹⁶ They were also qualitatively different from Schairer and Schoeniger's study with respect to the designs, the detail provided on the recruitment of the controls, and the comparability of the latter with the cases.

In her 1926 report on the causes of breast cancer, Lane-Clayton and her colleagues in the UK, including Major Greenwood, compared 'a sufficient and suitable series of cases of cancer of the breast' with hospital controls defined as 'women whose conditions of life were broadly comparable to those of the cancer series but who had no sign of cancer'.¹⁰ Lane-Clayton specified appropriately that 'the control patients were not healthy women' and she convincingly argued that the controls could 'be regarded as suitable for comparison' on the basis of several comparative tables indicating similar nationality, age, civil state, occupation and children mortality between the two groups.¹⁰ The study has been recently reanalysed using modern statistical methods.¹⁷

It may be argued that Lane-Claypon's report, published in London by the Ministry of Health, did not have a great visibility in Germany. But a study with a case-control design appeared in 1928 in *The New England Journal of Medicine*. Lombard and Doering reported the results of a study based on a Massachusetts cancer control program, in which each cancer record was matched with the record of an 'individual without cancer, of the same sex and approximately the same age.'¹¹ The design of the cancer control program had been described in detail in a separate publication.¹⁸

Further, in 1933, Stocks and Karn, in the UK, reported the results of a complex case-control study of the behavioural causes of cancer conducted in multiple medical settings.¹² Patient controls were matched to cancer cases, and, when possible, the same person interviewed members of each pair. The detailed Method section specified that: 'The control series is not a random sample, but is made to conform to the case series, which is a random sample of a cancerous population.'¹² Again, the paper provided abundant tabulated evidence of the comparability of the groups.

Another illustrative example is the disease, by English *et al*,¹⁴ which appeared in JAMA in 1940, that is, about 3 years before Schairer and Schoeniger's study.⁴ The case group comprised 'a random series of 1000 patients with coronary disease'. The authors explain: 'Then we secured for a control group of individuals without coronary diseases the histories of 1000 males taken consecutively from our files for the same years as the series of cases of coronary disease. Only age and sex and the non-existence of coronary disease were consulted in this selection; no attention was paid to the individual's status as a smoker'.¹⁴

It is not by chance that these first case-control studies were explicit about their designs. Cancer and coronary heart disease were still rare at the time, even if their incidence was rising. Large numbers could only be accrued from selected populations in hospitals or other clinical settings. Comparing their characteristics with those of people free of the cases disease was not a trivial question. It led to the invention of the case-control study design.¹⁹ The authors of these six case-control studies¹⁰⁻¹⁵ felt therefore compelled to emphasise that the process of selection of the cases and controls had been conceived to yield valid comparisons.

These concerns about the comparability of the compared groups are absent in Schairer and Schoeniger's report,⁴ as well as in Mueller's 1939 report.⁶ These two German studies did not describe how the population samples were selected, recruited and analysed, and did not compare them on age and socio-economic status, both variables for which they claimed having collected information. Schairer and Schoeniger⁴ reported the 'average age' of the lung cancer group but not that of the men with other cancers, even though we know from Mueller's study that the type of tobacco use, and in particular pipe versus cigarette smoking, was strongly related to age. Thus, in the two German studies,^{4,6} reporting the smoking habits of the population sample did not pertain to a case-control study comparison. It appears to be provided as an indication of the prevalence in the population in a way that is reminiscent of pre case-control study comparisons, such as in Snow²⁰ or in Newsholme.²¹ It is of note that the German papers did not use the term 'controls' (Kontroll) to characterise their comparison groups, but the 2001 English translation of Schairer and Schoeniger's paper⁵ inappropriately translated (normal cases) as (controls), and misleadingly added the caption 'Smoking patterns among cancer patients and controls' to a table (table 2) which had originally no caption in German.⁴

'However difficult it may be to prove the case against cigarette-smoking...'

In hindsight, the link between cigarette smoking and lung cancer was not obvious to demonstrate. First, smoking was so prevalent in men that most cases and controls were

smokers. Second, because case-control studies were typically hospital-based, controls often suffered from diseases that were not suspected then to be tobacco-related, but today we know they are. Hospital controls were likely to have abundantly smoked.

Pre-1945 case-control studies ended up missing the association. In the carefully conducted, hospital-based case-control study of lifestyle and cancer by Stocks and Karn, matched non-cancer controls smoked *more* cigarettes than the cancer cases.¹² In their Massachusetts population-based case-control study Lombard and Doering did not observe large variations in smoking histories across cancer types.¹¹

One study however was right on. Hoffman,²² in the US, had reported in his extended San Francisco Cancer Survey a prevalence of heavy smoking of 67% among 27 lung cancer patients, of 46% among 1356 cancer patients and of 43.9% among 537 non-cancer patients. He also mentioned that only 12.5% of industrial workers, from a different survey,²³ had smoked more than a pack of cigarettes a day. This study was known in Germany: in a paper entitled 'Again about cigarette smoking and lung cancer', published in 1941 in the *Zeitung fuer Krebsforschung*, Victor E Mertens²⁴ wrote that 'extensive statistical analyses have convinced Hoffman that cigarette smoking predisposes to lung cancer'. Mertens also attributed to Hoffman the idea that passive smoking by non-smokers can be carcinogenic and did not cite Mueller's 1939 report.⁶

Some characteristics of Hoffman's,²²

Mueller's,⁶ and Schairer and Schoeniger's⁴ studies are compared in table 3. None of the three reports can be considered a case-control study, in the meaning that case-control design has acquired since Lane-Clayton's publication of 1926. Hoffman was the first of the three to conclude on the basis of his group comparisons that 'smoking habits *unquestionably* increase[d] the liability to cancer of the mouth, throat, esophagus, larynx and lungs.' Hoffman's work²² was not cited by either Mueller⁶ or Schairer and Schoeniger.³⁴ The question of who first reported the tobacco and lung cancer association has been discussed by Samet²⁵ and Stellman.²⁶

The inconsistent results of pre-1945 animal study results—some failing to show a tumorigenic effect of tobacco tar^{27,28}—was a third obstacle on the way of a correct appreciation of the tobacco–cancer connection. A 1932 editorial by *The Lancet* summarised the feeling in the scientific community before World War II that the dire health effects of exposure to tobacco smoke still had to be demonstrated: 'However difficult it may be to prove the case against cigarette-smoking, it has not yet been cleared from suspicion'.²⁹

CONCLUSIONS

Schairer and Schoeniger's 1943 report was technically weak. The elusiveness of the normal survey and sample, the omission of the pipe smokers, the gaps in the smoking categories, the speculation about issues for which they had collected data and the perplexing inter-study comparisons based on a widely, but unnecessarily different categorisation of tobacco usage reflect a great amateurism in population research. Overall, it did not generate qualitatively new evidence on the carcinogenic effect of tobacco compared with Hoffman's 1931 report.²²

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Box 1**Translation of the questionnaires sent by Schairer and Schoeniger to the relatives of the dead cancer cases.⁸**

- ▶ Was the late Mr/Mrs.... a smoker? If yes, what was his/her daily consumption of tobacco? (a) While sick? (b) While healthy? (Please provide exact information, in numbers, how many cigarettes, cigars and how much tobacco per day)
- ▶ With respect to smoking, had the deceased during his/her illness: (a) stopped? (b) reduced?
- ▶ Up to which age has he/she smoked?
- ▶ Was the deceased, during his occupational activity or outside this activity, exposed to toxic atmospheric gasses? Smoke, soot, dust, tar, fumes, combustion products, exhaust gasses, coal or metal dust, chemical products, vapour of cigarettes or analogous material?
- ▶ What was the occupation of the deceased? (eg, not porcelain-worker but porcelain turner or porcelain painter). (a) Did the deceased change his/her occupation? (b) When, what was his/her previous occupation?

Table 1

Distribution of daily tobacco use in male lung cancer, gastric cancer and 'normal' cases in Schairer and Schoeniger.⁴

Smoking categories	<u>Lung cancer</u>		<u>Gastric cancer</u>		<u>'Normal cases'</u>	
	N	%	N	%	N	%
Very heavy (>4 cigars/day or >20 cigarettes/day)	29	31.2	13	10.2	25	9.3
Heavy (3–4 cigars/day or 11–20 cigarettes/day)	19	20.4	14	10.9	47	17.4
Moderate (2 cigars/day or 6–10 cigarettes/day)	31	33.3	26	20.3	57	21.1
Light (1 cigar/day or 1–5 cigarettes/day)	11	11.8	55	43.0	98	36.3
Non-smoker	3	3.2	20	15.6	43	15.9
Total	93	99.9	128	100	270	100

Germany, 1930–1942.⁴

Table 2

Distributions of smoking histories of lung cancer cases in Mueller's study,⁶ as reported, and as computed using the categories of smokers of Schairer and Schoeniger⁴

Smoking categories in Schairer and Schoeniger ⁴	Reanalysed		Original		Smoking categories in Mueller ⁶
	N	%	N	%	
Very heavy (>4 cigars/day or >20 cigarettes/day)	28	59.6	25	29.1	Extreme smoker (daily consumption of 10–15 cigars, more than 35 cigarettes, more than 50 g of pipe tobacco)
Heavy (3–4 cigars/day or 11–20 cigarettes/day)	7	14.9	18	20.9	Very heavy smoker (7–9 cigars, 26–35 cigarettes, 36–50 g of pipe tobacco)
Moderate (2 cigars/day or 6–10 cigarettes/day)	7	14.9	13	15.1	Heavy smoker (4–6 cigars, 16–25 cigarettes, 21–35 g of pipe tobacco)
Light (1 cigar/day or 1–5 cigarettes/day)	2	4.3	27	31.4	Moderate smoker (1–3 cigars, 1–15 cigarettes, 1–20 g of pipe tobacco)
Non-smoker	3	6.4	3	3.5	Non-smoker
Total	47	100.1	86	100.0	

Table 3

Comparison of characteristics of three pre-1945 group comparisons on tobacco and lung cancer

Authors	Hoffman ²²	Mueller ⁶	Schairer and Schoeniger ³⁴
Year of publication	1931	1939	1943
Place	Several cities, USA	Cologne, Germany	Jena, Germany
Lung cancer cases, n	27 men	86 men + 10 women	93 men + 16 women
Source	Community survey	Hospitals	Hospitals
Status	Living	Mostly deceased	All deceased
Other cancer cases	Many cancer sites	None	Tongue, oesophagus, stomach, colon, prostate
Non-cancer patients	'Chronic diseases of adult life' (cardiovascular diseases, diabetes, etc)	None	None
Non-patients	Industrial workers	'Healthy' men	'Normal male population'
Source	Community survey ²³	Unknown	Unknown
Conclusions	'smoking habits <i>unquestionably</i> increase the liability to cancer of the mouth, throat, esophagus, larynx and lungs.'	'tobacco smoking is a major etiologic cause of the primary lung carcinoma.'	'statistically and therefore also causally, there is only a probable association between heavy tobacco use and lung cancer'