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Mortality in relation to smoking: 20 years' observations on male British doctors

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Summary

In 1951 the British Medical Association forwarded to all British doctors a questionnaire about their smoking habits, and 33440 men replied. With few exceptions, all men who replied in 1951 have been followed for 20 years. The certified causes of all 10 072 deaths and subsequent changes in smoking habits were recorded. The ratio of the death rate among cigarette smokers to that among lifelong non-smokers of comparable age was, for men under 70 years, about 2:1, while for men over 70 years it was about 1·5:1. These ratios suggest that between a half and a third of all cigarette smokers will die because of their smoking, if the excess death rates are actually caused by smoking.

To investigate whether this is the case, the relation of many different causes of death to age and tobacco consumption was studied. Lung cancer, other cancers, coronary heart disease, other vascular diseases, bronchitis, and other respiratory diseases, stomach ulcer, and other gastrointestinal diseases, cirrhosis of the liver, and other diseases were all significantly related to smoking habits. Lung cancer, bronchitis, and coronary heart disease were the most important causes of death among smokers, and together accounted for about 72% of the excess deaths among cigarette smokers. Cigarette smoking was also the most important cause of obstructive lung disease, and various vascular diseases. The distinctive features of this study were the completeness of follow-up, the accuracy of death certification, and the fact that the study population as a whole reduced its cigarette consumption substantially during the period of observation. As a result lung cancer grew relatively less common as the study progressed, but other cancers did not, thus illustrating in an unusual way the causal [illegible] cancer

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Introduction

At the end of October 1951 Doll and Hill sent a questionnaire to all the men and women whose names were on the current British *Medical Register* and who were believed to be resident in the United Kingdom.[1] In addition to name, address, and age, they were asked a few simple questions about their smoking habits. Replies that were sufficiently complete to be used were received from 34 440 men*—that is, about 69% of the men who were alive when the questionnaire was sent. Observations of mortality began on 1 November 1951 and continued until 31 October 1971. Further inquiries about changes in habit and some additional characteristics of the men were made in November 1957, March 1966, and July 1972.

An account of this study and its earlier results have been reported.[1-3] We report now the mortality rates of male doctors over the 20 years from November 1951 to 31 October 1971, both in total and in relation to their smoking habits at different periods. Observations on the women doctors will be reported later.

Data

SMOKING HABITS

The numbers of men replying to the repeat questionnaires and the numbers not replying for different reasons are shown in table I. Further questionnaires were not sent to doctors who had been struck off the *Medical Register* nor to those who had refused to answer previously or had asked not to be written to again, although their mortality was still monitored. The proportions of survivors who did not supply us with further information in 1957, 1966, and 1973 were, respectively, 1·6%, 3·6%, and 2·1%.

On the first questionnaire doctors were asked whether they were (*a*) then smoking, (*b*) had smoked in the past, or (*c*) were lifelong non-smokers (defined as never having smoked as much as one cigarette a day for as long as one year). The smokers and ex-smokers were asked the age at which they had begun and how much they were now smoking, or had smoked when they gave up (in cigarettes

*The total is different from that reported in 1964, as the sex of five women had been incorrectly recorded.

†Subsequently amplified to include an alternative of a quarter of an ounce of tobacco a week.

TABLE III—*Death rate by cause of death and smoking habits when last asked*

Cause of death	No of deaths	Annual death rate per 100 000 men, standardised for age								
		Non-smokers	Current or ex-smokers	Ex-smokers	Current smokers, any tobacco	Current smokers, any tobacco (g/day)			χ²†	
						1-14	15-24	≥25	Non-smokers v others	Trend
Cancer										
Lung	441	10	83	42	104	52	106	224	41·98	197·04
Oesophagus	65	1	12	5	16	12	13	30	3·94	14·94
Other respiratory sites*	46	1		4	11	*b*		21	3·31	21·68
Stomach	163	23	28	21	32	28	38	32	—	—
Colon	195	27	34	34	34	35	31	31	—	—
Rectum	78	6	14	14	14	10	14	27	2·81	10·76
pancreas	92	14	16	12	18	14	18	27	—	3·98
Prostate	186	39	30	31	30	28	31	38	—	—
Kidney	46	3			8	8	9		—	—
Bladder	80	9	14	11	16	16	16	12	—	—
Marrow and reticuloendothelial system	152	31	24	26	24	27	22	19	—	(3·51)
Unknown site	64	12	11	9	12	10	13	14	—	—
Other site	222	25	26	29	24	19	24	35	—	—
Respiratory disease										
Respiratory tuberculosis	57	3	11	11	10	8	7	21	3·83	10·51
Asthma	40	4	7	12	5	5	7	0	—	—
Pneumonia	345	54	59	62	57	47	62	91	—	6·94
Chronic bronchitis and emphysema	254	3	48	44	50	38	50	88	25·58	47·23
Other respiratory disease	121	16	21	24	19	20	14	26	—	—
Pulmonary heart disease										
Pulmonary heart disease*	50	0	9	7	11	9	10	19	4·72	8·37
Cardiac and vascular disease										
Rheumatic heart disease	77	14	13	12	11	14	16	5	—	—
Ischaemic heart disease	3191	413	554	533	565	501	598	677	22·59	53·56
Myocardial degeneration*	615	67	103	98	116	111	111	160	9·58	13·92
Hypertension	239	37	41	41	41	33	43	58	—	4·67
Arteriosclerosis	117	21	20	11	21	17	21	46	—	4·85
Aortic aneurysm (non-syphilitic)	121	5	22	16	26	18	28	45	8·40	25·60
Venous thromboembolism	48	9	8		8	8	5	13	—	—
Cerebral thrombosis	616	86	106	105	107	92	123	131	—	9·54
Other cerebrovascular disease	692	107	118	122	115	112	114	128	—	—
Other cardiovascular disease	267	53	44	49	41	17	42	52	—	—
Other diseases										
Parkinsonism	51	14	8	13	5	8	1	4	—	(9·10)
Peptic ulcer	79	8	14	12	15	10	20	23	—	8·26
Cirrhosis of liver, alcoholism	80	7	14	10	16	10	10	40	—	22·53
Hernia	16	0	—	2	4	3	4	7	—	4·16
Other digestive disease	144	20	25	27	24	18	33	26	—	3·25
Nephritis	79	10	14	10	16	15	14	21	—	—
Other genitourinary disease	136	19	23	24	23	22	14	26	—	—
Other disease	391	59	67	73	64	65	58	73	—	—
Violence										
Suicide	173	21	31	27	32	30	28	46	—	6·26
Trauma	240	46	39	36	41	47	25	56	—	—
All causes (No of deaths)	10 072	1317 (940)	1748 (9132)	1652 (3114)	1802 (6018)	1581 (2707)	1829 (1986)	2452 (1325)	68·47	244·16

*See text for definition.
†Figures are given whenever the value was greater than 2·71 ($P<0·1$); figures in parentheses indicate a decreasing trend from non-smokers to heavy smokers; others indicate an increasing trend.

. Cancer of the lung, including trachea or pleura, was given as the underlying cause of 467 deaths and as a contributory ause in a further 20. For each of these 487 daths we sought confirmationof the diagnosis from the doctor who had certified the death and, whm necessary, from the consultant to whom the patient had been referred. We thus obtained information about the nature Of the evidence in all but two cases. When there seemed any doubt about the interpretation of the report we sought the advice of J R Bignall (professor of medicine, Brompton Hospital for Diseases of the Chest), who was kept in ignorance of the patient's smoking history. As a result, we accepted carcinoma of the lung as the underlying cause of 441 deaths and as a contributory cause of 17. Twenty-six deaths were considered to be due to other underlying causes* and three to other contributory causes.†

Statistical analysis

Almost all the docton who replied to the first questionnaire did so Within a few weeks and those who did not reply to a single mailing were not pursued. Most of the survivors responded equally quickly to the later questionnaires, but we had to send reminders on two or mor: occasions to obtain the high response rata shown in table I. As we continued to accept replies to the second questionnaire up to 31 October 1958 and to the third up to 31 October 1966, we related deaths to the information received in reply to these two questionnaires only if dath occurred on or after I November 1958 or 1 November 1966, respectively. Therefore, apart from the deaths recorded in 1951-2, the mortality usually relate, to smoking habits more than a year before death. We have no useful information about the possible effect on mortality of changes of habit within a year of their being made.

We always asked about the method of smoking, the amount smoked, and, if relevant, the date of stopping. Thus we could examine mortality in relation to these aspects of the smoking history by relating deaths that occurred in the fint seven yean of the study to information obtained in the first questionnaire, deaths that occurred in the next eight years to information obtained in the second questionnaire, and deaths that occurred in the last five yan to information obtained in the third questionnaire. The few docton who did not reply to the second or third questionnaires were retained in the study, and r e related the deaths that occurred among them to the information provided in the last questionnaire to which they had replied. Information about inhalation and the previous use of cigarettes by pipe and cigar smokers was not obtained until the second questionnaire, so that we could use this information only in relation to deaths in the last 13 years of the study.

For each of the subgroups defined by smoking habits and age, we calculated the person-years at risk of death between 1951 and 1971 in fire-year age groups from 20 to 84 years of age and 85 years and

*Cancers of the trachea (2); pleura; stomach; colon; rectum (2); kidncy; bladder; and prostate (2); melanoma of skin; leukaemia; carcinomatosis, primary not known (5); peripheral neuritis; aortic valve disease; non-syphilitic aortic aneurysm; heart failure; pulmonary embolus; broncho-Pneumonia; collapsed lung; and coma.

†Carcinomatosis, primary not known; coronary thrombosis (2).

ower.* (Further division at older ages was not justified despite the fact that the oldest attained age was 101 years, as four-fifths of the man-years in the last group were accumulated under 90 years of age.) Taking all men in the study together, we then calculated the total number of deaths from a particular cause per person-year in each age group. These age- and cause-specific rates were applied to the number of person-years at risk in each age and smoking subgroup to estimate the number of deaths that would have been expected from this cause if mortality were unrelated to smoking. The observed and expected numbers for a particular smoking category were then summed over all ages. The observed a d expected numbers in each smoking category form the chief basis of our analysis. For some purposes their ratio (observed:expected) was multiplied by the total annual death rate for that disease among all men of all ages together, giving for each smoking category death rates indirectly standardised for age that could be used for comparison with each other.

Values of χ^2 with correction for continuity were calculated for the difference between the rates for life-long non-smokers and all other men, and for the trend in the rata for non-smokers and current smokers of 1-14, 15-14, and 25 or more grams of tobacco a *by*, for each of the causes of death examined. In each case, χ^2 values were based on the expected numbers rather than on the exact variance/covariance matrix.

Results and comment

MORTALITY BY CAUSE AND PRINCIPAL SMOKING HABITS

The numbers of deaths attributed to 40 different causes (or groups of causes) and the corresponding mortality rates, standardised for age, are shown in table III for all men who had ever smoked, ex-smokers, and current smokers, and for men smoking 1-14, 15-24, and 25 or more grams of tobacco a dry (the last p u p smoking on average slightly more than 30 g a day).† For this purpose we regarded any cigarette as equivalent to 1 g of tobacco, and cigars as equivalent to 3 g of tobacco (if small) or 5 g of tobacco (if large). Causa of death were examined separately if there were 40 or more such death, since at least five deaths would then have been expected among non-smokers if smoking were not associated with the disease. All such causes of death are included in table III if we had any reason to suppose that they might be related to smoking habits, either positively or negatively, or if they constituted a clearly defined group of interest for comparison. Cancers of the tip, tongue, mouth, pharynx (excluding nasopharynx), larynx, and trachea were classed together as "other respiratory cancers" because the numbers of deaths attributed to the individual typa were too few. Deaths attributed (*a*) to myocardial degeneration or functional and other diseases of the heart (ICD Nos 422 and 430-434) with mention of chmnic bronchitis or emphysema on the death certificate or (6) to cor pulmonale were classed together as "pulmonary heart disease."‡ Other deaths attributed to myocardial degeneration and other conditions classified under ICD No 422 were described simply as "myocardial degeneration." The 16 deaths attributed to hernia were included as a separate group because of the interest of the observations.

Half the conditions in table III were positively related to smoking, some very strongly so, and one disease, Parkinsonism. was negatively related. To say that these conditions were related to smoking does not necessarily imply that smoking caused (or prevented) them. The relation may have been secondary in that smoking was associated with some other factor, such as alcohol consumption or a feature of the personality, that caused the disease. Alternatively, smoking habits may have been modified by the disease or the relation may have been an artefact due to misdiagnosis. so that deaths that were really due to diseases associated with smoking may have been miscertified as due *to* diseases that are not. We postpone discussion of the interpretation of the relation for individual diseases until later, when our other results can also be taken into account.

*A man aged 38 yean at entry. for example. was taken to be 38·5 years old and death during any particular study year, numbered from 1 to 20 from 1 November 1951 to 31 October 1971. was assumed to have occurred at mid-year for calculating man-years (but for no other purpose).

†Tables showing the numbers of deaths observed and expected fur each group of causes and each smoking category from which the rates shown in tables III-IX have been calculated are held in the Radcliffe Science Library, Oxford. and in the library uf the National Institute ut' Medical Research, Mill Hill.

‡The underlying causes of death were dcscribed as myocardial degeneration (20), myocarditis (5), congestive heart failure (8), cor pulmonale (6), and 11 other terms each once.

was

and the trend in mortality from non-smokers through light and moderate to heavy smoken was statistically significant ($P<0·01$), Parkinsonism is a chronic disease and it was a contributory cause in 26 other deaths. These also showed a similar type of relation, and when the two groups were combined, making 77 deaths in all, the differences were more distinct (χ^2 comparing non-smokers with men who had ever smoked = 2·73; $P<0·1$; for the trend from non-smokers through light and moderate to heavy smokers = 1370; $P<0·001$).

The remaining 18 conditions. did not, in our data, show any significant association with smoking. Neither did cancer of the bladder, although it has consistently been related to smoking in other studies.[8-10] Only 80 deaths were attributed to this disease in our study. Possibly chance operated to prevent the appearance of a positive relation. as our data were easily compatible with the existence of the twofold relative risk that has commonly been reported. In eight other deaths cancer of the bladder was referred to as a contributory cause but their inclusion did not materially affect the results. For our present purpose we classed cancer of the bladder with the conditions associated with smoking and described the other 18 groups together as unrelated to smoking. Altogether, these unrelated conditions accounted for 3102

Neither the difference between non-smokers and men who had ever smoked, nor the increase with amount smoked, was statistically significant (χ^2 for trend = 3·12). But the highest rate was in men who smoked the most. Some small excess in smokers must be expected. however, as a result of misdiagnosis of other conditions, and the death of at l a s t one man. who smoked 30 cigarettes a day and died of burns caused by setting fire to his bedclothes while smoking in bed, was directly attributable to the habit.

TYPE OF SMOKING

Table IV shows mortality rates similar to those in table III for men who, at the time of the last questionnaire before their death smoked cigarettes only, pipes or cigars (or both) only, or a combination including cigarettes (mixed smokers). The rates also differ from those in table III in that men are subdivided bv numbers of cigarettes smoked instead of total tobacco consumption. Rates are given for

*Cancers of the stomach, colon, prostate, and kidney; cancers of the blood and reticuloendothelial systems; other cancers; cancers of unknown primary site; asthma; rheumatic heart disease; venous thromboembolism; nephritis; trauma; and residual groups of other cerebrovascular, cardiovascular, respiratory, digestive, and genitourinary diseases, and all other diseases not separately considered.

TABLE IV—*Death rate by cause of death, method of smoking, and number of cigarettes smoked per day when last asked*

Cause of death	No of deaths (excluding ex-smokers)	Annual death rate per 100 000 men, standardised for age					
		Non-smokers	Current smokers				
			Cigarettes only	Pipe and or cigars only†	Mixed (cigarettes and others)	Cigarettes only, No day: 1-14	15-24	25
Closely associated causes								
Cancer of lung	362	10	140	58	82	78	127	251
Cancer of oesophagus	56	3	14	11	27‡	11	12	21
Cancer of other respiratory sites*	38	1	13		10	5	7	33
Respiratory tuberculosis	38	3	15	3	8	9	10	30
Chronic bronchitis and emphysema	167	3	74	28	34	51	78	114
Pulmonary heart disease*	35	0	10	9	14‡	6	9	25
Aortic aneurysm (non-syphilitic)	91	5	33	18	23	17	38	52
Hernia	12	0	5	4	0	3	4	11
Ischaemic heart disease								
Ischaemic heart disease	2205	413	669	425	528	608	652	792
Other associated causes								
Cancer of rectum	51	6	16	10	17‡	11	11	33
Cancer of pancreas	70	14	22	12	16	19	20	29
Cancer of bladder	58	9	19	14	15	20	20	13
Pneumonia	218	54	73	38	54	56	84	105
Myocardial degeneration*	408	67	139	101	103	136	116	202
Hypertension	162	37	50	34	30	33	59	69
Arteriosclerosis	82	21	29	17	17	21	25	68
Cerebral thrombosis	402	86	115	99	104	94	134	137
Cirrhosis of liver, alcoholism	63	7	21	9	13	11	14	44
Peptic ulcer	81	8	20	10	13	1	30	27
[illegible]	138	21	33	32	25	30	43	53
[illegible]	99	9	17	11	11	14	17	28
Parkinsonism								
Parkinsonism	25	14	6	4	4	9	2	6
Unrelated causes								
All other causes	2157	518	616	473	434	615	573	697
All causes (No of deaths)	6958	1317 (940)	2154 (3343)	1454 (1527)	1591 (1148)	1857 (1209)	2066 (1137)	2843 (997)

*See text for definition.
†About half these men had once smoked cigarettes (see table VI).
‡Mortality rates for mixed smokers, smoking 1-14, 15-24, or ≥25 g day respectively were: 22, 20, and 49 per 100 000 for cancer of the oesophagus; 12, 17, and 15 per 100 000 for pulmonary heart diseaase; and 10, 24, and 15 per 100 000 for cancer of the rectum.

ischaemic heart disease, the conditions closely associated with smoking, the other associated conditions. the one negatively associated cause of death, and all the unrelated causes grouped together. In every case the rate was higher in cigarette smokers than in those who smoked pipes or cigars or both. For three conditions, however, the rate was higher in mixed smokers than in men who smoked only cigarettes, owing partly perhaps to chance variation of small numbers. For these conditions (cancer of the oesophagus, cancer of the rectum, and pulmonary heart disease) mortality rates for mixed smokers hy total tobacco consumption are given in the footnote to table IV. Only for cancer of the oesophagus were the rata consistently higher than among cigarette smokers.

CIGARETTE SMOKING

Table IV also show the mortality rates for continuing smoken rho smoked only cigarettes and smokcd different amounts a day. For all but four of the positively associated conditions the mortality increased progressively iron light. to moderate, to heavy cigarette smokers. For cancer of the rectum it was equal in light and moderate smokers, for myocardial degeneration it was higher in light smokers than in moderate ones, and for cancer Of the bladder and peptic ulcer it was higher in moderate smokers than in heavy ones. Some such irregularities must be expected when the numbers of deaths are small (as with cancers of the bladder and rectum and peptic ulcer) and particularly when the relation with smoking is weak. Even for other conditions, little attention can be paid to the exact shape of the dose-response relation as many men changed the amount smoked during the course of the study, especially after the age of 65. Havy cigarette smokers, particularly, tended to reduce the number smoked a day, so that the *group* of light smokers contained an appreciable proportion of men who had smoked heavily in the past. Such changes will hare a particularly strong effect on the dose-response relarion Cor diseases that may manifest themselves many years before death (for example. anginal symptoms can occur years before a fatal infarct, or chronic dyspnoea lung before death Loin bronchitis), since these manifestations may cause heavy smokers to smoke less and to have reported their reduced consumption to us in the last questionnaire before they died. The effect of such changes on the dose-response relation for lung cancer will bc discussed elsewhere.[1]

Table V shows the mortality rates at different ages in non-smokers and in cigarette smokers from ischaemic hart disease. myocardial degeneration, and cerebral thrombosis. For ischaemic hurt diseasethe mortality rate increased progressively from non-smokers through light and moderate smokers to heavy cigarette smokers at all ages under 65 yars. The relative risk in heavy cigarette smoken compared with non-smokers was 15:1 at ages under 45 years, 3:1 at 45-54 years, and 2:1 at 55-64 years of age. Over 65 years of age the progression was irregular and the risk in heavy cigarette smokers was increased by leu than 50%.

Myocardial degeneration is an ill-defined diagnosis that is rarely cited as the cause of death under 65 yean of age. At older ages the relation with smoking was more definite than for ischaemic heart disease, the relative risk in heavy smokers compared with non-smokers being 5:1 at age 65-74 and 2:1 at 75 years and over.

TABLE V—*Mortality in non-smokers and current cigarette smokers, by age: selected causes. Numbers of deaths are given in parentheses*

Age (in years)	Annual death rate per 100 000 men*			
	Non-smokers	Current smokers, smoking only cigarettes: No day		
		1-14	15-24	25
Ischaemic heart disease				
<45	7 (3)	46 (12)	61 (22)	104 (18)
45-54	118 (32)	220 (38)	305 (90)	393 (69)
55-64	531 (79)	732 (91)	819 (123)	1025 (125)
<65	166 (114)	278 (141)	358 (235)	427 (212)
65-74	1191 (85)	1466 (134)	1511 (101)	1731 (45)
75	2132 (92)	2719 (113)	2400 (50)	3247 (27)
Myocardial degeneration				
<65	6 (4)	6 (3)	9 (6)	23 (11)
65-74	44 (3)	124 (9)	146 (12)	204 (9)
75	945 (40)	1942 (79)	1397 (21)	2114 (11)
Cerebral thrombosis				
<65	10 (6)	18 (9)	11 (9)	22 (11)
65-74	131 (9)	166 (12)	383 (23)	266 (11)
75	1039 (41)	985 (41)	1397 (26)	1418 (10)

*Indirectly standardised for age to make the four entries in any one line comparable

TABLE VI—*Mortality in non-smokers and pipe or cigar smokers by additional cigarette smoking: selected causes (last 13 years of study only)*

Cause of death	No of deaths (excluding ex-smokers)	Annual death rate per 100 000 men, standardised for age				
		Non-smokers	Current pipe or cigar smokers			Current smokers of cigarettes only
			Never cigarettes	Cigarettes previously	Cigarettes now	
Cancer of lung	232	11	54	77	113	156
Cancers of oesophagus and other respiratory sites	65 (519)	4 (23)	23 (138)	21 (182)	46 (257)	35 (350)
Chronic bronchitis and emphysema and pulmonary heart disease	139	3	31	60	64	101
Other conditions closely associated with smoking	84	9	30	24	35	58
Ischaemic heart disease under 65 years	607	189	124	240	285	413
Ischaemic heart disease age 65 years and over	830	1655	1586	1536	1945	2259
Myocardial degeneration	236	75	114	82	108	142
Other conditions associated with smoking	843	275	324	312	371	465
All other conditions	1353	560	493	524	498	701
All causes (No of deaths)	4394	1418 (628)	1540 (388)	1000 (595)	1855 (737)	2456 (2046)

Examination of the mortality rate for cerebral thrombosis shows that the relation with smoking was somewhat similar, at each age, to that for ischaemic hart disease. Deaths under 75 years of age were, however, much less common, so that the overall relation was less close, being dominated by the weak relation in old age.

PIPE AND CIGAR SMOKING

It is evident from table IV that the excess overall mortality among smokers was due principally to an excess among men who had smoked cigarettes. Those who smoked only pipes or cigars experienced mortality rates which, with few exceptions, were similar to, or only slightly above, those of men who did not smoke at all. Substantial differences between pipe and cigar smokers and non-smokers were observed only for the eight conditions closely associated with smoking and for myocardial degeneration, which, it has already been noted, was more closely related to smoking among men aged 65 years and over than was ischaemic heart disease. The numbers of deaths attributed to these conditions in pipe and cigar smokers were small, and significant excesses over the rates for non-smokers were observed only for lung cancer, chronic bronchitis and emphysema, pulmonary heart disease, non-syphilitic aortic aneurysm, and myocardial degeneration.

The first questionnaire in this study did not inquire whether pipe or cigar smokers had ever smoked cigarettes, some had undoubtedly done so, and the excess mortality among them might therefore have been attributable to cigarette smoking in the past. The second questionnaire asked specifically about cipr consumption as well as other forms of smoking and about any history of cigarette consumption so that, during the last 13 years of the study, we could describe the death rates of pipe and cigar smokers who had never smoked cigarettes. The results are shown in table VI.

Because the numbers of deaths in several of the smoking categories were small, we have presented only the maior causes of death related to smoking and have grouped allied conditions together. The results show an excess mortality among those pipe and cigar smokers who had never smoked cigarettes for the eight conditions closely related to smoking and for myocardial degeneration, but not for ischaemic heart disease. For lung cancer, chronic bronchitis and emphysema, and pulmonary heart disease, then was a progressive increase in mortality from non-smokers through pipe and cigar smokers who had never smoked cigarettes and those who had smoked cigarettes only in the past to those who were also smoking cigarettes at the time of observation. The trends for cancers of the oesophagus and other respiratory sites and for other conditions closely associated with smoking were irregular, perhaps because of the small numbers. Then seemed, however, to be a distinction between cancer of the lung and cancers of the oesophagus and ocher respiratory sites, in that the risk of cigarette smoking was much greater than the risk of pipe or cigar smoking for the former, but not for the latter—an observation that is relevant to the interpretation of secular trends in mortality (see Discussion).

INHALING

Not all smokers smoke in the same way. In our second and third questionnairesr e asked whether they thought they inhaled the smoke, and the great majority who replied to both questionnaires answered

TABLE VII—*Death rate by cause of death and inhaling in continuing cigarette smokers: standardised for age and amount smoked*

Cause of death	No of deaths	Annual death rate per 100 000 men responding to question: "Do you inhale?"*		Risk of inhalers compared with unity in non-inhalers
		Yes	No	
Cancer of lung	123	124	147	0·84
Cancers of oesophagus and other respiratory sites	28	31	27	1·13
Chronic bronchitis and emphysema and pulmonary heart disease	71	89	59	1·53
Other conditions closely associated with smoking	49	63	31	2·01
Ischaemic heart disease under 65 years	305	418	266	1·57
Ischaemic heart disease at 65 years and over	320	2444	2164	1·13
Myocardial degeneration	76	88	80	1·09
Other conditions associated with smoking	331	356	3s9	0·99
All other conditions	509	559	529	1·06
All causes (No of deaths)	1812	2034 (1177)	1810 (635)	1·12

*Excluding the 6% of men who gave an indefinite answer, as the deaths among them were few (117) and the rates were subject to large random errors.

similarly both times, despite an interval of nearly nine years. Of those cigarette smokers who had said they inhaled in response to the second questionnaire, 83% said in the third questionnaire that they usually inhaled and 16% that they sometimes inhaled. Of those who had said they did not inhale in response to the second questionnaire, 68% later said that they never inhaled and 28% that they sometimes inhaled. Even the few who pave indefinite answers to the second questionnaire (that could not be understood as either a clear yes or a clear no) were consistent, only 18% saying that they usually inhakd and IO'.., that they never inhaled when questioned again.

The proportions of men who responded in different ways varied with the method of smoking and the amount smoked. We therefore limited our comparison to cigarette smokers only and standardised the mortality rates for age and for amount smoked:

As we could use only those observations made after the completion of the second questionnaire, the number of *deaths* available for analysis was substantially reduced. We have therefore presented only the broad groupings of selected causes of death which we examined in relation to pipe and cigar smoking. The results (table VII) show a notably higher mortality among men who said they inhaled than among men who said they did not for chronic bronchitis and emphysema and pulmonary heart disease, for ischaemic heart disease at young ages, and for "ocher conditions closely associated with smoking," but not for cancer of the lung, cancers of the oesophagus and other respiratory sites, or for any other group of diseases. Indeed, the mortality rate for lung cancer was lower among inhalers than among non-inhalers. This last result corresponds to that in a restropective study,[13] when Doll and Hill found that the relation with .nhaling varied with the amount smoked. We have. therefore, presented the figures ior lung cancer separately for three levels of smoking. The results support the findings in the earlier study (table VIII). For light and moderate smokers the mortality rates were higher in men

*In nine groups. from 1-4 cigarettes a day up tu M or more a Jay.

TABLE VIII—*Death rates from amount smoked and inhaling ra*

No of cigarettes smoked per day	res
	Yes
1-14	95 (1
15-24	113 (2
25	185 (3

*Standardised for age and amount s should therefore be comparable we

who said they inhaled than who smoked 25 or more c found. A few men were u either category, and they c rates, irrespective of the a

STOPPING SMOKING

Many doctors had opp mortality rates in ex-smok of time. To facilitate comp who at the time of our first ex-smokers who had smok stopped, or were lifelong no as smokers if they starte Smokers were reclassified a that they had stopped sm cigarette smokers and nor cigars were excluded from smokers who had not start who had given up before ex-smokers studied had th most had smoked for muck men started to smoke show had started to smoke at abo ive of the length of time t topped smoking, however er day than men of the sa The results (tables IX elected causes of death in r leriods, compared with th rom the experience of me igarette smokers (ignorin

TABLE IX—*Mortality in ex- topped smoking compared wi*

Cause of death
Cancer of lung
Cancer of oesophagus and othe respiratory sites
Chronic bronchitis and emphysema and pulmonary heart disease
Other conditions closely associated with smoking
Ischaemic heart disease in men 30-64 years
Ischaemic heart disease in men 55-64 years
Ischaemic heart disease in men 65 years and over
Myocardial degeneration
Other conditions associated wi smoking
All other conditions
All causes at 30-64 years
All causes at 65 and over
All causes
Mean No of years stopped

*When five men who stoppe excluded the percentage reduc †When one man who stopped the percentage reduced to 25

TABLE VIII—*Death rates from lung cancer in continuing cigarette smokers by amount smoked and inhaling habits. Numbers of deaths are given in parentheses*

No of cigarettes smoked per day	Annual death rate per 100 000 men* responding to question "Do you inhale?"		
	Yes	Indefinite	No
1-14	99 (16)	188 (4)	54 (8)
15-24	113 (29)	196 (6)	75 (8)
≥ 25	185 (32)	420 (5)	417 (29)

*Standardised for age in quinquennia and for amount smoked in categories of five cigarettes a day up to 15-19 a day and then 40 or more a day. Entries in any line should therefore be comparable with each other though not with entries in other lines.

who said they inhaled than in men who said they did not. For men who smoked 25 or more cigarettes a day, however, the reverse was found. A few men were unable to classify themselves definitely in either category, and they consistently recorded the highest mortality rates, irrespective of the amount smoked.

STOPPING SMOKING

Many doctors had stopped smoking, so we were able to observe mortality rates in ex-smokers who had stopped for different lengths of time. To facilitate comparisons we confined the analysis to men who at the time of our first questionnaire smoked only cigarettes, were ex-smokers who had smoked only cigarettes at the time they last stopped, or were lifelong non-smokers. Non-smokers were reclassified as smokers if they started smoking cigarettes and nothing else. Smokers were reclassified as ex-smokers if they subsequently reported that they had stopped smoking. Ex-smokers who started again and cigarette smokers and non-smokers who started smoking pipes or cigars were excluded from the time we learnt of the change. Cigarette smokers who had not started before 25 years of age and ex-smokers who had given up before 30 years of age were also excluded. All ex-smokers studied had therefore smoked for at last five years, and most had smoked for much longer. Examination of the ages at which men started to smoke showed that continuing smokers and ex-smokers had started to smoke at about the same age (about 19 years), irrespective of the length of time that smoking had been stopped. Those who stopped smoking, however, had smoked about 10% fewer cigarettes per day than men of the same age who continued.

The results (tabla IX and X) show the numbers of deaths from selected causes of death in men who had given up smoking for different periods, compared with the numbers that would have been expected from the experience of men of the same age who were *(a)* continuing cigarette smokers (ignoring the fact that those who gave up smoked on avenge 10% less than smokers of the same age who did not give up) (table IX), and (*b*) life-long non-smokers (table X).

TABLE IX—*Mortality in ex-cigarette smokers by number of years they had stopped smoking compared with mortality in continuing cigarette smokers*

Cause of death	No of deaths as % of No expected in continuing cigarette smokers (actual No in parentheses) Years since smoking stopped:			
	<5	5-9	10-14	15
Cancer of lung	102*(15)	35 (12)	28*(9)	11 (7)
Cancer of oesophagus and other respiratory sites	45 (4)		17 (3)	
Chronic bronchitis and emphysema and pulmonary heart disease	112 (9)	158 (30)	22 (4)	28 (12)
Other conditions closely associated with smoking	145 (7)	44 (5)	49 (5)	49 (10)
Ischaemic heart disease in men 30-54 years	54 (7)	35 (10)	45 (10)	47 (7)
Ischaemic heart disease in men 55-64 years	111 (19)	83 (34)	102 (38)	74 (45)
Ischaemic heart disease in men 65 years and over	76 (24) 91 (3)†	102 (76) 87 (21)	87 (62) 76 (19)	83 (118) 47 (11)†
Myocardial degeneration				
Other conditions associated with smoking	72 (26)	79 (87)	84 (65)	71 (118)
All other conditions	102 (55)	100 (135)	84 (97)	86 (210)
All causes at 30-64 years	86 (67)	80 (141)	69 (104)	56 (106)
All causes at 65 and over	87 (99)	89 (212)	78 (206)	71 (484)
All causes	87 (166)	85 (354)	75 (310)	68 (590)
Mean No of years stopped	3·5	7·5	12·1	21·0

*When five men who stopped smoking after they developed lung cancer were excluded the percentage reduced to 68.
†When one man who stopped smoking after he developed lung cancer was excluded the percentage reduced to 25.

TABLE X—*Mortality in ex-cigarette smokers by number of years stopped smoking compared with mortality in lifelong non-smokers. Current smokers are described as having stopped 1·9 years ago*

Cause of death	No of deaths divided by number expected in lifelong non-smokers Years since smoking stopped:					No of deaths in lifelong non-smokers
	0	<5	5-9	10-14	15	
Cancer of lung	15·8	16·0*	5·9	5·3*	2·0	7
Cancer of oesophagus and other respiratory sites	6·1	2·9		1·2		3
Chronic bronchitis and emphysema and pulmonary heart disease	35·6	34·2	47·7	7·3	8·1	2
Other conditions closely associated with smoking	7·7	10·2	3·2	3·4	3·2	5
Ischaemic heart disease in men 30-54 years	3·5	1·9	1·3	1·4	1·3	32
Ischaemic heart disease in men 55-64 years	1·7	1·9	1·4	1·7	1·3	75
Ischaemic heart disease in men 65 years and over	1·3	1·0	1·3	1·2	1·1	182
Myocardial degeneration	2·1	0·7	2·1	1·8	1·0	47
Other conditions associated with smoking	1·8	1·2	1·3	1·4	1·1	194
All other conditions	1·2	1·2	1·2	1·0	1·0	390
All causes at 30-64 years	2·0	1·7	1·6	1·4	1·1	326
All causes at 65 and over	1·6	1·4	1·4	1·2	1·1	611
All causes	1·8	1·5	1·5	1·3	1·1	937

*When five men who stopped smoking after they developed the disease were excluded the ratio reduced to 1·7.
†When one man who stopped smoking after he developed the disease was excluded the ratio reduced to 4·7.

For lung cancer the relative (though not the absolute) mortality decreased steadily with duration of stopping until more than 15 years after stopping (table IX)*; but at this time the mortality was still double the rate in life-long non-smokers of similar ages (table X). The few deaths from cancers of the oesophagus or other respiratory sites and from other conditions closely associated with smoking (excluding chronic bronchitis and pulmonary heart disease) also showed a decline in relative mortality. For chronic bronchitis and pulmonary heart disase, however, the pattern was materially different, a peak mortality being recorded five to nine years after stopping followed by a rapid decline to a death rate only a quarter of that in continuing cigarette smokers after a longer interval. Other conditions associated with smoking showed variable patterns, but in general the mortality tended to resemble that for lifelong non-smokers after smoking had been stopped for 15 years or more. For the group of other conditions the rate remained much the same throughout.

In interpreting these results, it must be remembered that men do not stop smoking at random. Some give up because of ill health, particularly if they have a condition like chronic bronchitis that is likely to be improved symptomatically by Stopping. For such a conditio?. in which the progression of the disease itself strongly affects smoking habits during the decade preceding death, mortality should be related to the smoking habits at least 10 years before death. Better still, the effect of smoking can be determined directly by measuring the rate of loss of lung function and relating it to contemporaneous smoking habits, as has been done by Fletcher *et al*.[14]

Another form of bias may be introduced if men who know they are seriously ill see no point in stopping and become less likely to give up than men who are well or do not reply to our questionnaires at all. Such biases could well account for the relatively low mortality from a variety of chronic diseases during the first five years after stopping. Lung cancer, in contrast, is usually fatal within two years, and such selective factors are less likely to influence its pattern of mortality. Our inquiries about individual case histories identified six men who gave up smoking only after they had developed lung cancer and who were recorded as having been ex-smokers when they died (five living for less than tire years after stopping and one for 12 years). These men should properly be excluded from the ex-smokers (see footnote to tabla IS and X). The more pertinent relation between the incidence of (as opposed to the death rate from) lung cancer and the length of time that smoking has been stopped will be reported elsewhere.[11]

Comparisons with the mortality of non-smokers (table X) are crucially dependent on the numbers of deaths in non-smokers and, for several of the diseases of greatest interest, these were so small that

*The extra death rate from lung cancer among smokers seems to have remained constant after smoking stopped, so the effect of giving up was to avoid the increase in the death rate that would have occurred had smoking continued.[11,13]

the confidence limits of the estimated relative ricks were large. In the case of lung cancer we can check the reliability of the estimate by using the mortality rates of non-smokers in two American studies,[7] in which 127 deaths from lung cancer occurred in male non-smokers. On the basis of these rates, we should have expected nine daths among our non-smoking doctors whereas we observed seven; there was, therefore. no reasdh to suppose that the incidence of the disease in non-smokers differed materially between the two countries. Had the relative risks in the first line of table X been derived from the American rata, they would have been within 30% of the tabulated values.

Another comparison of interest was made possible by the separate examination of the ex-smokers who had stopped smoking cigarettes beiore they had reached 30 years of age. Such men had smoked for an avenge of seven yean. Only 57 deaths occurred among them. which was *too* few to permit the calculation of disease-specific mortality rates. Nevertheless, their mortality was 53% of that in men of the same age who continued to smoke ($P < 0.001$) and 93% of that in non-smokers. This statistically non-significant difference suggested that these men suffered few, or no, deaths due to the seven years for which they smoked.

TRENDS IS MORTALITY WITH TIME IS DOCTORS COMPARED WITH TRESDS i s GENERAL POPULATION

During 1951-71 each cohort of Brirish men smoked fairly steadily throughout their working lives from 25 to 64 years of age. From retirement, however, average tobacco consumption decreased steadily throughout old age,[8] partly because older men really did reduce their smoking and partly because death removed disproportionately many of :he heavier smokers. In 1951 the consumption among doctors aged 25 to 64 years was similar to the national average in that age group, although the lower consumption among older men was less pronounced than in the general population, possibly because of better financial resources. The pattern among doctors of decrease on retirement was similar at each subsequent survey, but the mean amount smoked at each age decreased progressively, until by 1971 doctors in each age group were smoking between 'about a quarter and a half as much as men of the same ages in the general population [table II).

To compare the trends in smoking habits, we calculated the average daily number of cigarettes smoked per man in each five-year age group in 1951, 1956. 1966, and 1971. Our own data were numerous enough to allow us to do this for doctors with confidence; but the national data, which had been collected by the Tobacco Research Council' for commercial purposes, had been derived from quota samples and were relatively few. We therefore avenged the national data over three-year periods to diminish inaccuracy due to random variation. The results are shown in fig 1.

If smoking is a cause of disuse it might be supposed that the ratio of the mortality rates of doctors to those of other men would also have

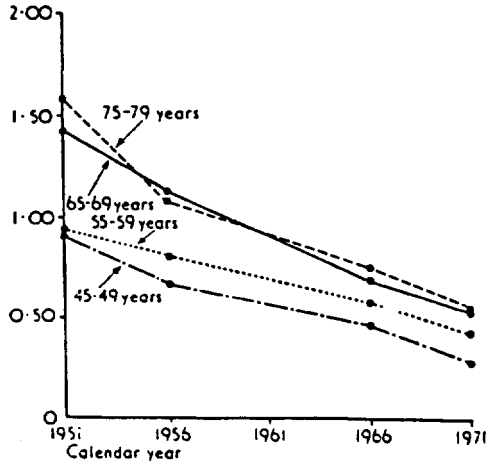

FIG 1—Trend in numbers of cigarettes smoked by male doctors as fraction of numbers smoked by all British men of same ages 1951-71—four age groups: 45-49 years, 55-59 years, 65-69 years, and 75-79 years (from table II).

TABLE XI—*Deaths of doctors as percentage of deaths expected at British rates and trend of percentage with time: study years 4-20, ages under 85 years*

Cause of death	Age at death (years)	No of deaths observed	Observed deaths as % of No expected	Slope of* regression of percentage on time ± SE
Cancer of lung, trachea, pleura, or mediastinum	20-64	159	35	−1·9 ± 0·6*
	65-84	242	60	−2·1 ± 0·8**
Cancers of oesophagus and other respiratory sites	20-84	93	78	−0·8 ± 1·6
Chronic bronchitis, emphysema, and bronchiectasis	20-84	220	27	−0·5 ± 0·4
Ischaemic heart disease and myocardial degeneration	20-54	356	90	−4·6 ± 1·0***
	55-64	746	106	−3·1 ± 0·8***
	65-74	984	102	−1·4 ± 0·7**
	75-84	875	93	+1·2 ± 0·7
Other vascular causes associated with smoking†	20-64	166	84	−3·0 ± 1·5*
	65-84	615	77	−1·1 ± 0·6
Other non-vascular causes associated with smoking‡	20-64	367	87	+1·1 ± 0·9
	65-84	436	61	+1·3 ± 0·6*
All other causes	20-64	900	74	−0·1 ± 0·5
	65-74	723	77	+0·4 ± 0·6
	75-84	745	91	−1·5 ± 0·6*
All causes	20-64	2788	76	−1·2 ± 0·3***
	65-74	2423	75	−0·4 ± 0·3
	75-84	2453	78	+0·9 ± 0·3**

*P < 0·05, **P < 0·01, ***P < 0·001. (Negative slopes indicate relative improvement among doctors.)
†Aortic aneurysm, hypertension, cerebral thrombosis, and arteriosclerosis.
‡Respiratory tuberculosis; cancers of rectum, pancreas, and bladder; pneumonia; hernia; hepatic cirrhosis and alcoholism; peptic ulcer; suicide; and poisoning.

decreased. This would be so, however, only if smoking were sufficiently important as a cause of disease for changes in smoking habits to outweigh the differential effects of other environmental changes, the efficacy of treatment, and accuracy of certification, and if the effect of reduced consumption showed itself within 10 years.

In examining trends in mortality among docton, we were further handicapped by the fact that those doctors who replied to our first questionnaire were a self-selected sample of all those to whom it was sent. The seriously ill would have been unable *to* respond, so that the mortality rate *oi* those who replied would have been, at least for a time, abnormally low. This bias would presumably have affected different diseases to a different extent and would have worn off mare quickly for diseases that are rapidly fatal than for those that usually muse death only after a long period of ill health. We preferred. however. to ignore differences between diseases that would have been difficult to allow for objectively and studied the experience of the total mortality in a random sample of the non-responders. The figures on grounds of health had effectively disappeared.[4]

For each of the 20 years of the study, we compared the numbers of deaths certified from different causes in each five-year age group among the doctors with the numbers certified as due to those causes in such men in England and Wales. To make the two sets of data as comparable as possible, we attributed deaths of docton to lung cancer (including trachea, pleura, or mediastinum) if that was the stated cause on the death certificate, even if our subsequent inquiries showed that the certified cause was wrong, and we excluded observations on men aged 85 years and over because we could nut

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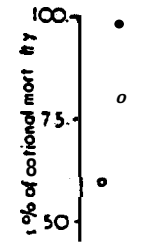

Results

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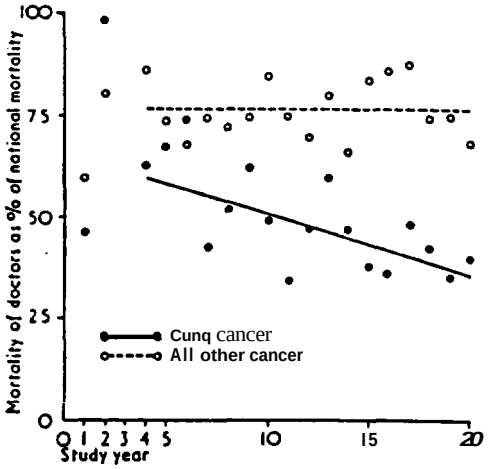
ercentages were unstable and even the slopes of many of the regres-on lines for individual conditions were unreliable. We therefore ombined many diseases into broad groups. The results are sum-narised in table XI, which shows the overall percentage and the slope f the regression line for various conditions in various age groups. f any slope is negative, then mortality among doctors is progressively pproving compand with that in the general population.

For lung cancer the trends were significantly downwards both under nd over 65 years of age. For chronic bronchitis and emphysema here were far fewer deaths than expected, reflecting the social class radient of the disease, so that the downward trend, although substantial, was not statistically significant. Likewise, the downward trend or cancers of the oesophagus and other respintory sites was not tatistically significant, although it too may have been real and due artly to changes in smoking. The trends for heart diseases and other ascular diseases associated with smoking were hard to interpret. hese diseases were strongly related to smoking only in younger dults (table V), and so we would expect changes in smoking to ffect trends only in these age groups. This is what we observed. The agnitude of the change was, however, surprisingly large. and we ere probably chiefly observing the secular tendency for decline in the tandardised mortality ratio (SMR) for coronary heart disease in ocial class I, some of which may have been due to factors other than moking habits. It will, therefore, be of interest to compare the vends the SMR for doctors with those for other professional groups and ocial class I as a whole when the occupational mortality tables r 1971 are published. Despite these reservations, we note that the end was downwards for all of the major diseases that are believed o be caused by smoking.

Detailed figures for all ages (25-84 years) for each year of the study om the second to the 20th are shown for cancer of the lung and for il othcr cancers in fig 2. The regression lines arc those calculated om the data for the fourth to the 20th years. The contrast was great: he slopes of the regression lines were, respectively, −1·4 (SE ±0·47) nd 0·0 (SE ±0·50). Had data for the second and third years been ncluded, the difference between the slopes would have been greater nd statistically more significant ($P < 0·01$). On this evidence it seems nlikely that the relative reduction in the certified death rate for ung cancer in doctors could have been an artefact of diagnosis or ertification.



2—Trend in number of deaths certified in male doctors as percentage of mber expected from experience of all men in England and Wales of same s. Results are given from second to 20th years of study for (a) lung cancer 9 deaths observed v 931·9 expected) and (b) all other cancers (1238 deaths erved v 1630·7 expected). Regression lines on time were calculated from for fourth to 20th years of study (regression coefficients: −1·4 for lung cer and 0·0 for all other cancers).

Discussion

Cancers of the lung, oesophagus, and other respiratory sites, ronic bronchitis and emphysema. and pulmonary heart ease have been known to be associated with smoking for ny years, and there is a mass of evidence to indicate that the association is mostly causal, without, of course, implying that smoking is the only cause (see [6–10 17–23] and, for chronic bronchitis and emphysema[24]). Only the cancers of the oesophagus and other respiratory sites does it seem likely that some of the excess in smokers can be attributed to a secondary association with other factors, particularly alcohol consumption. Our present data reinforce earlier conclusions and are qualitatively new only in so far as they provide detailed comparisons between mortality rates in the general population and a subgroup that reduced its consumption of cigarettes more than avenge. The results of this comparison confirm that death rates were reduced correspondingly, in the way that would be expected if smoking were a cause of disease. The extent of the reduction did not correlate exactly with the extent of the reduction in smoking, but neither could it be expected to do so. The reduction in smoking was achieved partly by docton not starting to smoke. but mostly by smokers giving up or reducing the number of cigarettes smoked. and the effects of these changes in habit are likely to manifest themselves to different extents and after different periods for different diseases. The most we can expect, therefore, is that trends should be compatible in direction and then only if there have not been other changes that outweigh the beneficial effect of decreased smoking in one or other group.

LUNG CANCER

We note that the results of the Swedish twin study do not support Fisher's genetic explanation for the association between smoking and lung cancer.[25 26] The only material objection to the inference that smoking causes lung cancer is the difference in the trends in mortality between cancer of the lung and cancers of the oesophagus and other respiratory sites,[26–29] despite the fact that smoking is associated with the development of cancer of all three types. In England and Wales, for example, men began to smoke cigarettes at about the turn of the century and the annual standardised mortality rate for cancer of the lung in men increased fiftyfold from 2 per 100 000 in 1911–15 to 102 per 100 000 in 1966–70. The mortality from cancer of the oesophagus, however, decreased from 12 to 7 pet 100000, and the mortality from other respiratory cancers (lip, tongue, mouth and tonsil, pharynx,* and larynx) actually decreased from 22 per 100 000 to 7 per 100 000.[30†] These differences are likely to be due to a combination of facton, including the failure to diagnose a large proportion of lung cancers before about 1950, different trends in the efficacy of treatment, and differential relationships to pipe, cigar, and cigarette smoking. The last of these is confirmed by our data in table VI, which show that changes from pipe to cigarette smoking would have had a far greater effect on the incidence of lung cancer than on the incidence of other types of cancer. More important still may be the fact that smoking interacts with other environmental factors to produce its effect.[31 32] One of these is the consumption of alcoholic drinks, which is closely related to the incidence of oesophageal and other respiratory cancers, but not of lung cancer[33–36]; another is exposure to asbestos, which might be related to the incidence of lung cancer but not of oesophageal cancer.[37 38]

Whether our observations on inhaling support the belief that cigarette smoking is a cause of lung cancer is uncertain. To produce the disease cigarette smoke must, we presume. reach the bronchi. principally the primary divisions but also to some extent the smaller bronchi. and it has usually been assumed that cancer would be most likely to occur in men who said they inhaled. Several investigators have reported a higher mortality in inhalers than in non-inhalers,[9 10] but they have not standardised for amount rmoked. In Doll and Hill's retrospective study" there was a slight excess of inhalers among patients with lung

*Including the nasopharynx, which is excluded from our group of cancers ui "other respiratory sites."

†The comparable figures for women were 2 and 20 per 100 000 for cancer of the lung, 4 and 5 per 100 000 for cancer of the oesophagus, and 3 and 3 per 100 000 for other respiratory cancers.

cancer who smoked less than 15 cigarettes a day, hut a greater excess of non-inhalers among men who smoked more heavily, and similar results were obtained by Spicer[11] In England and by Schwartz *et al*[10] in France. In the only other prospective study that separated inhaling by amount smoked, Cederlöf *et al*[14] found that an excess mortality in inhalers disappeared when the comparison was limited to cigarette smokers who smoked 16 or more cigarettes a day (relative risk in comparison to non-smokers: deep inhalers 15·7:1; light or non-inhalers 16·2:1). In our study the relative risk comparing inhalers with non-inhalers changed from about 2:1 for light smokers to 1:2 for heavy smokers (table VIII). There relative risks are, of course, subject to considerable statistical error, as the numbers in each category arc small. (The greater risk in men who were unable to classify themselves was based on very small numbers indeed, but it was consistent at all levels of smoking and should perhaps be noted.)

The distinction between inhaling and not inhaling is not absolute and smokers who say they do not inhale nearly always take enough smoke into their lungs to raise their carboxyhemoglobin level well above that in nun-smokers. Preliminary results of a large-scale survey being undertaken by Wald[12] show, for example, a greater difference between non-inhalers (including slight inhalers.) and non-smokers (4·6"., and 0·6 '., carboxyhaemoglobin) than between deep inhalers and non-inhalers who have smoked the same number of cigarettes on the day of the test (5·2"., and 4·6"„). The fact remains, however, that we still do not know where the smoke droplets are most likely to deposit when people describe their method of smoking in different ways, and it is impossible to interpret the results until we do. Meanwhile we note that smoke droplets that contain polycyclic hydrocarbons are initially so small when drawn into th mouth (less than 1 μm in diameter) that they could be carried down into the alveoli in the main stream without touching the walls of the bronchi. In a warm moist atmosphere they swell rapidly and if held in the respiratory tract for more than a second may deposit; but whether this will be on the bronchial epithelium or in the alveoli, whence they will be speedily removed by the lymph stream and the blood, will depend on the level they have reached in the lungs.[13]

CHRONIC OBSTRUCTIVE LUNG DISEASE

The deaths certified as due to chronic bronchitis, emphysema, or pulmonary heart disease, which may bc grouped together as "chronic obstructive lung disease," were somewhat fewer than those attributed to lung cancer (304 against 441; table III); but the number was probably underestimated, since some of the deaths attributed to pneumonia or myocardial degeneration (or even, perhaps, other forms of heart disease) may have been due to complications of obstructive disease. Death rates from chronic obstructive lung disease are, moreover, much lower in social class I men than in the general population, so our data also underestimate the real death rates due to the condition in a general population of smokers. In our study the relative risk for cigarette smokers compared with nun-smokers was actually greater for chronic obstructive lung disease than for lung cancer, although in other prospective studies the relative risks have been about the same. It seems, therefore, that chronic obstructive lung disease is as important a fatal effect of smoking as lung cancer. The interactive effect of atmospheric pollution may, however, be greater for chronic obstructive lung disease thin for lung cancer. and the relative importance of chronic obstructive lung disease as an effect of smoking may be less great in countries with less pollution than the UK.[11]

A recent monograph[11] described rhc development of chronic obstructive lung disease in smokers as in irreversible process (except among asthmatics), in which lung function deteriorates slowly over decades. This deterioration is much more rapid in some smokers than in others and is least rapid among non-smokers. When a smoker suffering excessively rapid progressive deterioration gives up smoking, lost lung function is not restored, but the subsequent rate of loss reverts to the normal rate of loss typical of non-smokers. This offers hope for the smoker who is prepared to stop smoking as soon as simple spirometry shows his lung function to have fallen well below the normal range for non-smokers. Those who wait until they are really disabled before they stop may prolong life a little, but their lung function does not recover and death probably ensues within five or 10 years. This description of the disease explains the initially surprising finding in table IX that the greatest death rate among ex-smokers (156"„ of that expected among continuing smokers) occurred five to nine years after stopping. The men who died in this period were presumably the men who stopped because they were becoming disabled but who had already lost so much lung function that a further few years of normal decline sufficed to kill them. The fact that the death rate in the first five years after stopping was less than that five to nine years after stopping suggests that it usually takes more than five years to progress from respiratory disability severe enough to cause the doctors we studied to stop smoking to death from the disease.

OTHER CONDITIONS CLOSELY ASSOCIATED WITH SMOKING

Of the three other conditions that were found to be closely associated with smoking, one inon-syphilitic aortic aneurysm) has been similarly associated with smoking in several ocher major studies."[13] In this study the death rate in heavy cigarette smokers was 10 times the rate in non-smokers, but the number of deaths was small and this estimate of the relative risk is about double that in ocher studies.

Respiratory tuberculosis has also been associated with smoking in retrospective studies' and in Dorn's prospective study,[15] and it is easy *to* understand how smoking could facilitate the spread of the disease by decreasing the ciliary activity of the bronchial mucosa. There is, however, also some evidence to suggest that the association might, in part, be secondary to the consumption of alcohol,'; though perhaps not in members of the upper socio-economic classes, who maintain a reasonable standard of nutrition.

The third condition, hernia, was responsible fur only 16 deaths and has not been examined separately before. That deaths from the complications of hernia should be more likely in smokers seems reasonable when one considers the extent to which a hernia can be aggravated by a chronic cough.

ISCHAEMIC HEART DISEASE ASD MYOCARDIAL DEGENERATION

Our data for ischaemic heart disease are similar to those that have been reported in many other studies throughout the world.[3 13-19] As in other studies, the relation with smoking is strong in young people and weakens as age increases. Seventy-one deaths were attributed to ischaemic heart disease in men under 45 years of age. At these ages the risk among heavy cigarette smokers was 15 times that in non-smokers. This relative risk is subject to large random error, but is similar to that recorded by Hammond[15] and slightly less than that estimated from a retrospective study of women who were aged under 65 and who were discharged from hospital with a diagnosis of myocardial infarction.[16] In that study of women information had been obtained about four other risk factors which, it was found, interacted with one another so that when three or more risk factors were present the relative risk was estimated to be more than 100:1. This implies a considerable absolute risk and suggests that the fall in the relative risk in smokers with age might be due in part to the progressive elimination of people who are

*Wald found that 34"., of smokers said that they did not inhale or inhaled slightly, which is similar to the proportion of "non-inhalers" in our study, and we have therefore used this combined group for the purpose of comparison.

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particularly susceptible to its effects. The mortality for younger smokers was so much greater than that for non-smokers that it seems reasonable to suppose that most of the excess was caused by smoking. Among older men, however, the relative risk was much less pronounced. It is possible that much of the excess mortality from ischaemic heart disease in this group of men arises not because of an effect of smoking, but because smoking correlates with some other factor which contributes directly to the disease. If, however, smoking is a major cause of ischemic heart disease in young men, it would seem likely that it also contributes to causing the disease in the old.

Associations between smoking and myocardial degeneration or cerebral thrombosis have not been reported before, but similar findings for cerebrovascular disuses as a whole have been reported by Hammond[16] and Kahn[14] in rhe USA. The fact that the relation with cigarette smoking was closer for myocardial degernation thin for ischaemic heart disease at ages 65 years and over (table V) makes it difficult to believe that the deaths attributed to myocardial degeneration should properly have been attributed to ischaemic hurt disease. Myocardial degeneration was also more closely related than ischaemic hurt disease to pipe and cigar smoking (table VI). The term includes a notch-potch of diagnoses like myocarditis and cardiovascular degeneration that were classified under Code No 422 of the ith revision of the ICD. The close relation with smoking would readily be explained if about half of these 615 deaths were actually due to pulmonary heart disease or to the aggravation of ocher heart disease by respirator), insufficiency even though we have already subtracted and classified separately those 27 deaths irom ICD 422 for which chronic bronchitis or emphysema was mentioned on the certificate as a contributory cause.

OTHER CONDITIONS ASSOCIATED WITH SMOKING

There remain the nine other conditions that were positively associated with smoking in our study, and cancer of the bladder. There is independent evidence to suggest that both peptic ulcer and cancer of the bladder a n be produced or aggravated by smoking[17-19] and there is nothing in our data to throw doubt on this conclusion. Cancer of the bladder was not found unusually often in heavy smokers, but the deaths were few and the deficiency might have been due to chance. For three of the conditions—cirrhosis of the liver and alcoholism, suicide, and poisoning—the association was presumably secondary to an association with psychological factors.

Non-causal associations could also be produced by the misdiagnosis of other conditions and may, perhaps, have contributed to the slightly increased death rates recorded among cigarette smokers from cancer of the pancreas, hypertension, arteriosclerosis, and pneumonia. Pneumonia, however, m3y result from lung cancer or be caused or aggravated by chronic obstructive lung disease without either of these underlying conditions being referred to on the death ccrtificatc, and then: is substantial evidence that smoking may contribute to the production of arteriosclerosis in general,[1 10] apart from the evidence relating it to ischaemic heart disease, cerebral thrombosis, and aortic aneurysm. Nothing is known about the causes of cancer of the pancreas, apart from its association with diabetes and the repeated finding in both retrospective and prospective studies that it is particularly common in heavy cigarette smokers.[1 21 41 42] The increasing death rate due to cancer of the pancreas may be an artefact due to improved diagnosis but it may also be partly due to the increased prevalcnce of an external carcinogen. It is, of course. immaterial from the point of view of estimating rhe mortality attributable to smoking whether these four conditions can be caused by smoking or whether the excess in smokers is due to diagnostic confusion with other conditions that ace.

An association between cancer of the rectum and smoking has not generally been found in other studies and may be due to chance or to a secondary association with some other factor, though what that factor might be is difficult to envisage. T recent observations that rectal cancer may also be associ with the consumption of beer do not provide any obvious clue

A negative relation between Parkinsonism and smoking w found originally by Dorn.[15] It was confirmed by Hammond and by an earlier analysis of our own data, and similar resu have been obtained in Luge-scale retrospective studies.[1 40] T deficiency of deaths in heavy smokers must partly be becau the disease makes smoking more difficult, but this cannot be t whole explanation. If it were one would expect compensato increases in light smokers and ex-smokers, and these were n found. The negative relation is, therefore, unlikely to be entire the result of the disease, unless the disease makes itself appare so early in life at to affect the start of the habit. No ready e planation exists, however, by which cigarette smoke could exe a beneficial effect on the central nervous system

Conclusion

From this review, we conclude that much of the exce mortality in cigarette smokers can be attributed with certain to the habit, but whether the greater part is attributable depen on the interpretation of the evidence regarding ischaemic hea disease. In table XII we list the 23 causes and groups of caus of death that we used to summarise our results in four ca gories according to whether the excess mortality in cigare smoken: (a) could be directly attributed to smoking, (6) cou probably be attributed to smoking, (c) was of uncertain origin or (d) could be attributed to other causes. Because so ma deaths were attributed to ischaemic heart disease and there w some doubt about its categorisation, particularly for the old age groups, we placed ischaemic heart disease in a separ subdivision of the second category. On this basis table X shows the quantitative distribution of the excess mortality the five categories by age. The results suggest that at ages 35- years the excess mortality in cigarette smokers that was actua caused by smoking was at least 22% of the total mortality non-smokers (the excess in category 1) and may have been o 52% (the excess in categories 1, 2A, and 2B). In the older groups the excess in cigarette smokers, and particularly excess in categories 1 and 2, must have been underestima because (a) men with chronic heart and pulmonary disease t to stop smoking some years before these diseases kill them, so do not appear as cigarette smokers when they die, and

TABLE XII—*Reason for excess mortality in cigarette smokers by cause of dea*

Excess mortality in cigarette smokers	Category	Cause of death
Caused by cigarette smoking	1	Cancer of lung Cancer of oesophagus* Cancer of other respiratory si Chronic bronchitis and emphy Pulmonary heart disease
Probably wholly or partly attributable to smoking	2A	Ischaemic heart disease
	2B	Non-syphilitic aortic aneurysr Myocardial degeneration Cerebral thrombosis Arteriosclerosis Respiratory tuberculosis Pneumonia Peptic ulcer Hernia Cancer of bladder Parkinsonism*
Reason unknown	3	Hypertension Cancer of pancreas All other causes
Attributable to [illegible] than smoking and [illegible] chance	4	Cancer of oesophagus* Cancer of other respiratory s Cancer of rectum Cirrhosis of liver and alcohol Suicide Poisoning

*Half number of deaths arbitrarily attributed to each of categories 1 and 4.
†Deficiency of deaths in cigarette smokers.

TABLE XIII—*Excess death rate in cigarette smokers by age and attribution category*

Age (years)	Annual death rate per 100 000 men: Non-smokers (No of deaths)	Excess in cigarette smokers due to diseases in category: 1	2A	2B	3	4	Cigarette smokers‡ (No of deaths)
35-9	132 (20)	*−7*†	*33*	*−1*	*−3*	*41*	196 (47)
40-4	151 (27)	*11*	*120*	*16*	*−5*	*33*	326 (91)
45-9	221 (35)	45	175	23	84	26	574 (152)
50-4	540 (66)	105	267	63	43	72	1090 (261)
55-9	844 (75)	146	342	110	162	75	1679 (324)
60-4	1431 (89)	406	366	209	238	116	2767 (384)
65-9	2081 (90)	741	650	282	684	136	4573 (426)
70-4	4236 (114)	1011	*349*	*303*	*593*	*150*	6642 (355)
75-9	7529 (131)	1495	*508*	*393*	*−109*	*114*	9636 (286)
80-4	9071 (105)	1056	*558*	*1232*	*2171*	*173*	14 261 (206)
All ages* 35-84	1245	270	255	126	184	73	2153

*Directly standardised to male population of England and Wales 1961.
†Rates in italics are unreliable because the standard errors of the rates of the corresponding diseases in non-smokers and in cigarette smokers were both large.
‡Started smoking before 25 years of age and continuing to smoke and no history of ever smoking anything but cigarettes.

social class I men *get* far less chronic obstructive lung disease than avenge. At ages 35-39 years, the observed excess (from alcohol-related diseases, suicide, and poisoning) was largely attributed to other factors with which smoking is associated.

After 1951 many doctors gave up smoking or reduced the number of cigarettes smoked, and the mortality rate* among the doctors in our study fell from the fourth to the 20th years of the study by 28% in those under 65 years of age (from 564 to 404 per 100 000) and by 5% in those aged 65-84 years (from 5703 *to* 5405 per 100 000). Men in England and Wales as a whole reduced their consumption much less and their mortality rates* fell in the same age groups by 9% (from 700 to 634 per 100 000) and 5% (from 7583 to 7192 per 100 000) respectively. Total mortality must be affected by many factors other than smoking and it seems probable that the progressive improvement in social conditions in the postwar period had a relatively greater beneficial effect on the population as a whole than on doctors, particularly after the age of retirement, thus obscuring (especially at old ages) the greater benefit that doctors obtained from their greater reduction in cigarette smoking.

For 25 years this work has been based on the records and cooperation of the British Medical Association and was made possible by thousands of doctors who completed the questionnaires and gave details of the evidence on which their diagnoses were based. We are most grateful to them for their help. The study was conceived by Sir Austin Bradford Hill and guided by him for 10 years, and our debt to him is immense. We also thank Professor J R Bignall, who advised on the diagnosis of difficult cases; the Registrars-General of the United Kingdom and the Registrars of the General Medical Council and its councils in Ireland and Scotland, who provided information about doctors' deaths; Mr Richard Gny, Ms Susannah Howard, and Dr Malcolm Pike, who helped with some of the analyses; Mrs Jean Gilliland and Miss Barbara Hafner, who collected and maintained the mass of individual records; Mrs Sutherland. who traced many missing doctors; Mrs Norton and Mrs Thompson. who prepared the data for computer analysis and, with Mrs Sutherland, helped with much of the clerical work; Ms Gale Mead, who typed innumerable manuscripts; Dr J Howlett, Dr G Manning, and the staff of the SRC Atlas Computing Laboratory, who provided excellent computing facilities, without which our analyses would have been impossible; and the Medical Research Council for financial support.

References

1 Doll. R, and Hill, A B, *British Medical Journal*, 1954, 1. 1451.
2 Doll, R. and Hill, A B, *British Medical Journal*, 1956, 2, 1071.
3 Doll, R. and Hill. A B, *British Medical Journal*, 1964, I, 1399–1460.
4 Doll, R. and Hill, A B, in *Epidemiological Study of Cancer and other Chronic Diseases*, National Cancer Institute Monograph No 19, p 205. Bethesda, Maryland. NIH, 1966.
5 Doll, R, and Pike, M C, *Journal of the Royal College of Physicians*, 1972, 6, 216.
6 Todd, G F, *Changes in Smoking Patterns in the UK*. London, Tobacco Research Council, 1975.
7 World Health Organisation, *Manual of the International Statistical Classification of Diseases, Injuries and Causes of Death*, Seventh Revision. Geneva, World Health Organisation, 1957.
8 Surgeon General, *Smoking and Health. Report*. Washington, DC, Department of Health, Education and Welfare, 1965.
9 Surgeon General, *Health Consequences of Smoking. Report*, Washington, DC, Department of Health, Education and Welfare, 1971.
10 Surgeon General, *Health Consequences of Smoking. Report*. Washington, DC, Department of Health, Education and Welfare, 1972.
11 Peto, R, and Doll, R, in preparation.
12 Doll. R, and Hill. A B. *British Medical Journal*. 1952. 2. 1271.
13 Doll, R, *Oncology*, 1950. 5, 1.
14 Fletcher, C M, *et al*, *Natural History of Chronic Bronchitis and Emphysema*. Oxford, Oxford University Press, 1976.
15 Kahn, H A. in *Epidemiological Study of Cancer and Other Chronic Diseases*, National Cancer Institute Monograph No 19, p 1. Bethesda, Maryland, NIH, 1966.
16 Hammond, E C, in *Epidemiological Study of Cancer and Other Chronic Diseases*. National Cancer Institute Monograph No. 19, p 127. Bethesda, Maryland, NIH. 1966.
17 US Public Health Service, *The Health Consequences of Smoking. A Public Health Service Review*. Washington, DC, Department of Health, Education and Welfare, 1967.
18 US Public Health Service, *The Health Consequences of Smoking*. 1968 Supplement to the 1967 *Public Health Service Review*. Washington, DC, Department of Health, Education and Welfare, 1968.
19 US Public Health Service, *The Health Consequences of Smoking*. 1969 Supplement to the 1967 *Public Health Service Review*. Washington, DC, Department of Health, Education and Welfare, 1969.
20 US Public Health Service, *The Health Consequences of Smoking*. Washington, DC, Department of Health, Education and Welfare, 1973.
21 US Public Health Service, *The Health Consequences of Smoking*. Washington, DC, Department of Health, Education and Welfare, 1974.
22 Royal College of Physicians, *Smoking and Health*. London, Pitman Medical, 1962.
23 Royal College of Physicians, *Smoking and Health Now*. London, Pitman Medical, 1971.
Fisher, R A, *Smoking: The Cancer Controversy*. Some *Attempts to Assess the Evidence*. Edinburgh, Oliver and Boyd, 1959.
25 Cederlöf, R, Friberg, L, and Lundman, T, in pmi.
Hueper, W C, *Industrial Medicine and Surgery*, 1954, 23, 13.
Passey, R D, *British Medical Journal*, 1954, 2, 1485.
28 Maxwell, J, *Lancet*, 1955. 1, 193.
29 Burch. P R J, *Thr Biology of Cancer. A New Approach*. Lancaster, Medical and Technical Publishing, 1956.
30 Care. R A At. *et al*, *Serial Mortality Tables, Neoplastic Diseases*, Vol 1, England and Wales, 1911-70. London, Institute of Cancer Research, 1976.
31 Doll, R, *Aristotelian University of Thessaloniki, Annual of the Faculty of Medicine*. 1974, 10, 9.
32 Wynder, E L, Bross, I J, and Day, E, *Cancer*, 1956, 9, 86.
33 Wynder, E L, Bross, I J, and Feldman, R M, *Cancer*, 1957, 10, 1300.
34 Wynder, E L, and Bross, I J, *Cancer*, 1961, 14, 389.
35 Schwartz, D, *et al*, *Revue Française d'etudes Cliniques et Biologiques*, 1962, 7, 590.
36 International Agency for Research on Cancer, *Annual Report*. Lyon, IARC, 1975.
37 Selikoff, I J, Hammond, E C, and Churg, J, in *Pneumoconiosis. Proceedings of the 3rd International Conference, Johannesburg, 1969*, ed H A Shapiro. London, Oxford University Press, 1970.
38 Berry, G, Newhouse, M L, and Turok, M, *Lancet*, 1972, 2, 476.
39 Spicer, C C, 1964, personal communication.
40 Schwartz, D, *et al*, *Journal of the National Cancer Institute*, 1961, 28, 1085.
41 Cederlöf, R, *et al*, *Relationship of Smoking and Some Social Covariables to Mortality and Cancer Morbidity*. Stockholm, Department of Environmental Hygiene, Karolinska Institute, 1975.
42 Wald, N, 1976, personal communication.
43 Davies, C N, *British Medical Journal*, 1957, 2, 410.
44 Royal College of Physicians, *Air Pollution and Health*. London, Pitman Medical, 1970.
45 Brown, K E, and Campbell, A H, *British Journal of Diseases of the Chest*, 1961, 55, 150.
46 Mann, J I, *et al*, *British Journal of Preventive and Social Medicine*, 1970, 30, 94.
47 Wynder, E L, *et al*, *Journal of the National Cancer Institute*, 1973, 50, 5[illegible].
48 Nefzger, M D, Quadfasel, F A, and Karl, V C, *American Journal of Epidemiology*, 1968, 88, 119.
49 Kessler, I I, and Diamond, E L, *American Journal of Epidemiology*, 1971, 94, 16.

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