

What happens when cigarette smokers give up the habit? Do their chances of dying of pulmonary and cardiac diseases decrease? Do they lose various physical complaints? Evidence on these points is presented in this report, and the evidence indicates that those who stop have a more favorable future, and the longer they stop the better the outlook.

EVIDENCE ON THE EFFECTS OF GIVING UP CIGARETTE SMOKING

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EVIDENCE on the effects of giving up smoking is more difficult to obtain than one might suppose. We must first inquire why some habitual smokers give up the habit and whether, once having stopped smoking, they are likely to resume the habit at a later date.

In a mail survey conducted in 1958, we asked ex-cigarette smokers why they had stopped and whether they thought that giving up the habit had any effect on their health or the way they felt.¹ About 60 per cent said that they had stopped because of some physical complaint such as cough, chest or throat complaints, loss of appetite, stomach trouble, or circulatory difficulties. Eighty-two per cent of those who said that they had stopped because of a physical complaint indicated some improvement (such as less coughing) as an apparent result of giving up the habit. Seventy-four per cent of the men said that they gained weight.

Table 1 shows the reasons for giving up smoking as stated by a sample of men between the ages of 50 and 69 who filled out questionnaires in late 1959 and early 1960. All of these men

had a history of only cigarette smoking and had stopped less than a year prior to answering the questionnaire. About 17 per cent of them were "sick at present." Over half of those who were sick said that they quit smoking because of some illness or physical complaint and over three-quarters of those who were not "sick at present" gave the same sort of reasons. The most frequently stated reasons were "doctor's orders," heart and circulatory diseases, and pulmonary complaints such as cough, flu, sinus trouble, and other respiratory conditions.

Two years after enrollment in a prospective epidemiological study, surviving subjects were requested to fill out a second questionnaire.² They were asked whether they had been hospitalized and whether they had any serious diseases since enrolling in the study. They were also asked how many cigarettes they currently smoked per day.

The data shown in Table 2 are confined to male subjects between the ages of 50 and 69 who were smoking cigarettes regularly when enrolled in the study. It shows the per cent who were

no longer smoking cigarettes when questioned two years later in relation to whether or not they had been hospitalized and whether or not they had had an attack of heart disease, stroke, or high blood pressure during the intervening two years.

A considerably larger percentage had stopped cigarette smoking among those who had been hospitalized or had heart or circulatory disease than among those not hospitalized and those who had not had heart or circulatory disease. This difference was most pronounced in the erstwhile heavy cigarette smokers. For example, in age group 50-59, 24.3 per cent of heavy smokers who had heart or circulatory disease quit cigarette smoking. In contrast, only 5.4 per cent of those who did not have heart or circulatory disease quit cigarette smoking.

Obviously, recent ex-cigarette smokers are, as a group, heavily weighted with persons in ill health; and the subsequent death rate of persons in ill health

is usually higher than the subsequent death rate of persons in good health. One might expect this difference to gradually wear off with time due to selective mortality; but it is questionable whether it would ever completely disappear.

Table 3 is confined to men in age groups 50-59 and 60-69 who were ex-cigarette smokers at the time they enrolled in the study in 1959-1960. They are classified by how long they had been ex-smokers and whether they were smoking cigarettes regularly when questioned again two years later.

Thirty-seven and a half per cent of the men who had been ex-cigarette smokers for less than a year at the time they enrolled in the study were smoking cigarettes again when requested two years later. The corresponding figure dropped to 16 per cent or 18 per cent for men who had been ex-cigarette smokers for a year prior to enrollment. It dropped still further for

Table 1—Reasons Why Ex-Cigarette Smokers Gave Up the Habit. Men Between the Ages of 50-69 Who Had a History of Smoking Cigarettes Only and Who Had Stopped Smoking Less than a Year Prior to Enrollment in Study.

Reason for Stopping Smoking	Sick at Present		Not Sick at Present	
	No.	%	No.	%
Disease or physical complaint*	396	76.7	1,457	56.8
Other reason	81	15.7	943	36.8
No answer	39	7.6	163	6.4
Total	516	100.0	2,563	100.0
Doctor's orders	113	21.9	275	10.7
Heart, circulatory disease	98	19.0	143	5.6
Cough	42	8.1	382	14.9
Cold, flu, sinus, etc.	30	5.8	166	6.5
Other respiratory conditions	42	8.1	140	5.5
Ulcer or stomach trouble	18	3.5	84	3.3
Other diseases or complaints	73	14.1	376	14.7
Nonspecific (e.g., "just quit")	64	12.4	714	27.9
Smoking-cancer reports	15	2.9	174	6.8
Cost, religion, etc.	13	2.5	89	3.5

* A few of these men also gave some other reason.

Table 2—Percentage of Men Who Had Stopped Smoking Cigarettes at the Time They Filled Out the Second Questionnaire in Relation to Their Current Amount of Cigarette Smoking Reported on First Questionnaire. Men with a History of Only Cigarette Smoking Classified by Whether They Were Hospitalized or Had Circulatory Disease* Between the Time of the First Questionnaire and the Time of the Second Questionnaire.

Current Amount of Cigarette Smoking 1st Questionnaire	Hospitalized Between Questionnaires		Not Hospitalized Between Questionnaires		Circulatory Disease* Between Questionnaires		No Circulatory Disease Between Questionnaires	
	No. of Men	% Stopped Smoking Cigarettes	No. of Men	% Stopped Smoking Cigarettes	No. of Men	% Stopped Smoking Cigarettes	No. of Men	% Stopped Smoking Cigarettes
(a) Men aged 50-59 at time of enrollment								
1- 9 a day	638	27.3	3,488	19.6	133	41.4	3,993	20.1
10-19 a day	1,493	17.0	7,605	9.4	328	30.2	8,770	9.9
20-39 a day	5,630	13.6	25,868	6.4	1,168	25.6	30,330	7.0
40+ a day	1,426	11.4	5,611	4.8	296	24.3	6,741	5.4
(b) Men aged 60-69 at time of enrollment								
1- 9 a day	414	32.6	1,862	23.4	114	44.7	2,162	24.0
10-19 a day	876	20.8	3,319	12.7	252	23.0	3,943	13.9
20-39 a day	2,047	15.8	7,371	9.0	599	24.5	8,819	9.5
40+ a day	354	15.0	1,067	8.2	79	20.3	1,342	9.2

* Heart disease, stroke, or high blood pressure.

men who had been ex-cigarette smokers for two years or longer. In other words, the longer it is since an ex-cigarette smoker gave up the habit the less likely it is that he will resume the habit.

In prospective studies, subjects are usually divided into groups according to their smoking habits at the time of enrollment. Deaths occurring in each of these groups during the next several

years are recorded and death rates are then calculated for each group.

The following considerations are important in evaluating the results of such prospective studies:

1. Initially, the group designated as ex-cigarette smokers is heavily weighted with persons in poor health.
2. Many of the subjects in the group designated as ex-cigarette smokers resume the habit within a year or two after enrollment.

Table 3—Per cent of Ex-Cigarette Smokers in 1959-1960, Who Were Smoking Cigarettes Regularly in 1961-1962. Men with a History of Regular Cigarette Smoking Only.

Years Since Last Smoking (1959-1960)	Age 50-59			Age 60-69		
	Total	Smoking Again in 1961-1962		Total	Smoking Again in 1961-1962	
		No.	%		No.	%
Under 1 year	1,956	733	37.5	742	278	37.5
1 year	1,108	207	18.7	537	87	16.2
2-4 years	3,387	315	9.3	1,674	126	7.5
5-9 years	4,746	211	4.4	2,289	77	3.4
10+ years	7,605	178	2.3	4,490	85	1.9

NOTE: Ex-cigarette smokers who did not state the time since last smoking are omitted from this table.

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Table 4—Mortality Ratios for Ex-Smokers and Current Smokers of Cigarettes. Data From Four Prospective Studies as Reported by the Surgeon General's Committee.³

	Doll Hill	Hammond Horn	Dorn	Best, Josie, Walker
Ex-cigarette	1.04	1.40	1.41	1.42
Current cigarette	1.44	1.70	1.79	1.65

Table 5—Mortality Ratios of Current Cigarette Smokers and of Ex-Cigarette Smokers. The Mortality Ratio of Men Who Never Smoked Was Set at 1.00. Hammond and Horn.⁴

Cigarettes Smoked per Day	Current Cigarette Smokers	Stopped <1 Year	Stopped 1-10 Years	Stopped 10+ Years
Less than 20	1.61	2.04	1.30	1.08
20 or more	2.02	2.69	1.82	1.50

Thus this group ceases to consist entirely of ex-smokers.

3. Both of these factors apply with greatest force to recent ex-cigarette smokers. They apply with much less force to ex-smokers who gave up the habit many years before enrollment.

In light of this, the findings in prospective studies are most interesting.

Table 4 shows mortality ratios of ex-cigarette smokers and current cigarette smokers based upon data from four prospective studies (i.e., the Doll and Hill study, the Hammond and Horn study, the Dorn study and the Best, Josie, and Walker study) as reported by the Surgeon General's Advisory

Table 6—Age-Standardized Death Rates of Men Who Never Smoked Regularly, Current Cigarette Smokers and Ex-Cigarette Smokers. The Cigarette Smokers Had a History of Only Cigarette Smoking. Hammond.²

Years Since Last Cigarette Smoking	Smoked 1-19 Cigarettes a Day			Smoked 20+ Cigarettes a Day		
	No. of Men	No. of Deaths	Death Rate	No. of Men	No. of Deaths	Death Rate
Ex-Smokers:						
<1 year	1,118	40	1,327	3,628	190	2,221
1-4 years	2,755	99	1,247	8,050	366	1,716
5-9 years	2,552	79	1,077	8,588	282	1,229
10+ years	5,852	129	703	10,788	334	1,008
Total, ex-smokers*	12,277	347	955	31,054	1,172	1,372
Current cigarette smokers	34,543	1,366	1,463	97,776	3,703	1,673
Never smoked regularly	79,969	1,974	812	79,969	1,974	812

* Ex-smokers who did not state the number of years since last smoking are omitted from this table.

Table 7—Lung Cancer Mortality Ratios of Current Cigarette Smokers and Ex-Cigarette Smokers. Data from Dorn's Study as Reported by the Surgeon General's Committee.³

Cigarettes per Day	Current Smokers	Ex-Smokers
<10	5.2	} 1.3
10-20	9.4	
21-39	18.1	} 1.6
40+	23.3	

Committee on Smoking and Health.³ In all four of these studies, the mortality ratio of ex-cigarette smokers was considerably lower than the mortality ratio of current cigarette smokers.

As shown in Table 5, Hammond and Horn⁴ classified ex-cigarette smokers by previous amount of cigarette smoking and by length of time since last smoking. Ex-cigarette smokers who had stopped less than one year before enrollment in the study had higher mortality ratios than men who were currently smoking cigarettes at the time of enrollment. This is not surprising in light of the fact that recent ex-smokers, as a group, are heavily weighted with men in ill health. However, the mortality ratio of ex-cigarette smokers who had stopped one to ten years prior to enrollment was lower than the mortality

ratio of current cigarette smokers; and the mortality ratio of ex-cigarette smokers who had stopped for ten years or longer was still lower.

As shown in Table 6, findings in the first 34 months of follow-up in our current prospective study³ confirmed the findings in the Hammond and Horn study.

Lung cancer is of particular interest here since it is highly related to cigarette smoking as judged in terms of mortality ratios. Coronary artery disease is of even greater interest since half of the excess deaths associated with cigarette smoking are attributed to this disease.

Dorn classified current cigarette smokers by current number of cigarettes smoked per day and classified ex-cigarette smokers by maximum number previously smoked per day (see Table 7). Taking daily amount of smoking into consideration, the lung cancer mortality ratios were far lower for ex-cigarette smokers than for current cigarette smokers.

Doll and Hill also found lung cancer death rates to be lower in ex-cigarette smokers than in current cigarette smokers (see Table 8).

Both amount of smoking and years since last smoked were taken into account in the Hammond and Horn study and in our current study (see Tables 9 and 10). Ex-heavy-cigarette smokers who had given up the habit less than a

Table 8—Continuity of Smoking: Standardized Death Rates from Cancer of the Lung. Doll and Hill.⁵

Continuity of Smoking	Death Rate per 1,000 (No. of Deaths)		
	Cigarette Smokers	Mixed Smokers	Pipe and/or Cigar Smokers
Continuing at January 11, 1951	1.25 (133)	0.59 (36)	0.47 (21)
Stopped before January 11, 1951	0.24 (10)	0.48 (6)	0.23 (3)

Table 9—Lung Cancer. Age-Standardized Death Rates Due to Well Established Cases of Bronchogenic Carcinoma (Exclusive of Adenocarcinoma). Current Cigarette Smokers and Ex-Cigarette Smokers with a History of Only Cigarette Smoking and Men Who Never Smoked Regularly. Hammond and Horn.⁴

	Smoked Less than 1 Pack a Day Death Rate	Smoked 1 Pack or More a Day Death Rate
Ex-smokers (Years Since Last Cigarette Smoking)		
<1 year	56.1	198.0
1-10 years	35.5	77.6
10+ years	8.3	60.5
Current cigarette smokers	57.6	157.1
Never smoked regularly	3.4	3.4

year prior to enrollment had lung cancer death rates higher than those of current cigarette smokers; but ex-heavy-cigarette smokers who had given up the habit for a year or longer had lung cancer death rates lower than those of current cigarette smokers.

What I have just said about total death rates and about death rates from lung cancer might be repeated for death rates from coronary artery disease. This is shown in Table 11 based upon the Doll and Hill study,⁵ Table 12 based upon the Framingham and Albany studies,⁶ and Table 13 based upon the first 34 months of follow-up in our current study.²

This evidence makes one thing quite clear:

Giving up cigarette smoking eventually results in a reduction in death rates (as compared with the death rates of men who do not give up cigarette smoking).

However, due to the difficulties mentioned earlier, the evidence just described gives almost no indication of how rapidly death rates drop upon giv-

Table 10—Lung Cancer. Age-Standardized Death Rates of Men Who Never Smoked Regularly, Current Cigarette Smokers and Ex-Cigarette Smokers. The Cigarette Smokers Had a History of Only Cigarette Smoking. Hammond.²

Years Since Last Cigarette Smoking	Smoked 1-19 Cigarettes a Day			Smoked 20+ Cigarettes a Day		
	No. of Men	No. of Deaths	Death Rate	No. of Men	No. of Deaths	Death Rate
Ex-Smokers:						
<1 year	1,118	3	97	3,628	30	330
1-4 years	2,755	5	62	8,050	24	118
5-9 years	2,552	1	13	8,588	16	72
10+ years	5,852	1	6	10,788	4	12
Total, ex-smokers*	12,277	10	27	31,054	74	87
Current cigarette smokers	34,543	62	66	97,776	283	137
Never smoked regularly	79,969	27	11	79,969	27	11

* Ex-smokers who did not state the number of years since last smoking are omitted from this table.

ing up smoking; and it leaves in doubt whether ex-cigarette smokers ever completely recover from the effects of their past smoking.

It may perhaps be possible to obtain such evidence from our current prospec-

tive study after the subjects have been traced for another two years. The problem is to eliminate the bias introduced by the inclusion of a large number of ill men in the ex-smoker groups and the bias introduced by the fact that many of the men classified as ex-smokers resumed the habit.

The first of these two biases can be reduced by confining the analysis to men who at the time of enrollment said that they were not sick and had never had certain serious diseases. We have done this with the data already on hand. Of course, death rates are very low in such a select group of subjects, so relatively few deaths occurred in the first 34 months of follow-up. The results give the impression that a substantial reduction in death rates occurs within a short time after men give up cigarette smoking. However, the number of cases is not sufficient to draw definite conclusions.

At a later date, we should be able to evaluate the second of the two biases (i.e., the tendency of many ex-smokers to return to the habit). This will be possible since at intervals of two years we requestion the subjects about their smoking habits and their illnesses.

Table 11—Standardized Death Rates per 1,000 from Coronary Disease (With or Without Hypertension). Doll and Hill.⁵

Nonsmokers	3.61
Cigarette smokers	4.86
Ex-cigarette smokers	3.92

Table 12—Coronary Artery Disease. Ratio of Observed to Expected Number of Deaths Among Men Free of Disease at Entry Into Framingham and Albany Studies. Doyle, Dawber, Kannel, Heslin, and Kahn.⁶

Total Nonsmokers	54
Never smoked	70
Former smokers	32
Cigar or pipe only	56
Total Cigarette Smokers	129
<20 a day	105
20 a day	117
Over 20 a day	164

Table 13—Coronary Artery Disease. Age-Standardized Death Rates of Men Who Never Smoked Regularly, Current Cigarette Smokers and Ex-Cigarette Smokers. The Cigarette Smokers Had a History of Only Cigarette Smoking. Hammond.²

Years Since Last Cigarette Smoking	Smoked 1-19 Cigarettes a Day			Smoked 20+ Cigarettes a Day		
	No. of Men	No. of Deaths	Death Rate	No. of Men	No. of Deaths	Death Rate
Ex-Smokers:						
<1 year	1,118	19	621	3,628	67	805
1-4 years	2,755	48	605	8,050	153	701
5-9 years	2,552	40	545	8,588	113	488
10+ years	5,852	57	309	10,788	144	431
Total, ex-smokers*	12,277	164	450	31,054	477	555
Current cigarette smokers	34,543	616	660	97,776	1,663	735
Never smoked regularly	79,969	843	345	79,969	843	345

* Ex-smokers who did not state the number of years since last smoking are omitted from this table.

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Table 14—Per cent of Men Who Complained of Cough. Men Who Never Smoked Regularly and Current Regular Cigarette Smokers Compared with Ex-Cigarette Smokers Classified by Years Since Last Smoking.

Age	Never Smoked Regularly	Current Smokers	Ex-Cigarette Smokers			
			<1 Year	1-4 Years	5-9 Years	10+ Years
A. Smoked <20 Cigarettes a Day						
30-39	14.7	27.8	16.0	12.5	13.6	15.2
40-49	13.3	31.4	19.0	12.8	12.6	14.0
50-59	16.1	37.3	18.4	17.5	12.8	15.7
60-69	19.8	45.7	28.5	24.4	20.3	19.7
70-79	25.1	47.1	35.7	30.7	29.5	24.1
B. Smoked 20+ Cigarettes a Day						
30-39	14.7	45.1	17.6	11.1	13.4	14.7
40-49	13.3	52.3	17.9	11.0	10.4	13.8
50-59	16.1	57.9	25.6	16.9	13.7	14.4
60-69	19.8	63.2	34.6	27.8	21.4	20.4
70-79	25.1	65.8	58.0	42.8	35.2	30.8

Evidence of a totally different type is worth considering.

Auerbach, Stout, Hammond, and Garfinkel have studied changes in the bronchial tubes of nonsmokers, current cigarette smokers, and ex-cigarette smokers.⁷ Material was available for only 72 ex-cigarette smokers. Therefore, each of the 72 ex-smokers was

matched with a nonsmoker of the same age and also matched with a current cigarette smoker of the same age and who smoked the same number of cigarettes per day as the ex-smoker had previously smoked. Table 16 shows the findings in these matched triads.

In respect to all but two findings in the bronchial epithelium and the bron-

Table 15—Per cent of Men Who Complained of Shortness of Breath. Men Who Never Regularly Smoked and Current Regular Cigarette Smokers Compared with Ex-Cigarette Smokers Classified by Years Since Last Smoking.

Age	Never Smoked Regularly	Current Smokers	Ex-Cigarette Smokers			
			<1 Year	1-4 Years	5-9 Years	10+ Years
A. Smoked <20 Cigarettes a Day						
30-39	9.2	12.3	10.5	12.7	8.9	10.3
40-49	11.3	17.0	15.2	13.1	13.0	13.4
50-59	15.7	22.7	21.3	20.5	16.8	17.0
60-69	20.7	33.3	28.9	34.0	27.5	24.4
70-79	23.6	34.5	40.7	42.5	41.8	28.3
B. Smoked 20+ Cigarettes a Day						
30-39	9.2	23.3	20.6	11.8	12.1	8.1
40-49	11.3	28.8	22.6	18.4	14.2	14.8
50-59	15.7	35.5	35.7	30.1	24.8	19.7
60-69	20.7	42.0	43.2	43.2	36.1	28.4
70-79	26.6	43.1	60.7	49.8	44.0	35.1

Table 16—Findings in Matched Triads of Current* Cigarette Smokers, Ex-Cigarette Smokers and Men Who Never Smoked. Auerbach, Stout, Hammond, and Garfinkel.⁷

		Current* Cigarette Smoker	Ex-Cigarette	Never Smoked
Number of subjects		72	72	72
Total sections with epithelial		3,156	3,436	3,537
Section with one or more epithelial lesions	No.	3,087	2,287	910
	%	97.8	66.6	25.7
3+ cell rows, cilia present	No.	2,926	1,968	427
	%	92.7	57.3	12.1
Cilia absent	No.	647	519	522
	%	20.5	15.1	14.8
Atypical cells present	No.	2,941	207	43
	%	93.2	6.0	1.2
50% + atypical cells, cilia present	No.	2,551	86	17
	%	80.8	2.5	0.5
Atypical cells present, cilia absent	No.	600	32	5
	%	19.0	0.9	0.1
Entirely atypical cells, cilia absent (ca-in-situ)	No.	254	6	0
	%	8.0	0.2	0
Disintegrating nuclei	No.	0	518	0
	%	0	15.1	0
Total sections		3,520	3,676	3,665
Hyperplasia and goblet cells in glands	No.	2,811	2,147	445
	%	79.9	58.4	12.1
Ulceration	No.	253	599	802
	%	7.2	16.3	21.9
Inspissated secretion in lumen of gland	No.	1	91	0
	%	<0.1	2.5	0

* "Current cigarette smokers" are persons who smoked cigarettes regularly up to the time of their terminal illness.

chial walls, the ex-cigarette smokers were intermediate between the current smokers and the men who never smoked. In respect to most findings, the ex-cigarette smokers were closer to the current smokers than to the men who never smoked. However, in respect to epithelial cells with atypical nuclei (and in respect to lesions composed entirely of such cells) the ex-cigarette smokers were much closer to men who never smoked than to current cigarette smokers. One type of change (cells with disintegrating nuclei) were found only in the ex-cigarette smokers and another change (inspissated secretion in

lumen of glands) was found almost exclusively in ex-cigarette smokers.

Tipton and Crocker⁸ have recently reported rather similar findings in dogs. They treated the bronchial epithelium of their animals with cigarette smoke condensate and observed epithelial changes similar to those found in cigarette smokers. When treatment was discontinued, the epithelium returned to normal in about 18 weeks.

Auerbach, Stout, Hammond, and Garfinkel⁹ studied changes in the lung parenchyma in respect to smoking habits. Pulmonary fibrosis, rupturing of alveolar septums, and thickening of

walls of arterioles and small arteries were all highly associated with cigarette smoking, increased with amount of smoking and (in current smokers) increased with age. These changes were less marked in ex-cigarette smokers than in current cigarette smokers of the same age. However, the evidence indicated that lung parenchyma does not revert to normal after a cigarette smoker gives up the habit; the damage simply does not progress to a more advanced stage.

Presumably, changes in bronchial epithelium bear some relationship to cough and changes in lung parenchyma bear some relationship to shortness of breath. Therefore, in light of the histologic evidence mentioned above, I thought it would be interesting to ascertain the per cent of ex-cigarette smokers who report cough and shortness of breath. The findings are summarized in Tables 14 and 15.

Although the trends are not completely consistent, the general picture is quite clear. Both cough and shortness of breath were reported by a much larger percentage of current cigarette smokers than men who never smoked regularly; and both of these complaints were reported by a smaller per cent of ex-cigarette smokers than of non-smokers.

The per cent of men who reported cough was considerably less among ex-cigarette smokers who had stopped for less than one year than among current cigarette smokers. Except in the oldest age groups the per cent reporting cough was no higher among ex-cigarette smokers who had stopped for one to four years than among men who never

smoked. Thus it appears that this complaint diminishes rather quickly when a cigarette smoker gives up the habit.

The picture is rather different for shortness of breath. The frequency of this complaint apparently diminishes gradually with time when a cigarette smoker gives up the habit. However, shortness of breath was reported by a larger per cent of ex-cigarette smokers who had given up the habit for ten years or longer than of men who never smoked.

These two findings on physical complaints are consistent with findings in histologic studies.

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