# PART I

## Current Information on the Health Consequences of Smoking

# Highlights of The Report

*General Mortality Information*

Previous findings reported in 1967 indicate that cigarette smoking is associated with an increase in overall mortality and morbidity and leads to a substantial excess of deaths in those people who smoke. In addition, evidence herein presented shows that life expectancy among young men is reduced by an average of 8 years in "heavy" cigarette smokers, those who smoke over two packs a day, and an average of 4 years in "light" cigarette smokers, those who smoke less than one-half pack per day.

*Smoking and Cardiovascular Diseases*

Current physiological evidence, in combination with additional epidemiological evidence, confirms previous findings and suggests additional biomechanisms whereby cigarette smoking can contribute to coronary heart disease. Cigarette smoking adversely affects the interaction between the demand of the heart for oxygen and other nutrients and their supply. Some of the harmful cardiovascular effects appear to be reversible after cessation of cigarette smoking.

Because of the increasing convergence of epidemiological and physiological findings relating cigarette smoking to coronary heart disease, it is concluded that cigarette smoking can contribute to the development of cardiovascular disease and particularly to death from coronary heart disease.

*Smoking and Chronic Obstructive Bronchopulmonary Diseases*

Additional physiological and epidemiological evidence confirms the previous findings that cigarette smoking is the most important cause of chronic non-neoplastic bronchopulmonary disease in the United States.

Cigarette smoking can adversely affect pulmonary function and disturb cardiopulmonary physiology. It is suggested that this can lead to cardiopulmonary disease, notably pulmonary hypertension and cor pulmonale in those individuals who have severe chronic obstructive bronchitis.

*Smoking and Cancer*

Additional evidence substantiates the previous findings that cigarette smoking is the main cause of lung cancer in men. Cigarette smoking is causally related to lung cancer in women but accounts for a smaller proportion of cases than in men. Smoking is a significant factor in the causation of cancer of the larynx and in the development of cancer of the oral cavity. Further epidemiological data strengthen the association of cigarette smoking with cancer of the bladder and cancer of the pancreas.

## Smoking and Overall Mortality

The 1964 Advisory Committee's Report (3) clearly and emphatically outlined the dangers of cigarette smoking to health. The conclusions of the Committee, as outlined in the 1967 Report (2), were as follows:

CIGARETTE smoking is associated with a 70-percent increase in the age-specific death rates of males, and to a lesser extent with increased death rate of females. The total number of excess deaths causally related to cigarette smoking in the U.S. population cannot be accurately estimated. In view of the continuing and mounting evidence from many sources, it is the judgment of the Committee that cigarette smoking contributes substantially to mortality from certain specific diseases and to the overall death rate.

In general, the greater the number of cigarettes smoked daily, the higher the death rate. For men who smoke fewer than 10 cigarettes a day, according to the seven prospective studies, the death rate from all causes is about 40 percent higher than for nonsmokers. For those who smoke from 10 to 19 cigarettes a day, it is about 70 percent higher than for nonsmokers; for those who smoke 20 to 39 a day, 90 percent higher, and for those who smoke 40 or more, it is 120 percent higher.

Cigarette smokers who stopped smoking before enrolling in the seven studies have a death rate about 40 percent higher than nonsmokers, as against 70 percent higher for current cigarette smokers. Men who began smoking before age 20 have a substantially higher death rate than those who began after age 25. Compared with nonsmokers, the mortality risk of cigarette smokers, after adjustments for differences in age, increases with duration of smoking (number of years), and is higher in those who stopped after age 55 than for those who stopped at an earlier age.

In two studies which recorded the degree of inhalation, the mortality ratio for a given amount of smoking was greater for inhalers than for noninhalers.

The ratio of death rates of smokers to that of nonsmokers is highest at the earlier ages (40–50) represented in these studies, and declines with increasing age.

Possible relationships of death rates to other forms of tobacco use were also investigated * * *. The death rates for men smoking less than 5 cigars a day are about the same as for nonsmokers. For men smoking more than 5 cigars daily, death rates are slightly higher. There is some indication that these higher death rates occur primarily

in men who have been smoking more than 30 years and who inhale the smoke to some degree. The death rates for pipe smokers are little if at all higher than for nonsmokers, even for men who smoke 10 or more pipefuls a day and for men who have smoked pipes more than 30 years.

In fact, the Committee's concern was of such an immediate nature that they recommended: "* * * appropriate remedial action."

The 1967 report reviewed the literature of the 3½ years subsequent to the 1964 report and found no evidence to refute the conclusions of the latter.

Additional evidence was given which clarified some of the pathobiomechanisms of the diseases associated with smoking. The findings of the 1964 report were strengthened and some new ones stated. New data on the general mortality and morbidity associated with smoking were presented. The highlights of the 1967 report are given below:

1. The previous conclusions with respect to the association between smoking and mortality are both confirmed and strengthened by the recent reports. The added period of followup and analysis of deaths of nonrespondents as well as of respondents in the Dorn Study suggests that the earlier reports may have understated the relationship.

2. More information is now available for specific age groups than previously. A comparison of three ways of measuring the relationship indicates that cigarette smoking is most important among men aged 45 to 54 both in terms of mortality ratios and excess deaths expressed as a percentage of total deaths. Nevertheless, although both of these measures decline with advancing age, the increment added to the death rate, which reflects one's personal chances of being affected, continues to increase with age. For men between the ages of 35 and 59, the excess deaths among current cigarette smokers account for one out of every three deaths at these ages. For women, with their lower overall exposure to cigarettes, the comparable figure is about one death out of every 14 at ages 35 to 59.

3. Women who smoke cigarettes show significantly elevated death rates over those who have never smoked regularly. The magnitude of the relationship varies with several measures of dosage. By and large the same overall relationships between smoking and mortality are observed for women as had previously been reported for men, but at a lower level. Not only are the death rates for men who have never smoked regularly higher than those for women who have never smoked regularly, but the effect of smoking as measured either by differences in death rates or by mortality ratios is greater for men than for women. At least part of this can be accounted for by the lower exposure of female cigarette smokers whether measured by number of cigarettes, duration of smoking, or degree of inhalation.

4. Previous findings on the lower death rates among those who have discontinued cigarette smoking are confirmed and strengthened by the additional data reviewed. Kahn's analysis of ex-smokers in the U.S. veterans study—controlling for age at which they began smoking, amount smoked, and current age—reveals a downward trend in risk relative to those who continued to smoke as the duration of time discontinued increases. The British physician study, in which a down-

ward trend is reported in lung cancer death rates for the entire group (smokers, ex-smokers, and those who never smoked, combined) along with a very sharp reduction in cigarette smoking by the physician, is the best available example of a controlled cessation experiment with reduction of risks resulting from reduction of smoking. The findings of this report support the view that epidemiological data showing lower death rates among former smokers than among continuing smokers cannot be dismissed as due to selective bias and that the benefits of giving up smoking have probably been understated.

5. Cigarette smokers have higher rates of disability than nonsmokers, whether measured by days lost from work among the employed population, by days spent ill in bed, or by the most general measure —days of "restricted activity" due to illness or injury. Data from the National Health Survey provide a base for estimating that in 1 year in the United States an additional 77 million man-days were lost from work, an additional 88 million man-days were spent ill in bed, and an additional 306 million man-days of restricted activity were experienced because cigarette smokers have higher disability rates than nonsmokers. For men age 45 to 64, 28 percent of the disability days experienced represent the excess associated with cigarette smoking.

In the 1967 Report the following questions were emphasized:

1. How much mortality and excess disability are associated with smoking?

2. How much of this early mortality and excess disability would not have occurred if people had not taken up cigarette smoking?

3. How much of this early mortality and excess disability could be averted by the cessation or reduction of cigarette smoking?

4. What are the biomechanisms whereby these effects take place and what are the critical factors in these mechanisms?

The problem of how best to measure the relationship between smoking and mortality was presented by three meaningful measures of comparison:

1. Mortality Ratios: Obtained by dividing the death rate for a classification of smokers by the death rate of a comparable group of nonsmokers * * * A mortality ratio has been considered to reflect the degree to which a classification variable identifies or may account for variations in death rates. As such, it is a measure of relative risk which indicates the importance of that variable relative to uncontrolled variables—an indicator of *potential biological significance*.

2. Differences in Mortality Rates: Obtained by subtracting from the death rate for smokers, the death rate of a comparable group of nonsmokers * * *. This measure reflects the added probability of death in a 1-year period for the smoker over that for the nonsmoker. As such it is a measure of *personal health significance*, a means for the individual to estimate the added risk to which he is exposed.

3. Excess Deaths: Obtained by subtracting from the number of deaths occurring in a group of smokers, the number of deaths which would have occurred if that group of smokers had experienced the same mortality rates as a comparable group of nonsmokers. In the example which follows this has been reported as a percentage of all

TABLE 1.—*Comparison of mortality rates for smokers and nonsmokers by age and sex: Based on data from U.S. Veterans Study and Hammond Study*

| Study population, sex, and measure of mortality | 35–44 years | 45–54 years | 55–64 years | 65–74 years | 75–84 years |
|---|---|---|---|---|---|
| U.S. VETERANS: MEN | | | | | |
| Total number of deaths | 383 | 366 | 13, 840 | 17, 550 | 1, 932 |
| Death rates per 100,000: | | | | | |
| Never smoked regularly | 127 | 264 | 1, 056 | 2, 411 | 6, 214 |
| Current cigarette smokers | 232 | 728 | 1, 819 | 4, 032 | 8, 471 |
| Mortality ratio [1] | 1. 83 | 2. 76 | 1. 72 | 1. 67 | 1. 36 |
| Difference in death rates per 100,000 [2] | 105 | 464 | 763 | 1, 621 | 2, 257 |
| Excess deaths as percentage of total [3] | 33 | 43 | 21 | 17 | 8 |
| HAMMOND MEN | | | | | |
| Total number of deaths | 631 | 5, 297 | 8, 427 | 8, 125 | 3, 968 |
| Death rates per 100,000: | | | | | |
| Never smoked regularly | 210 | 406 | 1, 202 | 3, 168 | 7, 863 |
| Current cigarette smokers | 397 | 925 | 2, 202 | 4, 788 | 9, 674 |
| Mortality ratio [1] | 1. 89 | 2. 28 | 1. 83 | 1. 51 | 1. 23 |
| Difference in death rates per 100,000 [2] | 187 | 519 | 1, 000 | 1, 620 | 1, 811 |
| Excess deaths as percentage of total [3] | 33 | 38 | 25 | 13 | 4 |
| HAMMOND WOMEN | | | | | |
| Total number of deaths | 727 | 2, 826 | 3, 915 | 5, 115 | 4, 188 |
| Deaths rates per 100,000: | | | | | |
| Never smoked regularly | 165 | 304 | 698 | 1, 913 | 5, 914 |
| Current cigarette smokers | 186 | 384 | 838 | 2, 229 | 5, 846 |
| Mortality ratio [1] | 1. 13 | 1. 26 | 1. 20 | 1. 17 | . 99 |
| Difference in death rates per 100,000 [2] | 21 | 80 | 104 | 316 | 68 |
| Excess deaths as percentage of total [3] | 5 | 9 | 4 | 2 | ------ |

[1] Mortality ratios—death rate for current cigarette smokers divided by death rate for those who never smoked regularly.

[2] Differences in death rates—death rate for current cigarette smokers minus death rate for those who never smoked regularly.

[3] Excess deaths among current cigarette smokers (i.e., additional deaths that occurred among current cigarette smokers per year above those which would have occurred if smokers had the same death rates as those who never smoked regularly). This is expressed as a percentage of all deaths occurring in that age-sex group.

SOURCE: The Health Consequences of Smoking (2).

deaths in the appropriate age group * * *. It should be noted that this measure not only depends on the differences in death rates between the smokers and the nonsmokers, but also on the proportion of smokers in the group. Thus, even with a large difference in rates between smokers and nonsmokers, a population with very few smokers would have very few excess deaths. This measure is therefore an indicator of the *public health significance* of the differences found since it measures the number of people affected and therefore the magnitude of the problem for society as a whole.

As seen in table 1, from the 1967 report, the magnitude of the problem is reflected in the statement:

Reviewing both study groups it appears that for men between the ages of 35 and 60 approximately one-third of all deaths that occur are excess deaths in the sense that they would not have occurred as early as they did if cigarette smokers had the same death rates as the nonsmoking group. For women, the percentage is much lower, reaching a peak of 9 percent of all deaths in age group 45–54.

Another valuable measure of comparison was recently calculated by Hammond(1), from his study of over 1 million men and women. Life expectancy of men with respect to cigarette smokers and nonsmokers is shown in tables 2 and 3. The life expectancy for a two-pack a day, or more, smoker at age 25 is 8.3 years less than that for the corresponding nonsmoker. Men at age 35 and over, who smoke two or more packs of cigarettes per day, have between 20 and 25 per cent less life expectancy than their corresponding nonsmoking counterparts. Even "light" smokers, those who smoke less than 10 cigarettes per day, have from 2.8 to 4.6 fewer years of life expectancy than corresponding nonsmokers.

TABLE 2.—*Estimated years of life expectancy at various ages for males in the United States, by daily cigarette consumption*

| Age | Never smoked regularly | Number of cigarettes smoked per day | | | |
|---|---|---|---|---|---|
| | | 1–9 | 10–19 | 20–39 | 40 and over |
| 25 years | 48. 6 | 44. 0 | 43. 1 | 42. 4 | 40. 3 |
| 30 years | 43. 9 | 39. 3 | 38. 4 | 37. 8 | 35. 8 |
| 35 years | 39. 2 | 34. 7 | 33. 8 | 33. 2 | 31. 3 |
| 40 years | 34. 5 | 30. 2 | 29. 3 | 28. 7 | 26. 9 |
| 45 years | 30. 0 | 25. 9 | 25. 0 | 24. 4 | 23. 0 |
| 50 years | 25. 6 | 21. 8 | 21. 0 | 20. 5 | 19. 3 |
| 55 years | 21. 4 | 17. 9 | 17. 4 | 17. 0 | 16. 0 |
| 60 years | 17. 6 | 14. 5 | 14. 1 | 13. 7 | 13. 2 |
| 65 years | 14. 1 | 11. 3 | 11. 2 | 11. 0 | 10. 7 |

SOURCE: Hammond, E. C. (1).

TABLE 3.—*Loss in life expectancy at various ages for cigarette smokers compared with nonsmokers*

[Loss in years is also expressed as a percent of the total life expectancy of nonsmokers]

| Age | Number of cigarettes smoked per day | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1–9 | | 10–19 | | 20–39 | | 40 and over | |
| | Years lost | Percent | Years lost | Percent | Years lost | Percent | Years lost | Percent |
| 25 years | 4. 6 | 9. 5 | 5. 5 | 11. 3 | 6. 2 | 12. 8 | 8. 3 | 17. 1 |
| 30 years | 4. 6 | 10. 5 | 5. 5 | 12. 5 | 6. 1 | 13. 9 | 8. 1 | 18. 5 |
| 35 years | 4. 5 | 11. 5 | 5. 4 | 13. 8 | 6. 0 | 15. 3 | 7. 9 | 20. 2 |
| 40 years | 4. 3 | 12. 5 | 5. 2 | 15. 1 | 5. 8 | 16. 8 | 7. 6 | 22. 0 |
| 45 years | 4. 1 | 13. 7 | 5. 0 | 16. 7 | 5. 6 | 18. 7 | 7. 0 | 23. 3 |
| 50 years | 3. 8 | 14. 8 | 4. 6 | 18. 0 | 5. 1 | 19. 9 | 6. 3 | 24. 6 |
| 55 years | 3. 5 | 16. 4 | 4. 0 | 18. 7 | 4. 4 | 20. 6 | 5. 4 | 25. 2 |
| 60 years | 3. 1 | 17. 6 | 3. 5 | 19. 9 | 3. 9 | 22. 2 | 4. 4 | 25. 0 |
| 65 years | 2. 8 | 19. 9 | 2. 9 | 20. 6 | 3. 1 | 22. 0 | 3. 4 | 24. 1 |

Source: Hammond, E. C. (1).

## REFERENCES


(*1*) HAMMOND, E. C. Life expectancy of American men in relation to their smoking habits. Presented at the World Conference on Smoking and Health, New York City, September 11–13, 1967. 23 pp.

(*2*) U.S. PUBLIC HEALTH SERVICE. The Health Consequences of Smoking. A Public Health Service Review: 1967. Washington, U.S. Department of Health, Education, and Welfare, Public Health Service Publication No. 1696, 1967. 227 pp.

(*3*) U.S. PUBLIC HEALTH SERVICE. Smoking and Health. Report of the Advisory Committee to the Surgeon General of the Public Health Service. Washington, U.S. Department of Health, Education, and Welfare, Public Health Service Publication No. 1103, 1964. 387 pp.

# PART II

## Technical Reports on the Relationship of Smoking to Specific Disease Categories

# CHAPTER 1

## Smoking and Cardiovascular Diseases

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# INTRODUCTION

The primary purpose of the 1968 Supplemental Report is to review the pertinent literature that has become available subsequent to the 1967 Report. Brief mention of the conclusions of the 1964 Report and the highlights of the 1967 Report is made to facilitate an understanding of the significance of the most recent information. The current research findings should be considered in the perspective of the research evidence previously presented in the 1964 (*148*) and 1967 (*146*) Reports.

## Conclusions of the 1964 Report (*148*)

Male cigarette smokers have a higher death rate from coronary artery disease than nonsmoking males, but it is not clear that the association has causal significance.

## Highlights of the 1967 Report (*146*)

1. Additional evidence not only confirms the fact that cigarette smokers have increased death rates from coronary heart disease, but also suggests how these deaths may be caused by cigarette smoking. There is an increasing convergence of many types of evidence concerning cigarette smoking and coronary heart disease which strongly suggests that cigarette smoking can cause death from coronary heart disease.
2. Cigarette smoking males have a higher coronary heart disease death rate than nonsmoking males. This death rate may, on the average, be 70 percent greater, and, in some, even 200 percent greater or more in the presence of other known "risk factors" for coronary heart disease. Female cigarette smokers also have a higher coronary heart disease death rate than do nonsmoking females, although not as high as that for males. In general, the death rates from this disease increase with amount smoked. Cessation* of cigarette smoking is followed by a reduction in the risk of dying from coronary heart disease when compared with the risk incurred by those who continue to smoke.
3. A greater frequency of advanced coronary arteriosclerosis is noted in male cigarette smokers, especially in those who smoke heavily.
4. Additional evidence strengthens the association between cigarette smoking and cerebrovascular disease, and suggests that some of the pathogenetic considerations pertinent to coronary heart disease may also apply to cerebrovascular disease.

*Those who have stopped smoking cigarettes have a lower risk of dying from coronary heart disease than those who continue to smoke.

## SMOKING AND CORONARY HEART DISEASE

### Coronary Heart Disease Mortality

As in the past two decades, coronary heart disease in the United States continues as the leading cause of death, being responsible in 1967 for 567,710 deaths or 31.0 percent of the total of 1,833,900 deaths.

Since age specific data are not yet available for 1967, table 1 shows the number of deaths due to coronary heart disease and the death rates per 100,000 persons by age for 1966.

TABLE 1.—*Coronary heart disease deaths and death rates per 100,000 population, by age: United States, 1966*

[Disease category 420 in the ICD Manual, 1957]

| Age | Number of deaths | Death rates |
|---|---|---|
| Total | 573, 191 | 292. 7 |
| Under 25 years | 250 | 0. 3 |
| 25–34 years | 1, 469 | 6. 6 |
| 35–44 years | 12, 522 | 52. 0 |
| 45–54 years | 45, 997 | 206. 3 |
| 55–64 years | 99, 647 | 577. 3 |
| 65–74 years | 162, 555 | 1, 405. 2 |
| 75–84 years | 171, 737 | 2, 979. 5 |
| 85 and over | 78, 854 | 7, 015. 5 |
| Not stated | 160 | (X) |

X—Not applicable.

SOURCE: Monthly Vital Statistics, National Center for Health Statistics (147).

These data illustrate the dramatic increase in death rates as age advances, with the increase being particularly marked after age 45. The death rates for coronary heart disease for men and women continue to show a conspicuous difference. In 1966 it was 361.6 for males and 226.5 for females per 100,000 population.

While several studies of various aspects of the association between coronary heart disease mortality and cigarette smoking have been reported during the past year, the most significant studies of this association are contained in the 1967 report.

The several new studies of various aspects of the association between coronary heart disease mortality and cigarette smoking follow.

Friedman (*46*) reported a strong positive correlation between per capita cigarette sales and coronary heart disease death rates by states. The correlation is 0.76 when data only from those states with relatively accurate information of cigarette consumption are analyzed. Related factors such as urbanization or softness of the local water supply do not explain this degree of association.

Other studies deal with the excess deaths associated with smoking. Strobel, et al. (*140*) reported that among 3,479 Swiss physicians, over 50 percent of the excess deaths occurring over a 9-year period among smokers was due to coronary heart disease.

In contrast to the study above and data from the United States in which approximately one-half of the excess deaths associated with smoking are attributed to cardiovascular causes (*148*), preliminary data from Hirayama (*65*) show that the excess deaths in Japan associated with smoking were primarily explained by cancer of various sites. Only 12 percent of the excess deaths were associated with cardiovascular causes. This prospective study of 265,118 adults over the age of 40 encompassed a followup period of 15 months. Additional followup by Hirayama should yield useful data with respect to smoking and excess mortality from cardiovascular diseases in this Japanese population group, particularly with regard to the younger adults in the study.

Hyams, et al. (*67*), on the other hand, speculate that the apparent increase in the occurrence of coronary heart disease among Japanese males, especially under the age of fifty, may be due to a trend toward Westernization in both diet and smoking habits among younger Japanese men.

Hammond (*54*), in his prospective study of over 1 million men and women, showed a positive relationship between the duration of the smoking habit and coronary heart disease mortality. In the Framingham Heart Study (*71*), no association was found between the duration of the smoking habit and the incidence of mortality from heart attacks among men who were "heavy smokers" (more than one package of cigarettes per day).

These discrepancies between the relationship of smoking to the incidence of total coronary heart disease and mortality from acute coronary heart disease may be accounted for, in part, by the differences in population groups studied and by the possibility that duration of smoking may have a greater association with the fatal forms of coronary heart disease.

Kannel, et al. (*70*), in more recent data from the Framingham study, indicate that the fatal and more severe forms of coronary disease are more strongly associated with cigarette smoking that the less severe forms (figure 1).

## Coronary Heart Disease Morbidity *

Much of the morbidity data reported during this past year resulted from retrospective studies of patients or cross-sectional studies (*106*, *107*, *127*, *134*, *151*). In these studies the findings revealed that there

* Also may include mortality data in this presentation.

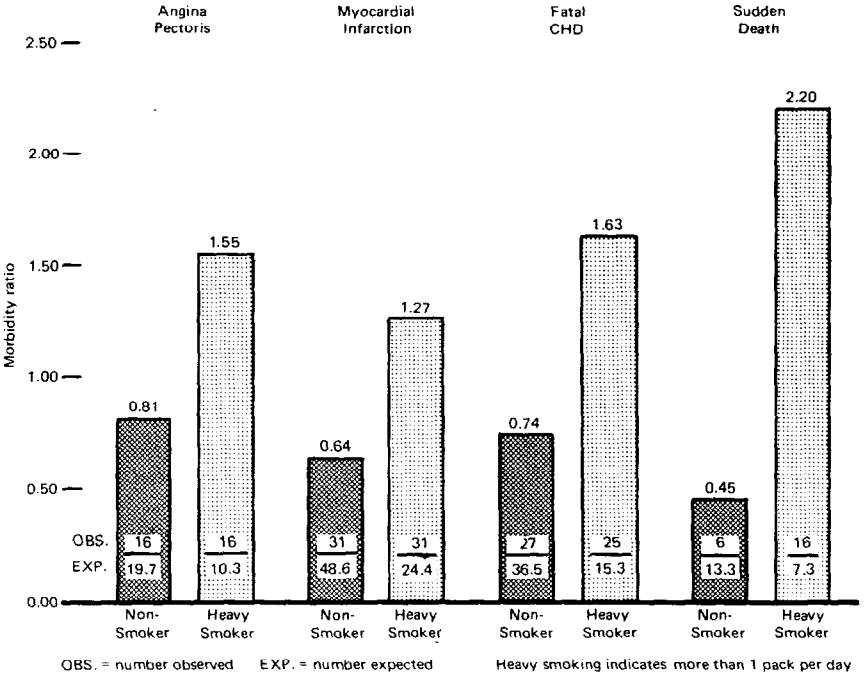



FIGURE 1—Morbidity ratios for specified manifestations of coronary heart disease, among men aged 30–59 years at entry into Framingham Heart Study, classified by smoking habit: 12 years' experience.

SOURCE: Kannel, et al. (*70*).

were relatively more smokers among the groups with coronary heart disease, than among the comparison, or control groups.

In a retrospective study of myocardial infarction patients in Japan, Hyams, et al. (*67*) reported similar findings, particularly among the men under age 50. Differences measured by an exposure index combining intensity and duration of smoking showed the same trend, though the data were not statistically significant.

Dorken (*30, 31*) reported on two retrospective studies in Hamburg, Germany: one, a study of female patients; the other, a study of male patients. He concluded that there is a strong association between smoking and myocardial infarction in both males and females under the age of 45.

In Dublin, Mulcahy, et al. (*106, 108, 109*) studied groups of male and female coronary heart disease patients under age 60. He found that a much greater portion of the patients, in comparison with a sample of the general population, smoked cigarettes. Also, the intensity (amount multiplied by duration) of smoking was as much as 2½ times greater among the male patients and 3 times greater among the

female coronary heart disease patients as contrasted with the males and females in the general population.

In a study of 675 aviators, smoking histories taken in 1963 did not show a positive association in the prevalence of coronary heart disease with either amount, duration, or intensity of smoking. These findings are based on 38 cases (5.7 percent) of coronary heart disease of all forms among a very select population and are therefore subject to large sampling variations (*96*). Moreover, since smokers may have an excessive mortality during an acute myocardial infarction, as mentioned before, prevalence rates are not as good a measure of the association between smoking and coronary heart disease as are incidence rates.

Epstein (*39*), although finding no prevalence differences between smokers and nonsmokers in his Tecumseh Study, found an increased incidence in cigarette smokers of both fatal and nonfatal coronary heart disease.

In a short prospective study of 14,000 Norwegian men (12,000 with smoking histories), Natvig (*113*) did find an increased risk of incidence of first myocardial infarction or angina pectoris among those men 50–59 years of age who smoked.

Since the 1967 Report, the continuing prospective epidemiologic studies have somewhat clarified the differential relationship between smoking and each of the manifestation categories of coronary heart disease: angina, nonfatal myocardial infarction, fatal myocardial infarction and sudden death.

Data from the Framingham Heart Study (*69*) revealed that "heavy" cigarette smoking, more than 20 cigarettes per day, is positively associated with uncomplicated angina in males but not in females (figure 2).

Similar findings were reported by Weinblatt (*155*) in a study of male subjects in the Health Insurance Plan with the associations more pronounced among those men who smoked two or more packages of cigarettes per day. As can be seen, in table 2, the arithmetic differences in rates between smokers and nonsmokers are greater for myocardial infarction than for angina; however, the risk ratios are similar.

In a retrospective study, Heyden-Stucki et al. (*61*) found no association of smoking with angina or other chest complaints.

The inconsistencies in data on the association between smoking and the development of angina may be due in part to differences in methods used to diagnose and classify angina and to record smoking habits in these epidemiologic studies. Further standardization in this area may help to determine more accurately the relationship of smoking to angina.

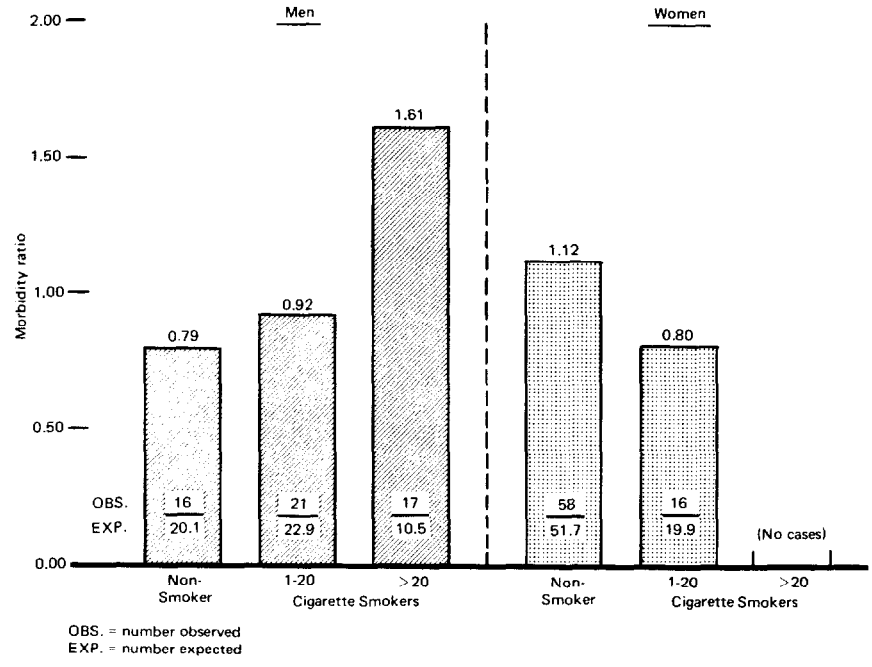



FIGURE 2—Angina pectoris morbidity ratios among persons aged 30–59 years at entry into Framingham Heart Study, classified by sex and number of cigarettes smoked: 12 years' experience.

SOURCE: Kannel, et al. (*69*).

TABLE 2.—*Age-adjusted incidence rates per 1,000 males aged 35–64, and morbidity ratios, for specified manifestations of coronary heart disease, by smoking category: Health Insurance Plan Study*

[3 year observation data]

| Smoking category | Myocardial infarction | | Angina | |
|---|---|---|---|---|
| | Incidence rate | Morbidity ratio | Incidence rate | Morbidity ratio |
| Current nonsmokers | 3. 27 | 1. 0 | 1. 37 | 1. 0 |
| Current cigarette smokers | 7. 01 | 2. 1 | 2. 62 | 1. 9 |
| Less than 2 packs | 5. 05 | 1. 5 | 2. 08 | 1. 5 |
| 2 or more packs | 20. 80 | 6. 4 | 6. 64 | 4. 8 |

Source: Weinblatt, E. (*155*).

In the Western Collaborative Study, Rosenman et al. reported higher rates of silent myocardial infarctions in younger men, and higher rates of recurrent myocardial infarctions at all ages among those who smoked more than 25 cigarettes per day (*123, 124*).

Friedemann, et al. (*44*) reported reinfarctions occurred more frequently among smokers than nonsmokers.

Dorken (*39*) found in a series of 330 men of all ages, in Hamburg, who survived at least 3 and up to 6 years after their first myocardial infarction, that 172 (52 percent) had stopped smoking completely after the first infarction. In contrast, of 85 subjects who had died from a second myocardial infarction or sudden coronary death after leaving the hospital, only 28 (32.9 percent) had given up smoking completely ($P<0.001$).

## Relationships of Cigarette Smoking to Other Risk Factors

The ongoing prospective and other epidemiologic studies have yielded findings which permit analysis of the interrelationships among cigarette smoking and other factors considered to increase the risk of coronary heart disease.

### *Age*

Generally, the findings show that the incidence rate of coronary heart disease increases with age, both among smokers and nonsmokers. The morbidity ratio of coronary heart disease in smokers versus nonsmokers decreases with age though the absolute number of excess deaths among smokers increases with age.

### *High Blood Pressure*

Recent reports on the relationship between smoking and blood pressure appear to support the findings in the 1967 report:

> Although the inhalation of cigarette smoke is frequently accompanied by acute transit elevations in blood pressure, habitual smokers tend to have lower blood pressures than do nonsmokers. But, given the presence of high blood pressure in an individual, smoking acts as an additional risk factor for the development of coronary heart disease.

Heyden-Stucki et al. (*61*) report that among 500 workers in Switzerland, smokers, particularly heavy smokers, have lower blood pressure as a group than do nonsmokers. Smokers also were found to have normal or subnormal weights in contrast to nonsmokers who had a greater mean weight; thus, confounding the relationship between smoking and blood pressure level. Tibblin (*144*) in a cohort study of Scandinavian men born in 1913, found a lower mean blood pressure among smokers than among nonsmokers. As the population was classified according to levels of blood pressure, a step-wise decrease in the prevalence of smoking was noted as the level of blood pressure in-

TABLE 3.—*Mean age and mean systolic and diastolic blood pressure, by smoking category: Los Angeles Heart Study, 1962*

| Current cigarette smoking status | | | Blood pressure (mm. of Hg.) | |
|---|---|---|---|---|
| | Number of subjects | Years of age | Systolic | Diastolic |
| Smokers | 407 | 54 | 133. 6 | 82. 5 |
| Nonsmokers | 728 | 57 | 137. 0 | 83. 9 |

SOURCE: Clark, V. A. (*23*).

creased. A similar trend for both systolic and diastolic pressures was also reported by Clark, et al. (*23*) as shown in table 3.

In the study of 675 aviators (*96*) smoking intensity, although not found to be associated significantly with systolic or diastolic blood pressures, was positively associated with pulse pressure. Reid, et al. (*122*) in a comparative study of workers in Great Britain and the United States noted lower diastolic blood pressures among smokers than among nonsmokers in both groups; adjustment for weight variations reduced this difference appreciably.

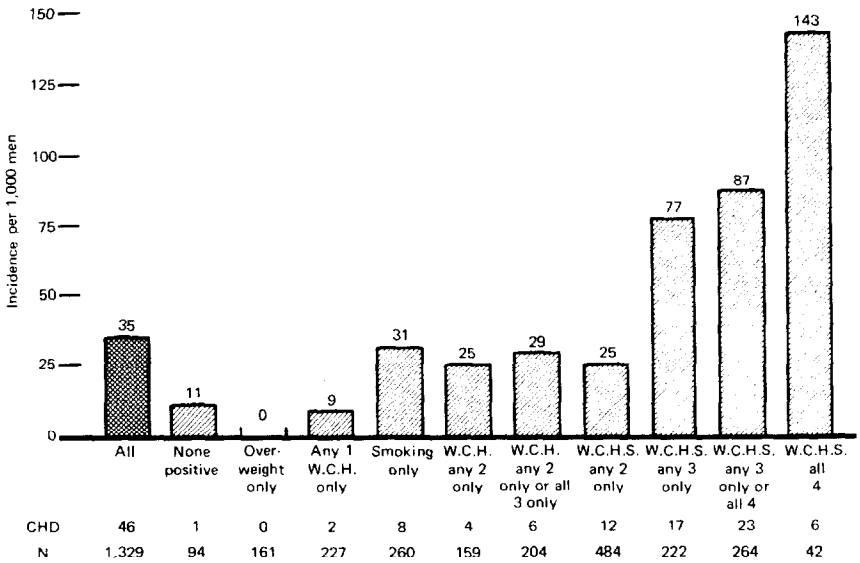
Mulcahy (*107*), in a retrospective study of 100 women coronary heart disease patients under 60 years of age, reported that 50 to 60 percent had diastolic hypertension (>90 mm. Hg.). Hypertension and cigarette smoking, together or separately, were present in over 80 percent of these patients.

In the major prospective studies, when both smoking and hypertension were present, an interactive increase in the risk of developing coronary heart disease was noted. When to these two risk factors elevated cholesterol levels were added, the risk of developing coronary heart disease was further increased (figures 3 and 4).

*High Serum Cholesterol and Related Diet*

Certain of the retrospective and cross-sectional studies (*62*, *151*) have, in general, demonstrated higher cholesterol levels in smokers than in nonsmokers. Pincherle, et al. (*119*) and Lane, et al. (*96*) report similar findings. A study by Heyden-Stucki (*61*) of 500 Swiss workers found a similar trend but the differences between smokers and nonsmokers with respect to cholesterol levels and other lipids were not statistically significant.

A recent report (*36*) describes some of the variability of interrelationships among smoking, blood pressure and cholesterol levels in different population groups throughout the world. It concludes that though nonsmokers tend to be heavier and have higher blood pressure levels than cigarette smokers, heavy smokers tend to be in the top




Relationship between status with respect to four coronary risk factors (hypercholesterolemia, hypertension, overweight, and cigarette smoking) as evaluated on original examination and incidence of clinical coronary heart disease in men originally age 40-59, free of definite CHD, and followed subsequently without systematic intervention, Peoples Gas Light and Coke Company study, 1958-1962. *W is overweight, ie, a ratio of observed weight to desirable weight of 1.15 or greater;* C is hypercholesterolemia, ie, serum cholesterol level of 250 mg/100 ml or greater; H is hypertension, ie, a diastolic blood pressure of 90 mm. Hg or greater; S is smoking of ten or more cigarettes per day.[1]

FIGURE 3—Incidence of coronary heart disease among men aged 40–59 years at entry into Peoples Gas Light and Coke Company Study, classified as to presence of specified risk factors: 1958–1962.

SOURCE: Stamler, et al. (*138*).

deciles for blood pressure and relative weight. Cholesterol-smoking relationships described in these studies do not show a consistent pattern.

In a controlled dietary intervention study of postinfarction patients Leren (*97*) found that smoking habits did not influence the serum cholesterol level or the coronary heart disease relapse rate in the control group. Among the study group of dieters there was a suggestion, although not statistically significant at the 0.05 level, that smokers had a higher coronary heart disease relapse rate than nonsmokers.

*Physical Inactivity*

The independent and combined effects of cigarette smoking and physical activity, as described in the 1967 report, continue to be demonstrated as more data are accumulated. The apparent protective effect of physical activity appears to be more pronounced with regard to myocardial infarction than angina [table 4, (*155*)]. Differences in methods of assessment of history of physical activity in case versus

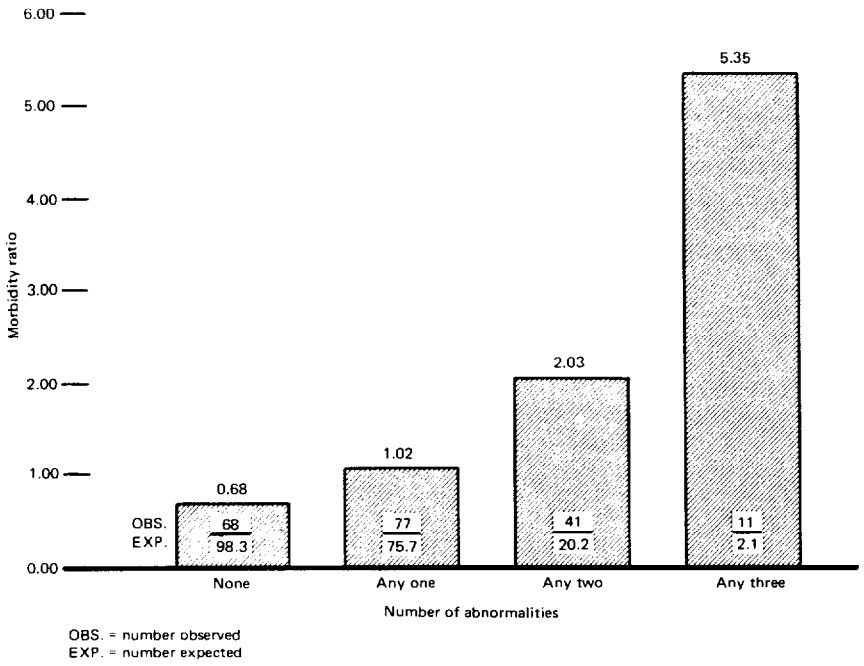



FIGURE 4—Myocardial infarction morbidity ratios among men aged 30–59 years at entry into Framingham Heart Study, classified according to presence of selected risk factors: 12 years experience (Risk factors are: cholesterol level over 250 mg/100 ml., systolic blood pressure over 160 mm. Hg., smoking over 1 pack of cigarettes per day).

SOURCE: Kannel, et al. (*70*).

control groups may account for some differences in the incidence rates noted.

Blackburn, et al. (*10*) found no relationship of smoking to the prevalence of postexercise ECG changes in a study of 10,260 men age 40 to 59 years. However, there were only 519 (5.1 percent) subjects with a "positive" ECG response.

*Sociological, Psychological and Personality Variables*

Two studies (*45, 64*) demonstrated an inverse relationship between the frequency of coronary heart disease and the educational level of the subjects. In the Bell Telephone System (*64*), those men without a college education had higher coronary heart disease rates than those with a college education. Also, those not attending college tended to smoke more.

In a study of factors related to coronary heart disease among Cleveland attorneys (*45*), the quality of the law schools attended by the sub-

TABLE 4.—*Annual age-adjusted incidence rates of specified manifestations of coronary heart disease per 1,000 males aged 35–64 and corresponding morbidity ratios, by smoking habits and physical activity class: Health Insurance Plan Study*

[3 year observation data]

| Smoking status and physical activity class | Myocardial infarction | | Angina | |
|---|---|---|---|---|
| | Incidence rate | Morbidity ratio | Incidence rate | Morbidity ratio |
| All current nonsmokers | 3. 27 | 1. 0 | 1. 37 | 1. 0 |
| Not cigarette smokers: | | | | |
| Least active | 6. 33 | 1. 9 | 2. 14 | 1. 6 |
| Intermediate | 3. 07 | 0. 9 | 1. 67 | 1. 2 |
| Most active | 3. 01 | 0. 9 | 1. 32 | 1. 0 |
| All current cigarette smokers: | | | | |
| Least active | 10. 89 | 3. 3 | 2. 31 | 1. 7 |
| Intermediate | 5. 80 | 1. 8 | 2. 83 | 2. 1 |
| Most active | 5. 77 | 1. 8 | 2. 74 | 2. 0 |
| Less than 2 packs: | | | | |
| Least active | 7. 61 | 2. 3 | 2. 05 | 1. 5 |
| Intermediate | 4. 71 | 1. 4 | 2. 37 | 1. 7 |
| Most active | 3. 85 | 1. 2 | 1. 95 | 1. 4 |
| 2 or more packs: | | | | |
| Least active | 39. 09 | 12. 0 | 4. 97 | 3. 6 |
| Intermediate | 11. 27 | 3. 5 | 5. 09 | 3. 7 |
| Most active | 24. 09 | 7. 4 | 12. 20 | 8. 9 |

So rce: Weinblatt, E. (*155*).

ject were ranked independently by a law school professor. Lawyers attending schools in the "highest law school quality group" had lower rates of coronary heart disease than those attending schools in the "lower law school quality group." Also, those in the latter group had started smoking at an earlier age. Since additional differences were noted for other risk factors, smoking alone may not be responsible for the total differences in these rates. In both studies, it was hypothesized that with respect to susceptibility to development of coronary heart disease, behavior patterns and attitudes established prior to professional training and prior to stresses resulting from job mobility and job tension, were more significant than the later stresses which resulted from their present jobs.

Recent data from the Western Collaborative Group Study (*125*) appear to show that among men 39–49 years of age, cigarette smoking was associated with several coronary heart disease risk factors (table 5). Though these findings may be statistically significant, the differences between smokers and nonsmokers were small.