# CHAPTER 1

## General Considerations, Preparation of the Present Document, and Summary of the Report

## GENERAL CONSIDERATIONS

The first major development in the modern history of the effects of smoking on health occurred in 1950 with the publication of four retrospective studies on smoking habits among lung cancer patients and among controls (*1, 4, 6, 7*). At that time, the question was, "Are smokers more likely to get lung cancer than nonsmokers?" Although some epidemiologists were satisfied that the answer was in the affirmative, others turned for confirmation to prospective studies in which the smoking habits of large populations were recorded and the populations followed to identify subsequent mortality. The first report of Hammond and Horn in 1954 (*2*), showed significantly elevated overall death rates for smokers as compared to nonsmokers. This elevation in death rates, almost entirely confined to those who smoked cigarettes, together with the evidence for a gradient according to the amount smoked, changed the question from one concerning only lung cancer to one concerning overall death rates and from one concerning smoking to one primarily concerned with cigarette smoking. In effect, the question became, "Do cigarette smokers have higher overall death rates than nonsmokers and smokers of pipes and cigars?"

With the publication of the later reports of the major prospective studies in the late 1950's and early 1960's, it became clear that cigarette smokers had higher overall death rates than nonsmokers, as well as higher death rates from a number of individual causes of death. The question then became, "Why?"

When the Advisory Committee on Smoking and Health to the Surgeon General was established in 1962, it undertook the evaluation of the scientific evidence up to that time. The conclusion of the Committee in its 1964 Report was that: "Cigarette smoking is a health hazard of sufficient importance in the United States to warrant appropriate remedial action." Not only did the Committee conclude that the evidence clearly showed that male cigarette smokers do in fact have higher death rates than nonsmokers but that the convergence of epidemiological, experimental, and pathological evidence also clearly indicated a cause-and-effect relationship for several of the implicated diseases, particularly cancer of the lung and chronic bronchitis. In several other important diseases, the evidence on biomechanisms to explain epidemiological

associations was felt to be inadequate at that time to draw firm conclusions about a cause-and-effect relationship.

Three and one-half years later, when The Health Consequences of Smoking: A Public Health Service Review, 1967 was published, the conclusions of the 1964 review were taken as a starting point, and the nature of the task of interpreting the scientific evidence was restated as follows:

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?

That and subsequent reviews in 1968 and 1969 have provided some answers to these questions, particularly in summarizing the evidence for various theories as to how cigarette smoking affects the human organism to produce elevated disease and death rates.

At least five different processes have been suggested whereby cigarette smokers experience higher mortality or morbidity rates than do nonsmokers.

1. Cigarette smoking initiates a disease process by producing progressive irreversible damage. In this case, the total effect would be approximately proportional to the total accumulated dosage experienced over the years. Cessation of smoking leaves impaired function which does not improve appreciably but does not continue to deteriorate from continued exposure to cigarette smoke. However, such function may deteriorate through aging or through exposure to other harmful agents. It appears that such a relationship probably exists for chronic obstructive lung disease and possibly for the development of atherosclerotic heart disease.

2. Cigarette smoking initiates a disease process with continual repair and recovery until some critical point is reached at which the process is no longer reversible. The total effect would therefore be affected to some extent by accumulated exposure but would be affected also by the level of contemporary smoking. Cessation of smoking would result in a rapid reduction of risk provided the critical level initiating an irreversible process has not been reached. The evidence supports this kind of mechanism accounting both for the high dose-response relationship in lung cancer and for the reduction in risk from lung cancer among ex-smokers.

3. Cigarette smoking promotes a disease process either by providing positive support to the development of a pathological condition or by interfering with and diminishing the normal capa-

bility of the organism to cope with and defend against a disease process. This may take place by promoting the development of a subclinical disease to a clinically recognizable one, by promoting a mild disease state to a more severe form, or by increasing fatality rates of severe disease states. This type of mechanism could account for modestly increased mortality rates for a number of severe diseases for which there is no evidence that cigarette smoking itself has a role in initiating the disease. Some of the excess mortality from infectious respiratory disease and from coronary heart disease might take place through this kind of mechanism.

4. Cigarette smoking produces a set of temporary conditions which increase the probability that a critical event will occur with attendant disability and possibly fatal consequences. For example, there is evidence to support the theory that each cigarette can produce a set of conditions which increase the probability of myocardial damage through increased demand for oxygen at a time when the suppy is diminished. Presumably, once the supply/demand imbalance is alleviated, the probability of myocardial damage would revert to its normal level. Cessation of smoking should have an almost immediate effect of reducing the risk sharply for morbidity or mortality produced through this mechanism.

5. Cigarette smoking may be artificially related to excess disability or death by way of a close association with some other condition or exposure which is found at a high level in smokers, but not in nonsmokers, and is itself responsible for the disease. The one cause of death for which cigarette smokers have elevated death rates that is generally interpreted in this way is cirrhosis of the liver. Since most heavy consumers of alcoholic beverages are smokers, and since alcohol consumption is an important part of the process that produces cirrhosis of the liver, the high rate of cirrhosis among cigarette smokers is discounted as resulting from this kind of artificial relationship. Some authors have proposed that there may be genetic factors that link smoking and certain diseases in this fashion. Obviously, the cessation of smoking would have no effect on morbidity or mortality from diseases which are artificially related to smoking.

These different ways in which cigarette smoking can be related to elevated morbidity and mortality rates are important considerations in attempting to estimate the potential public health benefits of giving up smoking. For some types of relationship, there would be no benefits; for some, rather small benefits; for some, substantial benefits, taking place over a long period of time; and for others, substantial benefits taking place rather rapidly.

During the past few years, a sharp reduction has taken place in the cigarette smoking habits of the U.S. population. The Na-

tional Center for Health Statistics has recently published a comparison of smoking habits in the U.S. in 1955 and 1966 based on two large scale household surveys (*5*). These showed a drop in cigarette consumption in men under 55 years of age but no appreciable change among those 55 or over. Among women, every age group showed an increase in the eleven year period. A recent survey conducted for the National Clearinghouse for Smoking and Health, based on a much smaller sample (approximately 5,000 interviews), was conducted in the Spring of 1970 (*3*) (table 1). Even with the smaller number of cases, it is clear that a much larger drop took place in the four years from 1966 to 1970 than in the eleven years from 1955 to 1966. The drop extended to the age group 55–64 among men, again with no appreciable drop among men over age 65. For the first time, the increase in smoking among women leveled off, or even dropped slightly among women under 55. The increase among women over 55 was of a lesser magnitude than previously observed.

TABLE 1.—*Percentage of Current Smokers of Cigarettes (regularly or occasionally) by sex and age. U.S. Surveys: 1955 and 1966 (CPS-Current Population Surveys) and 1970 (NCSH-Survey conducted for National Clearinghouse for Smoking & Health).*[1]

| | Male | | | Female | | |
|---|---|---|---|---|---|---|
| Age | CPS 1955 | CPS 1966 | NCSH 1970 | CPS 1955 | CPS 1966 | NCSH 1970 |
| 18–24 | 53.0 | 48.3 | [2]47.0 | 33.3 | 34.7 | [2]31.1 |
| 25–34 | 63.6 | 58.9 | 46.8 | 39.2 | 43.2 | 40.3 |
| 35–44 | 62.1 | 57.0 | 48.6 | 35.4 | 41.1 | 39.0 |
| 45–54 | 58.0 | 53.1 | 43.1 | 25.7 | 37.3 | 36.0 |
| 55–64 | 45.8 | 46.2 | 37.4 | 13.4 | 23.0 | 24.3 |
| 65 + | 25.8 | 24.6 | 23.7 | 4.7 | 8.1 | 11.8 |

[1] 1955 survey based on approximately 45,000 persons; 1966 survey based on approximately 35,000 persons; 1970 survey based on approximately 5,000 persons.
[2] Estimated.

With the massive changes in smoking behavior which have taken place among adults in the past few years, largely as an expression of the desire to protect health, changes should be expected in mortality rates among those groups which have experienced the greatest reduction both in accumulated dosage and in concurrent dosage. An analysis of U.S. mortality rates for 1970 and the years to follow will provide a very valuable addition to the knowledge concerning the effects of smoking on death rates.

## PREPARATION OF THE PRESENT DOCUMENT

Following the publication of Smoking and Health—Report of the Advisory Committee to the Surgeon General—in 1964, the fol-

lowing documents were published as reviews of the medical literature concerning the health consequences of smoking, as called for by Public Law 89–92:

1. The Health Consequences of Smoking, A Public Health Service Review: 1967.
2. The Health Consequences of Smoking, 1968 Supplement to the 1967 PHS Review.
3. The Health Consequences of Smoking, 1969 Supplement to the 1967 PHS Review.

These documents reviewed the medical literature which had been published since the original Surgeon General's Report. This format of publishing a supplement to a supplement has become unwieldy, particularly in the light of the lack of availability of the previous reviews to the general public. Therefore, when Public Law 91–222 was signed into law on April 1, 1970 calling for an eighteen month interval between the last report and the new report, the decision was made to review the entire field with emphasis on the most recent additions to the literature.

The National Clearinghouse for Smoking and Health has the responsibility for continuous monitoring and compilation of the medical literature on the health consequences of smoking. This is accomplished through several mechanisms:

1. A scientific review corporation is on contract to extract articles on smoking and health from the medical and scientific literature of the world. This organization provides a semi-weekly accessions list with abstracts and copies of the various articles. Translations are called for as needed. Articles of pertinence are identified by a series of code words and phrases.

2. The National Library of Medicine, through the Medlars system, sends the National Clearinghouse for Smoking and Health a monthly listing of articles in the smoking and health area. These are reviewed, and pertinent articles are ordered.

3. Staff members keep up with the current contents of medical and scientific literature and identify articles of pertinence.

Initial drafts of the present review were prepared by Clearinghouse staff and consultants who reviewed the previous reports and identified those articles which have been important in the development of knowledge in this field. These were abstracted and placed into tabular form, and a draft text of the report was prepared. The first drafts of the individual chapters were sent to experts for review, criticism, and comment with respect to the articles reviewed, those articles not included, and conclusions. The drafts were then revised on the basis of these comments and rewritten until they met with general approval of the reviewers. The final

drafts were reviewed as a whole by the Director of the National Clearinghouse for Smoking and Health, the Director of the National Cancer Institute, the Director of the National Heart and Lung Institute, the Director of the National Institute of Environmental Health Sciences, and by six additional experts both within and outside of the Public Health Service.

## SUMMARY OF THE REPORT

### CARDIOVASCULAR DISEASES

*Coronary Heart Disease*

1. Data from numerous prospective and retrospective studies confirm the judgment that cigarette smoking is a significant risk factor contributing to the development of coronary heart disease, including fatal CHD and its most severe expression, sudden and unexpected death. The risk of CHD incurred by smoking of pipes and cigars is appreciably less than that incurred by cigarette smokers.

2. Analysis of other factors associated with CHD (high serum cholesterol, high blood pressure, and physical inactivity) show that cigarette smoking operates independently of these other factors and can act jointly with certain of them to increase the risk of CHD appreciably.

3. There is evidence that cigarette smoking may accelerate the pathophysiological changes of pre-existing coronary heart disease and therefore contributes to sudden death from CHD.

4. Autopsy studies suggest that cigarette smoking is associated with a significant increase in atherosclerosis of the aorta and coronary arteries.

5. The cessation of smoking is associated with the decreased risk of death from CHD.

6. Experimental studies in animals and humans suggest that cigarette smoking may contribute to the development of CHD and/or its manifestations by one or more of the following mechanisms:

a. Cigarette smoking, by contributing to the release of catecholamines, causes increased myocardial wall tension, contraction velocity, and heart rate, and thereby increases the work of the heart and the myocardial demand for oxygen and other nutrients.

b. Among individuals with coronary atherosclerosis, cigarette smoking appears to create an imbalance between the increased needs of the myocardium and an insufficient increase in coronary blood flow and oxygenation.

c. Carboxyhemoglobin, formed from the inhaled carbon mon-

oxide, diminishes the availability of oxygen to the myocardium and may also contribute to the development of atherosclerosis.

d. The impairment of pulmonary function caused by cigarette smoking may contribute to arterial hypoxemia, thus reducing the amount of oxygen available to the myocardium.

e. Cigarette smoking may cause an increase in platelet adhesiveness which might contribute to acute thrombus formation.

*Summary Statement of Recent Additions to Knowledge Relating Smoking and Coronary Heart Disease.*—A number of epidemiologic studies have provided additional evidence concerning cigarette smoking as a significant risk factor in the development of CHD. Experimental studies on animals have suggested that cigarette smoking, particularly the absorbed nicotine and carbon monoxide, contributes to the development of atherosclerosis.

*Cerebrovascular Disease*

1. Data from numerous prospective studies indicate that cigarette smoking is associated with increased mortality from cerebrovascular disease.

2. Experimental evidence concerning the relationship of smoking and cerebrovascular disease is at present insufficient to allow for conclusions concerning pathogenesis. However, some of the pathophysiological considerations discussed concerning CHD may also pertain to the relationship of smoking and CVD, particularly cerebral infarction.

*Nonsyphilitic Aortic Aneurysm*

Cigarette smoking has been observed to increase the risk of dying from nonsyphilitic aortic aneurysm.

*Peripheral Vascular Disease*

1. Data from a number of retrospective studies have indicated that cigarette smoking is a likely risk factor in the development of peripheral vascular disease. Cigarette smoking also appears to be a factor in the aggravation of peripheral vascular disease.

2. Cigarette smoking has been observed to alter peripheral blood flow and peripheral vascular resistance.

## Chronic Obstructive Bronchopulmonary Disease

1. Cigarette smoking is the most important cause of chronic obstructive bronchopulmonary disease in the United States. Cigarette smoking increases the risk of dying from pulmonary emphysema and chronic bronchitis. Cigarette smokers show an increased prevalence of respiratory symptoms, including cough, sputum pro-

duction, and breathlessness, when compared with nonsmokers. Ventilatory function is decreased in smokers when compared with nonsmokers.

2. Cigarette smoking does not appear to be related to death from bronchial asthma, although it may increase the frequency and severity of asthmatic attacks in patients already suffering from this disease.

3. The risk of developing or dying from COPD among pipe and/or cigar smokers is probably higher than that among nonsmokers, while clearly less than that among cigarette smokers.

4. Ex-cigarette smokers have lower death rates from COPD than do continuing smokers. The cessation of cigarette smoking is associated with improvement in ventilatory function and with a decrease in pulmonary symptom prevalence.

5. Young, relatively asymptomatic, cigarette smokers show measurably altered ventilatory function when compared with nonsmokers of the same age.

6. For the bulk of the population of the United States, the importance of cigarette smoking as a cause of COPD is much greater than that of atmospheric pollution or occupational exposure. However, exposure to excessive atmospheric pollution or dusty occupational materials and cigarette smoking may act jointly to produce greater COPD morbidity and mortality.

7. The results of experiments in both animals and humans have demonstrated that the inhalation of cigarette smoke is associated with acute and chronic changes in ventilatory function and pulmonary histology. Cigarette smoking has been shown to alter the mechanism of pulmonary clearance and adversely affect ciliary function.

8. Pathological studies have shown that cigarette smokers who die of diseases other than COPD have histologic changes characteristic of COPD in the bronchial tree and pulmonary parenchyma more frequently than do nonsmokers.

9. Respiratory infections are more prevalent and severe among cigarette smokers, particularly heavy smokers, than among nonsmokers.

10. Cigarette smokers appear to develop postoperative pulmonary complications more frequently than nonsmokers.

*Summary Statement of Recent Additions of Knowledge Relating to Chronic Obstructive Bronchopulmonary Disease.*—Studies have demonstrated that cigarette smokers show increased symptoms and pulmonary dysfunction as well as mortality from COPD when compared to nonsmokers. Investigations of alpha$_1$-antitrypsin deficiency in relationship to pulmonary emphysema have sug-

gested that cigarette smoking may act jointly with hereditary factors in the pathogenesis of pulmonary emphysema. A pathological study on animals has shown that long-term inhalation of cigarette smoke produces lesions characteristic of pulmonary emphysema.

## CANCER

*Lung Cancer.*

1. Epidemiological evidence derived from a number of prospective and retrospective studies, coupled with experimental and pathological evidence, confirms the conclusion that cigarette smoking is the main cause of lung cancer in men. These studies reveal that the risk of developing lung cancer increases with the number of cigarettes smoked per day, the duration of smoking, and earlier initiation, and diminishes with cessation of smoking.

2. Cigarette smoking is a cause of lung cancer in women but accounts for a smaller proportion of the cases than in men. The mortality rates for women who smoke, although significantly higher than for female nonsmokers, are lower than for men who smoke. This difference may be at least partially attributable to differences in exposures: the use of fewer cigarettes per day, the use of filtered and low "tar" cigarettes, and lower levels of inhalation. Nevertheless, even when women are compared with men who apparently have similar levels of exposure to cigarette smoke, the mortality ratios appear to be lower in women.

3. The risk of developing lung cancer among pipe and/or cigar smokers is higher than for nonsmokers but significantly lower than for cigarette smokers.

4. The risk of developing lung cancer appears to be higher among smokers who smoke high "tar" cigarettes, or smoke in such a manner as to produce higher levels of "tar" in the inhaled smoke.

5. Ex-cigarette smokers have significantly lower death rates for lung cancer than continuing smokers. There is evidence to support the view that cessation of smoking by large numbers of cigarette smokers would be followed by lower lung cancer death rates.

6. Increased death rates from lung cancer have been observed among urban populations when compared with populations from rural environments. The evidence concerning the role of air pollution in the etiology of lung cancer is presently inconclusive. Factors such as occupational and smoking habit differences may also contribute to the urban-rural difference observed. Detailed epidemiologic surveys have shown that the urban factor exerts a small influence compared to the overriding effect of cigarette smoking in the development of lung cancer.

7. Certain occupational exposures have been found to be associated with an increased risk of dying from lung cancer. Cigarette smoking interacts with these exposures in the pathogenesis of lung cancer so as to produce very much higher lung cancer death rates in those cigarette smokers who are also exposed to such substances.

8. Experimental studies on animals utilizing skin painting, tracheal instillation or implantation, and inhalation of cigarette smoke or its component compounds, have confirmed the presence of complete carcinogens as well as tumor initiators and promoters in tobacco smoke. Lung cancer has been found in dogs exposed to the inhalation of cigarette smoke over a period of more than 2 years.

*Cancer of the Larynx*

1. Epidemiological, experimental, and pathological studies support the conclusion that cigarette smoking is a significant factor in the causation of cancer of the larynx. The risk of developing laryngeal cancer among cigarette smokers as well as pipe and/or cigar smokers is significantly higher than among nonsmokers. The magnitude of the risk for pipe and cigar smokers is about the same order as that for cigarette smokers, or possibly slightly lower.

2. Experimental exposure to the passive inhalation of cigarette smoke has been observed to produce premalignant and malignant changes in the larynx of hamsters.

*Oral Cancer*

1. Epidemiological and experimental studies contribute to the conclusion that smoking is a significant factor in the development of cancer of the oral cavity and that pipe smoking, alone or in conjunction with other forms of tobacco use, is causally related to cancer of the lip.

2. Experimental studies suggest that tobacco extracts and tobacco smoke contain initiators and promoters of cancerous changes in the oral cavity.

*Cancer of the Esophagus*

1. Epidemiological studies have demonstrated that cigarette smoking is associated with the development of cancer of the esophagus. The risk of developing esophageal cancer among pipe and/or cigar smokers is greater than for nonsmokers and of about the same order of magnitude as for cigarette smokers, or perhaps slightly lower.

2. Epidemiological studies have also indicated an association between esophageal cancer and alcohol consumption and that alcohol consumption may interact with cigarette smoking. This com-

bination of exposures is associated with especially high rates of cancer of the esophagus.

*Cancer of the Urinary Bladder and Kidney*

1. Epidemiological studies have demonstrated an association of cigarette smoking with cancer of the urinary bladder among men. The association of tobacco usage and cancer of the kidney is less clear-cut.

2. Clinical and pathological studies have suggested that tobacco smoking may be related to alterations in the metabolism of tryptophan and may in this way contribute thereby to the development of urinary tract cancer.

*Cancer of the Pancreas*

Epidemiological studies have suggested an association between cigarette smoking and cancer of the pancreas. The significance of the relationship is not clear at this time.

*Summary Statement of Recent Additions of Knowledge Relating Smoking and Cancer.*—Epidemiological studies have confirmed that cigarette smokers incur an increased risk of dying from lung cancer and that those smokers who switched to filter cigarettes incur a lesser risk. Pathological studies have shown that cancer of the lung and cancer of the larynx have been found in animals exposed to the long-term inhalation of cigarette smoke.

## Smoking and Pregnancy

Maternal smoking during pregnancy exerts a retarding influence on fetal growth as manifested by decreased infant birthweight and an increased incidence of prematurity, defined by weight alone. There is strong evidence to support the view that smoking mothers have a significantly greater number of unsuccessful pregnancies due to stillbirth and neonatal death as compared to nonsmoking mothers. There is insufficient evidence to support a comparable statement for abortions. The recently published Second Report of the 1958 British Perinatal Mortality Survey, a carefully designed and controlled prospective study involving large numbers of patients, adds further support to the conclusions.

## Peptic Ulcer

Cigarette smoking males have an increased prevalence of peptic ulcer disease and a greater peptic ulcer mortality ratio. These relationships are stronger for gastric ulcer than for duodenal ulcer. Smoking appears to reduce the effectiveness of standard peptic ulcer treatment and to slow the rate of ulcer healing.

Tobacco amblyopia is presently a rare disorder in the United States. The evidence suggests that this disorder is related to nutritional or idiopathic deficiencies in certain detoxification mechanisms, particularly in handling the cyanide component of tobacco smoke.

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# CHAPTER 2

## Cardiovascular Diseases

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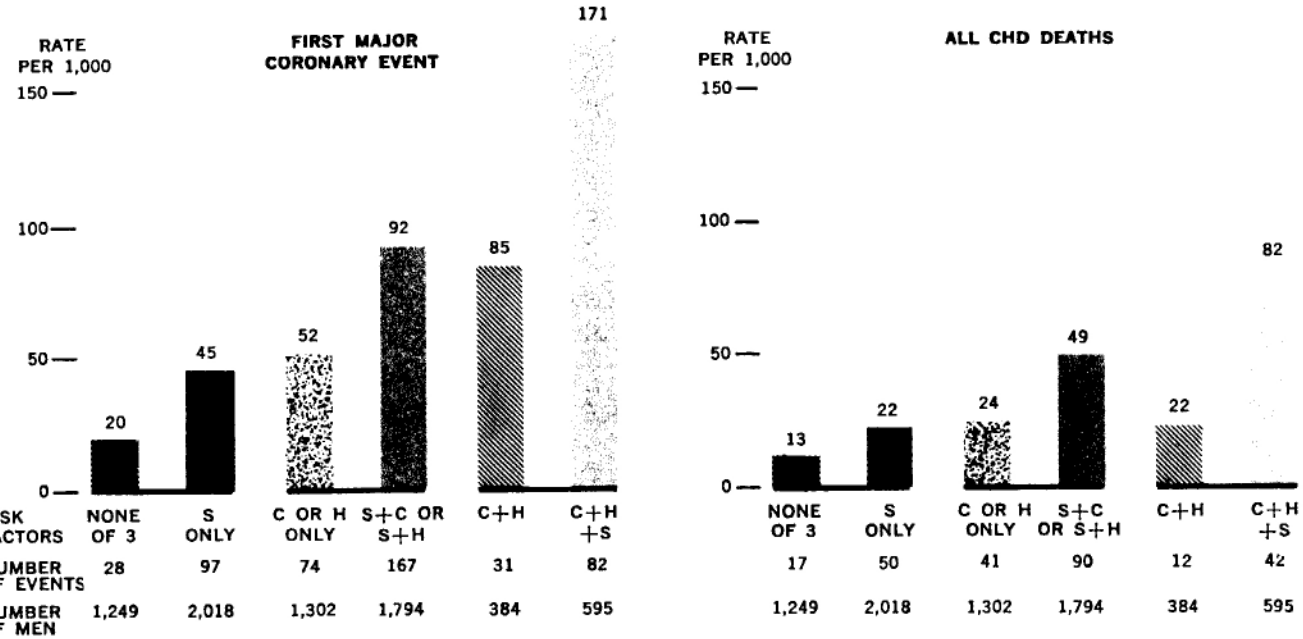
## INTRODUCTION

Coronary Heart Disease (CHD) cuts short the lives of many men in the Western World in their prime productive years. More Americans die from heart disease than from any other disease. In 1967, in this country, a total of 345,154 men and 227,999 women were classified as dying of arteriosclerotic heart disease (ASHD) (*196*), a category which consists largely of what is commonly called CHD. During the years from 1950 to 1967, the age-adjusted death rate from ASHD increased 15.1 percent (*196, 197*).

Besides the many deaths attributed to CHD, much morbidity results from this disease. The National Health Examination Survey of 1960–1962 estimated that 3.1 million American adults, ages 18 to 79, had definite CHD and 2.4 million had suspect CHD, together representing about 5 percent of the population. It was further estimated that of Americans under age 65, almost 1.8 million had definite CHD and 1.6 million had suspect CHD (*195*).

There are several manifestations of CHD, all related in part to the basic process of severe atherosclerosis, a disease of arteries in which fatty materials (lipids) accumulate in the form of plaques in the walls of medium and large arteries. This process, as it occurs in the coronary arteries, leads to stiffening of the wall and narrowing of the lumen which, when severe, result in a diminution in the blood supply to the cardiac muscle. Angina pectoris, a major manifestation of CHD, results from diminution in blood supply relative to the needs of the myocardium. If the blood supply to a portion of the myocardium is completely obstructed, due for example to the formation of a thrombus at the site of atherosclerotic narrowing, necrosis or death of a portion of heart muscle may occur. This occurrence is known as a myocardial infarction. In many cases, a disturbance of cardiac rhythm occurs at the time of thrombosis, and the patient may die immediately. It is estimated that approximately 25 percent of patients suffering coronary artery occlusion die within the first three hours following the occlusion (table 1) (*88*). Not infrequently, sudden death occurs in patients with severe coronary atherosclerosis but without a demonstrable arterial occlusion. In these cases, it is thought that the meager blood flow to a portion of the myocardium becomes so diminished with respect to cardiac needs as to lead to a fatal arrhythmia, as well as to, perhaps, a myocardial infarction.

**CIGARETTE SMOKING(S) AT ENTRY—WITH CONTROL OF SERUM CHOLESTEROL (C) AND DIASTOLIC BLOOD PRESSURE (H)—AND TEN YEAR INCIDENCE AND MORTALITY RATES. 7,594 WHITE MALES AGE 30–59 AT ENTRY, POOLING PROJECT**




National Cooperative Pooling Project; smoking status at entry and 10-year age-adjusted rates per 1,000 men for first major coronary event (incling nonfatal MI, fatal MI, and sudden death due to CHD) and any coronary death. U.S. white males age 30–59 at entry. All rates age-adjusted by 10-year age groups to the U.S. white male population 1960. Graphs present rates for noncigarette vs. cigarette smokers at entry with simultaneous control of blood pressure and serum cholesterol level. For this latter analysis, the following cutting points were used:

(a) Cigarette smoking S — any use at entry
(b) Serum cholesterol C — 250 mg./dl.
(c) Diastolic blood pressure H — 90 mm. Hg.

SOURCE: Inter-Society Commission for Heart Disease Resources. National Cooperative Pooling Project Data (88).

FIGURE 1—National Cooperative Pooling Project; smoking status at entry and 10-year age-adjusted rates per 1,000 men for first major coronary event (includes nonfatal MI, fatal MI, and sudden death due to CHD) and any coronary death. U.S. white males age 30–59 at entry. All rates age-adjusted by 10 year age groups to the U.S. white male population 1960. Graphs present rates for noncigarette vs. cigarette smokers at entry with simultaneous control of blood pressure and serum cholesterol level. For this latter analysis, the following cutting points were used:

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(c) Diastolic blood pressure—H–≧90 mm. Hg.

SOURCE: Inter-Society Commission for Heart Disease Resources. National Cooperative Pooling Project Data (*88*).

TABLE 1.—*Sudden death and acute mortality with first major coronary episodes*

| Author, year, country, reference | Number and type of population | Data collection | Event | Number of events | Proportion per 1,000 events (as calculated on the basis of age-adjusted rates) | Comment |
|---|---|---|---|---|---|---|
| Pooling Project, American Heart Association, 1970, U.S.A. (*88*). | 7,594 males males 30–59 years of age at entry. Ten-year experience. | Medical examination and follow-up. | All first major coronary episodes, nonfatal and fatal. | 501 | 1,000.0 | Data from the Pooling Project, Council on Epidemiology, American Heart Association, a national cooperative project for pooling data from the Albany civil servant, Chicago Peoples Gas Co., Chicago Western Electric Co., Framingham Community, Los Angeles civil servant, Minneapolis-St. Paul business men, and other prospective epidemiologic studies of adult cardiovascular disease in the United States. |
| | | | Sudden death (death within 3 hours of onset of acute illness). | 123 | 245.5 | |
| | | | All acute deaths with first episodes. | 165 | 329.3 | |

SOURCE: Inter-Society Commission for Heart Disease Resources (*88*). Representative references include: (*54, 94, 148, 177*) and others listed as 6a–6k in Inter-Society Commission for Heart Disease Resources report.

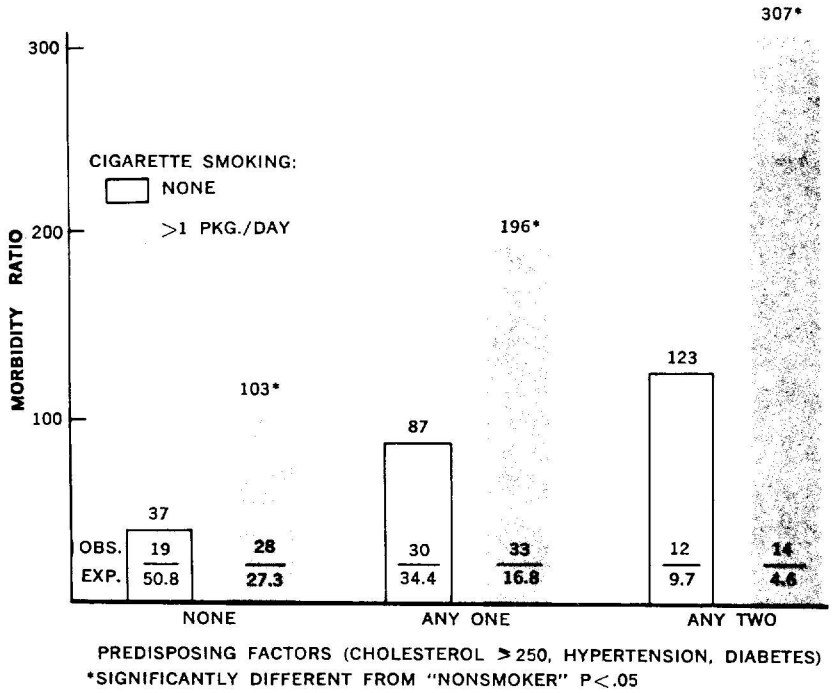
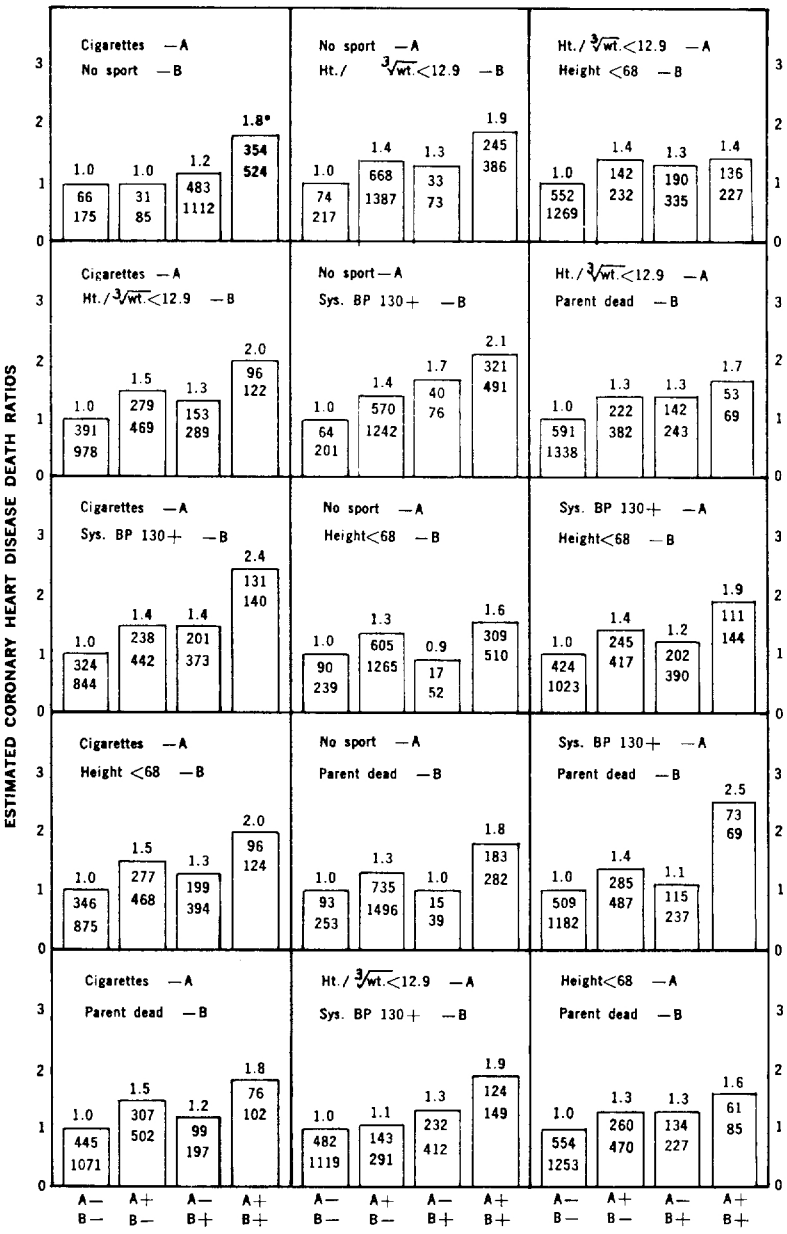



FIGURE 2—Risk of coronary heart disease (12 years) according to cigarette smoking habit and presence of "predisposing factors" (men 30–59 at entry). Framingham Heart Study.

SOURCE: Kannel, W. B., et al. (*94*).

Numerous epidemiological studies have indicated that cigarette smokers have increased mortality ratios for CHD; that is, cigarette smokers show significantly increased death rates compared with nonsmokers (table 2). The risk incurred by cigarette smoking increases with increasing dosage and, as measured by mortality ratios, is more marked for men in the younger age groups, under age 60, although the absolute increment in death rates experienced by smokers over that of nonsmokers continues to increase with increasing age. Table 2 lists the mortality ratios found in the major studies. Certain of these studies, including those at Framingham, Massachusetts, the Health Insurance Plan of New York City (HIP), and at Tecumseh, Michigan, have analyzed morbidity as well as mortality from CHD and have indicated that the risk of developing fatal and nonfatal CHD is greater among cigarette smokers than among nonsmokers (tables 3 and 4). Conflicting evidence has been published concerning the relationship of cigarette smoking and the incidence of angina pectoris. While some




Top numbers in bars are CHD decedents with paired combinations of characteristics; bottom numbers, control subjects with combinations.

*$1.8 = \frac{354}{66} \times \frac{175}{524}$

FIGURE 3—Estimated coronary heart disease death ratios in a 17–51 year follow-up, and frequencies of paired combinations of six high-risk characteristics in college, for all ages at death.

SOURCE: Paffenbarger, R. S., et al. (*146*).