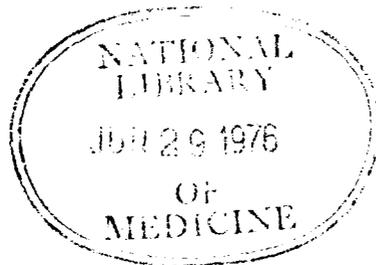


The
Health Consequences
of SMOKING
1975



The
Health Consequences
of SMOKING
1975

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
Center for Disease Control
Atlanta, Georgia 30333

July 23, 1975

Honorable Carl Albert
Speaker of the House of Representatives
Washington, D.C. 20515

Dear Mr. Speaker:

As required by Section 8(a) of the Public Health Cigarette Smoking Act of 1969, enclosed is the 1975 report on the health consequences of smoking. The recent scientific information reviewed in the report reaffirms the previous evidence that cigarette smoking is a serious public health problem. It is a major contributor to the development of cardiovascular disease, various types of cancer, and respiratory disease. Its toll in illness and premature death is needless and preventable. The recent literature further refines our understanding of the mechanisms by which smoking influences these disease states.

Under this Act, I am also required to submit to you such recommendations for legislation as I deem appropriate. This Department has previously taken a position in support of legislation which would authorize the regulation of cigarettes through the power to ban the manufacture and sale of cigarettes exceeding what are considered excessively hazardous levels of tar, nicotine, carbon monoxide, and other ingredients shown to be injurious to health. The extent to which the cigarette smoking public has over the years spontaneously moved towards this kind of self protection suggests that it would welcome the additional protection such legislation would bring. This Department, therefore, recommends to the Congress that it consider legislation providing this Department or some other appropriate agency with the authority to set maximum permissible levels of hazardous ingredients in cigarettes.

With kindest regards.

Sincerely,

Caspar W. Weinberger
Secretary

Enclosure

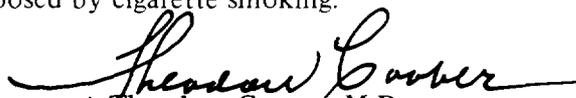
PREFACE

Each year the Public Health Service reviews the scientific data related to the health consequences of smoking and submits its review to the Congress. This report, the ninth in the series, summarizes recent research in four major areas: cardiovascular disease, cancer, respiratory disease, and the effects of smoking on the nonsmoker who shares the environment of those who smoke.

As has been the case with each of the previous reports in the series, the research summarized herein further confirms the relationships between cigarette smoking and disease and premature death and refines our understanding of the mechanisms underlying these relationships.

Cigarette smoking remains the largest single unnecessary and preventable cause of illness and early death. In the eleven years since the report of the Advisory Committee to the Surgeon General in 1964, there has been progress toward reducing this toll. Millions of Americans have stopped smoking cigarettes, and millions more have not taken up smoking. Even for those who continue to smoke, there has been a striking reduction in the "tar" and nicotine content of cigarettes used by the vast majority. At the same time, however, counter-balancing these gains, there has been an increase in cigarette smoking by women and young people, especially teen-age girls.

To eliminate the needless death and disability attributable to cigarette smoking, the Public Health Service remains committed today, as in the past, to increasing the knowledge about the health consequences of smoking and to educating the American people as to the nature and extent of the hazards of smoking. This is a task, not for government alone, but for the great institutions of society as a whole — the family, the schools, the health care system. Through concerted effort, a climate of respect for our own health and that of others can be created. Such a climate must certainly be conducive to reducing and eventually eliminating the needless burden of disease and premature death imposed by cigarette smoking.


Theodore Cooper, M.D.
Assistant Secretary for Health

June 1975

TABLE OF CONTENTS

Page

Preface	iii
Table of Contents	v
Preparation of the Report and Acknowledgments	vii
INTRODUCTION: Overview – The Health Consequences of Smoking	1
CHAPTER 1. Cardiovascular Diseases	9
CHAPTER 2. Cancer	39
CHAPTER 3. Non-Neoplastic Bronchopulmonary Diseases	57
CHAPTER 4. Involuntary Smoking	83
Index 1975	113
Index (Cumulative 1964-1975)	118

PREPARATION OF THE REPORT AND ACKNOWLEDGMENTS

Previous Reports

Reviews of the scientific evidence linking smoking to health effects began in 1964 with *Smoking and Health, Report of the Advisory Committee to the Surgeon General of the Public Health Service* or as subsequently referred to “the Surgeon General’s Report.” After this report, Public Law 89-92 was passed requiring supplemental reports to Congress on this subject. In compliance, three reports were submitted:

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.*

In April 1970, Public Law 91-222 amended the previous law and called for an updated report on the health effects of smoking no later than January 1, 1971, with annual reports thereafter. *The Health Consequences of Smoking, A Report of the Surgeon General: 1971*, a comprehensive review of all the scientific literature available to the National Clearinghouse for Smoking and Health and with emphasis on the most recent additions to the literature, was that updated report. Since then, the following annual reports on the health consequences of smoking have been submitted:

1. *The Health Consequences of Smoking, A Report of the Surgeon General, 1972.*
2. *The Health Consequences of Smoking, 1973.*
3. *The Health Consequences of Smoking, 1974.*

Each report since the original “Surgeon General’s Report” has reviewed the scientific literature relevant to the association between

smoking and cardiovascular diseases, non-neoplastic bronchopulmonary diseases, and cancer. Smoking as related to the following diseases and conditions has been reviewed periodically in the reports:

Pregnancy (1967, 1969, 1971, 1972, 1973)

Peptic Ulcer Disease (1967, 1971, 1972, 1973)

Noncancerous Oral Disease (1969)

Tobacco Amblyopia (1971)

Allergy (1972)

Public Exposure to Air Pollution From Tobacco Smoke
(1972)

Harmful Constituents of Cigarette Smoke (1972)

Pipe and Cigar Smoking (1973)

Exercise Tolerance (1973)

The 1975 Report

The present document, *The Health Consequences of Smoking, 1975*, begins with an overview of the health consequences of smoking and contains the current data on relationships between smoking and cardiovascular diseases, non-neoplastic bronchopulmonary diseases, and cancer. A fourth chapter, "Involuntary Smoking," reviews the effects to nonsmokers of exposure to smoke-filled environments. Although emphasis is on the latest additions to the literature, where necessary to provide the background or framework, research from earlier years is included.

This report was prepared by the staff of the National Clearinghouse for Smoking and Health in the following way:

1. The Technical Information Center of the Clearinghouse continually monitors and collects the scientific literature on the health consequences of smoking through several established mechanisms:
 - a. An information science corporation is on contract to extract articles on smoking and health from the scientific literature of the world.
 - b. The National Library of Medicine, through the MEDLARS system, provides a monthly listing of articles on smoking and health. Articles not provided by the information science corporation are ordered.

- c. Staff members review current medical literature and identify pertinent articles.
2. The literature was reviewed by the Medical Staff Director who wrote first drafts for this report. These drafts were sent to reviewers for criticism and comment regarding the format, the appropriateness of the articles selected for discussion, and the conclusions. The final drafts of the total report were reviewed by the Director of the National Clearinghouse for Smoking and Health, the Director of the National Cancer Institute, the Director of the National Institute of Environmental Health Sciences, the Director of the National Heart and Lung Institute, and by additional experts both inside and outside the Public Health Service.

ACKNOWLEDGEMENTS

The National Clearinghouse for Smoking and Health, Daniel Horn, Ph.D., Director, and Charles A. Althafer, Acting Director, are responsible for the preparation of this report. Medical Staff Director for the report was David M. Burns, M.D. Consulting editors were Elvin E. Adams, M.D., Daniel P. Asnes, M.D., John H. Holbrook, M.D., Paul Schneiderman, M.D., and H. Stephen Williams, M.D. Technical Editor was Priscilla B. Holman, and Technical Information Officer responsible for the literature collection was Donald R. Shopland.

The professional staff has had the assistance and advice of the following experts in the scientific and technical fields whose contributions are gratefully acknowledged.

Reviewers

ANDERSON, William H., M.D. - Chief, Section of Respiratory and Environmental Medicine, University of Louisville, Louisville, Ky.

AUERBACH, Oscar, M.D. - Senior Medical Investigator, Veterans Administration Hospital, East Orange, N.J.

BOCK, Fred G., Ph.D. - Director, Orchard Park Laboratories, Roswell Park Memorial Institute, Orchard Park, N.Y.

BOREN, Hollis G., M.D. - Assistant Director of the Medical Center and Associate Dean of the College of Medicine, University of South Florida, Tampa, Fla.

FALK, Hans L., Ph.D. – Associate Director for Program, National Institute of Environmental Health Sciences, Research Triangle Park, N.C.

FERRIS, Benjamin G., Jr., M.D. – Professor of Environmental Health and Safety, School of Public Health, Harvard University, Boston, Mass.

GOLDSMITH, John R., M.D. – Medical Epidemiologist, Epidemiological Studies Laboratory, California State Department of Health, Berkeley, Calif.

GORI, Gio B., Ph.D. – Deputy Director, Division of Cancer Cause and Prevention, National Cancer Institute, National Institutes of Health, Bethesda, Md.

HARKE, H.-P., Ph.D., – Forschungsinstitut der Cigarettenindustrie, e.V., Hamburg, Germany.

HIGGINS, Ian T. T., M.D. – Professor of Epidemiology, School of Public Health, University of Michigan, Ann Arbor, Mich.

HOFFMANN, Dietrich, Ph.D. – Member, and Chief, Division of Environmental Carcinogenesis, Naylor Dana Institute for Disease Prevention, American Health Foundation, Valhalla, N.Y.

KELLER, Andrew Z., D.M.D. – Chief, Research in Geographic Epidemiology Medical Research Service, Veterans Administration Central Office, Washington, D.C.

KRUMHOLZ, Richard A., M.D. – Medical Director, Institute of Respiratory Diseases, Kettering Medical Center, Kettering, Ohio.

LENFANT, Claude J. M., M.D. – Associate Director for Lung Programs, National Heart and Lung Institute, National Institutes of Health, Bethesda, Md.

MacMAHON, Brian, M.D. – Professor, Department of Epidemiology, School of Public Health, Harvard University, Boston, Mass.

McMILLAN, Gardner, C., M.D. – Associate Director for Etiology of Arteriosclerosis and Hypertension, National Heart and Lung Institute, National Institutes of Health, Bethesda, Md.

NETTESHEIM, Paul, M.D. – Group Leader, Respiratory Carcinogenesis Group, Biology Division, Oak Ridge National Laboratory, Oak Ridge, Tenn.

PAFFENBARGER, Ralph S., Jr., M.D. – Epidemiologist, Resource for Cancer Epidemiology, California State Department of Health, Berkeley, Calif.

PETTY, Thomas L., M.D. – Professor of Medicine and Head, Division of Pulmonary Diseases, University of Colorado Medical Center, Denver, Colo.

RALL, David P., M.D. – Director, National Institute of Environmental Health Sciences, National Institutes of Health, Research Triangle Park, N.C.

RAUSCHER, Frank J., M.D. – Director, National Cancer Institute, National Institutes of Health, Bethesda, Md.

RENZETTI, Attilio D., Jr., M.D. – Professor of Medicine and Head, Pulmonary Disease Division, University of Utah Medical Center, Salt Lake City, Utah.

RINGLER, Robert L., Ph.D. – Acting Director, National Heart and Lung Institute, National Institutes of Health, Bethesda, Md.

SAFFIOTTI, Umberto, M.D. – Associate Director for Carcinogenesis, National Cancer Institute, National Institutes of Health, Bethesda, Md.

SCHMELTZ, Irwin, Ph.D. – Associate Member and Head, Section of Bio-organic Chemistry, Division of Environmental Carcinogenesis, Naylor Dana Institute for Disease Prevention, American Health Foundation, Valhalla, N.Y.

SCHUMAN, Leonard M., M.D. – Professor and Director, Division of Epidemiology, School of Public Health, University of Minnesota, Minneapolis, Minn.

SHIMKIN, Michael B., M.D. – Professor of Community Medicine and Oncology, School of Medicine, University of California, La Jolla, Calif.

WYNDER, Ernst L., M.D. – President and Medical Director, American Health Foundation, Valhalla, N.Y.

Special assistance for the Cardiovascular Chapter was provided by:

JENNINGS, Michael, M.D. – Epidemic Intelligence Service Officer, CDC, located at Ohio Department of Health, Columbus, Ohio, and

MANNING, Kathleen, M., R.N. – Department of Staff Development, Boston City Hospital, Boston, Mass.

The following staff members of the Center for Disease Control also contributed to the preparation of this report: Bureau of Training – Julia M. Fuller, Winthrop N. Davey, M.D., and Seth N. Lejbler, Ed.D.; National Clearinghouse for Smoking and Health – Nancy M. Johnston and Sanda Lager.

INTRODUCTION

Overview – The Health Consequences of Smoking—

OVERVIEW – HEALTH CONSEQUENCES OF SMOKING

The statement, "*Warning: The Surgeon General Has Determined That Cigarette Smoking Is Dangerous to Your Health*," has been required by law on cigarette packaging since 1970 as a part of the Public Health Cigarette Smoking Act of 1969. This Act was a response by the U.S. Congress to the scientific information on the health consequences of cigarette smoking summarized in reports then available (the Surgeon General's Report of 1964 and the subsequent 1967, 1968, and 1969 PHS Health Consequences of Smoking). This Act was passed because a series of important questions concerning cigarette smoking and health had been answered.

The following discussion summarizes the basic questions, the methodology used to determine the answers, and the answers themselves.

The initial question to be answered concerning the health consequences of smoking was "*Are there any harmful health effects of smoking cigarettes?*" The answer to this question was provided in two ways. First, it was demonstrated that some diseases occurred more frequently in smokers than in nonsmokers. Second, a causal relationship was established between smoking and these diseases.

Concern about the possible health effects of smoking started when scientists began looking for an explanation to account for the rapidly increasing death rate from lung cancer. The early retrospective studies showed a link between lung cancer and smoking. The first prospective studies, however, found that only one-eighth of the excess overall mortality found among smokers could be accounted for by lung cancer; the rest was largely due to coronary heart disease, chronic respiratory disease, and other forms of cancer. They also found that the effect on overall mortality was largely confined to cigarette smokers rather than the users of other forms of tobacco.

However, demonstrating an association by statistical probability is not enough to establish the causal nature of a relationship. Determining that the association between smoking and excess death rates is cause and effect was a judgment made after a number of criteria had been met, no one of which by itself is sufficient to make this judgment. These criteria as listed in the Surgeon General's

Advisory Committee Report (1964) were the **consistency, strength, specificity, temporal relationship, and coherence** of the association.

In addition, convincing theories about the mechanisms whereby smoking contributes to the various diseases responsible for the excess mortality among cigarette smokers were developed from the evidence on the biochemical, cytologic, pathologic, and pathophysiologic effects of cigarette smoking, thereby providing the necessary support for the decision that the relationship was causal.

The most important specific health consequence of cigarette smoking in terms of the number of people affected is the development of premature coronary heart disease (CHD). Both prospective and retrospective studies clearly established that cigarette smokers have a greater risk of death due to CHD and have a higher prevalence of CHD than nonsmokers. Long-term followup of healthy populations has confirmed that a cigarette smoker is more likely to have a myocardial infarction and to die from CHD than a nonsmoker. Cigarette smoking has been shown to be one of the major independent CHD risk factors and to act in combination with other major alterable CHD risk factors (high blood pressure and elevated serum cholesterol). Autopsy studies have shown that persons who smoked cigarettes have more severe coronary atherosclerosis than persons who did not smoke. Physiologic studies and animal experiments have indicated several mechanisms whereby these effects can take place.

A second major health consequence of smoking is the development of cancer in smokers. Cigarette smoking was firmly established as the major risk factor in lung cancer. The risk of developing lung cancer was found to be 10 times greater for cigarette smokers than for nonsmokers. The risk of developing lung cancer increases with the number of cigarettes smoked per day and is greater in cigarette smokers who report inhaling, who started smoking at an early age, or who have smoked for a greater number of years. Smokers of filter cigarettes have been shown to have a lower risk of developing lung cancer than smokers of nonfilter cigarettes, but the risk remains well above that for nonsmokers. The risk of developing cancer of the larynx, pharynx, oral cavity, esophagus, pancreas, and urinary bladder was also found to be significantly higher in cigarette smokers than in nonsmokers. Pipe and cigar smokers were found to have elevated risks for the development of cancer of the oral cavity, pharynx, larynx, and esophagus when compared to nonsmokers. Fewer pipe and cigar smokers than cigarette smokers report that they inhale. As a result lungs of pipe and cigar smokers receive much less

exposure to smoke than the lungs of cigarette smokers. This is probably the primary reason for the lower incidence of cancer of the lung for pipe and cigar smokers compared to cigarette smokers.

Women have had far lower rates of lung cancer than men. This has been attributed to the fact that fewer women than men smoke and the fact that women smokers generally select filter and low tar and nicotine cigarettes. However, the percentage of women smokers in the United States has increased steadily in the last 30 years, and since 1955 the death rates from lung cancer in women have increased proportionately more rapidly than the rates for men, reflecting this increased proportion of women smokers.

The tar from cigarette smoke has been found to induce malignant changes in the skin and respiratory tract of experimental animals, and a number of specific chemical compounds contained in cigarette smoke were established as potent carcinogens or co-carcinogens. Malignant changes including carcinoma *in situ* were found in the larynx and in the sputum exfoliative cytology of experimental animals exposed to cigarette smoke.

Nonmalignant respiratory disease is a third area of smoking-induced morbidity and mortality. Cigarette smokers have been shown to have more frequent minor respiratory infections, miss more days from work due to respiratory illness, and report symptoms of cough and sputum production more frequently than nonsmokers. Retrospective and prospective studies with long-term followup have found that cigarette smoking is the primary factor in the development of chronic bronchitis and emphysema in the United States. Cigarette smokers have also been found to be more likely to have abnormalities of pulmonary function and have higher death rates from respiratory diseases than nonsmokers. Data from autopsy studies have shown that cigarette smokers were more likely to have the macroscopic changes of emphysema, and that these changes are closely related to the number of cigarettes smoked per day. Mucous cell hyperplasia has been found more often in cigarette smokers. Cigarette smoke also inhibits the ciliary motion responsible for cleansing the respiratory tract.

An additional area of health concern has been the effect of cigarette smoking during pregnancy. Mothers who smoke cigarettes during the last two trimesters of their pregnancy have been found to have babies with a lower average birth weight than nonsmoking mothers. In addition cigarette smoking mothers had a higher risk of having a stillborn child, and their infants had higher late fetal and

neonatal death rates. There are some data to show that these risks due to cigarette smoking are even greater in women who have a high risk pregnancy for other reasons. These effects may occur because carbon monoxide passes freely across the placenta and is readily bound by fetal hemoglobin, thereby decreasing the oxygen carrying capacity of fetal blood.

Having established that cigarette smoking is a significant causal factor in a number of serious disease processes, two additional questions became important. They are "*Can the health consequences to the individual be averted by stopping smoking or by changing the cigarette,*" and "*What are the overall public health consequences of cessation and of the changes made in cigarettes?*"

The first question is the simpler of the two to answer. In the individual, cessation of cigarette smoking results in a rapid decline of the carbon monoxide level in the blood over the first 12 hours. Symptoms of cough, sputum production, and shortness of breath usually improve over the next few weeks. A woman who stops smoking by the fourth month of her pregnancy has no increased risk of stillbirth or perinatal death in her infant related to smoking. The deterioration in pulmonary function tests that occurs in some smokers becomes less rapid than that of continuing smokers. The death rates from ischemic heart disease, chronic bronchitis, and emphysema also become less than those of the continuing smoker. The risk of developing cancer of the lung, larynx, and oral cavity declines relative to the continuing smoker in the first few years after cessation and 10 to 15 years after stopping smoking approximates that of nonsmokers. A smoker who switches to filter cigarettes and has smoked them for 10 years or longer has a lower risk of developing lung cancer than a smoker who continues to smoke nonfilter cigarettes. The risk to a filter cigarette smoker, however, still remains well above that of a nonsmoker.

The public health benefits of cessation are more difficult to determine than the effects of cessation on the individual. Just as cause-specific death rates have reflected the effect of cigarette smoking on certain diseases, they should also reflect any substantial benefits to be gained by cessation or reduction in cigarette smoking. Several factors combined to produce a reduction in per capita dosage of tobacco exposure in the United States for the years 1966-1970. First, per capita consumption of cigarettes declined from 4,287 cigarettes per person in 1966 to 3,985 in 1970. Second, during this period there was a slow but significant decrease in the average tar and nicotine content of cigarettes as well as a decrease in the amount of

tobacco contained in the average cigarette. The decline in per capita consumption during those years occurred in the face of a substantial increase in the proportion of young women becoming smokers as compared to women of previous generations and so reflected predominantly a decrease in cigarette consumption by men.

Since 1970, although the per capita consumption of cigarettes has increased, the average levels of tar and nicotine have continued to decline, making it more difficult to predict what has happened to per capita dosage.

Examination of cause-specific death rates for the period of this declining per capita consumption reveals that there was a downturn in the male death rate from ischemic heart disease beginning in 1966 which reversed the upward trend that had occurred over the previous two decades. This decline in the death rate from ischemic heart disease has not occurred in women.

The male death rate from chronic bronchitis has also been declining since 1967, and the male death rate for emphysema has declined since 1968 when it was first recorded as a separate category. Female death rates for these two diseases have not shown these trends.

Despite the impressive coincidences of the decline in death rates among males occurring at the same time that there was a decline in per capita cigarette consumption, it is impossible to be certain of the exact cause of the decline in the death rates. These diseases are influenced by a variety of factors in addition to cigarette smoking such as blood pressure and air pollution. Some of these factors have also been subject to major control efforts which may have contributed to the decline in the death rates. In addition, there have been therapeutic advances in the treatment of these problems which may also have helped lower the death rates.

A decline in male death rates from lung cancer should also follow the decline in per capita consumption. This rate would not be influenced as much by changes in other etiologic factors or changes in therapy because cigarette smoking causes from 85 to 90 percent of all lung cancer and there have been no major improvements in survival due to changes in therapy. With lung cancer, however, two additional considerations must be kept in mind. A decline in death rates from lung cancer would be expected to lag several years behind a decline in per capita consumption. In addition, the decline in consumption and switch to low tar and nicotine cigarettes occurred

predominantly in the younger age groups where death rates from lung cancer are low. For these reasons, it is necessary to look at lung cancer death rates by age group rather than total lung cancer death rates. The lung cancer rates by age groups for 1971 suggest a decline in the lung cancer rates for the younger males (under 45), but the confidence limits on these trends at present remain wide enough that it is impossible to say whether this is a real decline or merely a leveling off. The national health statistics broken down by 5-year age groups are currently available only through 1971. The data by age group from a few more years will be necessary to determine whether the changes in smoking behavior which have taken place have reversed the trend of the preceding 40 years of continually increasing lung cancer rates in men. In 1971, the last year for which detailed mortality statistics are available, the accumulated exposure to cigarettes reached its peak among men born between 1915 and 1919, a group then in their early 50's. Cumulative exposure has continued to decline with each successive 5-year birth cohort born since then. The trends of the last few years offer some hope that the peak of the "lung cancer epidemic," as some have termed this phenomenon, may have been reached with this group and that future years will show a slow but consistent decline.

CHAPTER 1
Cardiovascular Diseases

CHAPTER 1

Cardiovascular Diseases

CONTENTS

	<i>Page</i>
Coronary Heart Disease (CHD)	13
Introduction	13
Cigarette Smoking as a Major Risk Factor for Coronary Heart Disease	14
Cigarette Smoking in Relation to Other Risk Factors for Coronary Heart Disease	15
Hypertension	15
Coffee Drinking	19
Ventricular Premature Beats	20
Carbon Monoxide	20
Introduction	20
Sources of Carbon Monoxide Exposure and Human Absorption	21
Effects on Healthy Individuals	26
Effects on Persons With Atherosclerotic Cardiovascular Disease	27
Studies on the Pathogenesis of Cardiovascular Disease	28
Nicotine	29
Acrolein	29
Cerebrovascular Disease	29
Effects of Smoking on the Coagulation System	32
Summary of Recent Cardiovascular Findings	33
Bibliography	34

List of Tables

	<i>Page</i>
Table 1. — Age-standardized blood pressure changes (mm Hg) at followup for continuing cigarette smokers and quitters according to weight changes	17
Table 2. — Number of subjects who had developed hypertension at followup for continuing cigarette smokers and quitters	18
Table 3. — Mean percent of carboxyhemoglobin saturation in smokers and nonsmokers by sex and race	22
Table 4. — Mean percent of carboxyhemoglobin saturation in smokers and nonsmokers by employment status	23
Table 5. — Median percent carboxyhemoglobin (COHb) saturation and 90 percent range for smokers and nonsmokers by location	24
Table 6. — Mean percent carboxyhemoglobin (COHb) saturation in cigarette smokers 1 hour after last cigarette	25
Table 7. — Age-standardized death rates and mortality ratios for cerebral vascular lesions for men and women by type of smoking (lifetime history) and age at start of study	31

CORONARY HEART DISEASE (CHD)

Introduction

Coronary Heart Disease (CHD) is the most frequent cause of death in the United States and is the most important single cause of excess mortality among cigarette smokers. The evidence relating smoking to CHD has been reviewed in previous reports on the health consequences of smoking (61, 62, 63, 64, 65, 66, 67, 68). The following is a brief summary of the relationships between smoking and CHD presented in these reports.

Cigarette smoking, hypertension, and elevated serum cholesterol are the major alterable risk factors for myocardial infarction and death from CHD. Cigarette smoking acts both independently as a risk factor and synergistically with the other CHD risk factors. The magnitude of the risk increases directly with the amount smoked. The excess risk of CHD among smokers has been demonstrated in some Asian, Black, and Caucasian populations and is proportionately greater for younger men, especially those below age 50. Cessation of cigarette smoking results in a reduced mortality rate from CHD compared with the mortality rate for those who continue to smoke.

Pipe and cigar smokers have a slightly higher risk of death from CHD than nonsmokers, but they incur a much lower risk than cigarette smokers. This has been attributed to the lower levels of inhalation that characterize most pipe and cigar smoking.

Data from autopsy studies have shown coronary atherosclerosis to be more frequent and more extensive in cigarette smokers than in nonsmokers, and experimental work in humans and animals has suggested several mechanisms by which smoking may influence the development of atherosclerosis and CHD. The formation of carboxy-hemoglobin, release of catecholamines, creation of an imbalance between myocardial oxygen supply and demand, and increased platelet adhesiveness leading to thrombus formation have all been demonstrated in smokers and proposed as explanations for the excess CHD mortality and morbidity among smokers.

Cigarette Smoking as a Major Risk Factor for Coronary Heart Disease

The evidence establishing smoking as a major risk factor in CHD has been reviewed in previous reports (61, 62, 63, 64, 65, 66, 67, 68). During the last year new epidemiologic data have been published on the relationship between coronary artery disease and smoking.

Bengtsson (9, 10) studied the smoking habits of women with myocardial infarction (MI) in Goteborg, Sweden. He found that smoking was significantly more common in a group of 46 women (80 percent smokers), ages 50-54, who had a myocardial infarction than in a control group of 578 healthy nonhospitalized women (37.2 percent smokers).

Other investigators examined the effect of cigarette smoking on survival of people with acute myocardial infarction. In a study of 400 patients with documented myocardial infarction who survived to be admitted to a coronary care unit, Helmers (26, 27, 28) found no significant difference between the percentages of smokers and nonsmokers among survivors studied after the first 24 hours, from 2 days until discharge, and from discharge to 3 years. Reynertson and Tzagournis (52), in a 5-year prospective study of 137 patients with documented CHD at age 50 or less, were also unable to find any relationship between CHD mortality rates and smoking habits. Smoking habits after entrance into the study were also considered and again no difference in mortality rates was found.

The Coronary Drug Project (17) found an effect of cigarette smoking on mortality after myocardial infarction. This group studied 2,789 men ages 30-64 years for 3 years after myocardial infarction and found a statistically significant correlation between cigarette smoking determined 3 months after a myocardial infarction and mortality (t -value of 2.94). None of these studies (17, 26, 27, 28, 52) were able to examine the smoking habits of the group of people who die suddenly as a first manifestation of CHD, and therefore may have excluded that group in which there is the highest excess mortality due to cigarette smoking (31).

Additional data from the Swedish twin study of Friberg, et al. (23) have been reported. They found an excess CHD mortality among smokers in dizygotic twins with different degrees of smoking, but no similar excess in monozygotic twins. Although the numbers were too small to be significant, the authors suggest that this tends to support the theory that both smoking and CHD are constitutionally

determined. These data must be viewed with caution, however, since the difference was demonstrable only in the older age group (born 1901 - 1910). When the younger age group (born 1911 - 1925) was considered, no excess CHD mortality was seen in the dizygotic group but a small excess was noted in the monozygotic group (three CHD deaths in the high smoking group and one in the low smoking group). Also the difference in cigarette consumption between the high and low smoking groups was relatively small (seven cigarettes per day). Consequently, data from this study are not sufficient to warrant the conclusion that both smoking and excess CHD mortality are constitutionally determined rather than smoking being a cause of the excess CHD mortality.

Cigarette Smoking in Relation to Other Risk Factors for Coronary Heart Disease

Cigarette smoking, elevated serum cholesterol, and elevated blood pressure are generally accepted as the three major modifiable risk factors for CHD. However, there is less agreement concerning other CHD risk factors – obesity, physical inactivity, diabetes mellitus, elevated resting heart rate, psychologic type A behavior, etc. The following studies present recent evidence on the relationships between smoking and hypertension, coffee drinking, and ventricular premature beats.

Hypertension

Results from several studies have shown that smokers on the average have slightly lower blood pressure than nonsmokers. Some investigators have attributed this finding to the fact that smokers on the average weigh slightly less than nonsmokers. Three current studies (24, 36, 55) discuss this relationship. Gyntelberg and Meyer (24), based on their evaluation of 5,249 men ages 40-59, were of the opinion that lower blood pressure in smokers could not be accounted for by differences in weight, age, or physical fitness. Kesteloot and Van Houte (36), in a study of 42,804 men, performed a multiple regression analysis on age, weight, and height and found that cigarette smokers had lower blood pressure than nonsmokers; however, when they included serum cholesterol values in the analysis, the difference in blood pressure was reduced to approximately 1 mm Hg. Although this difference was statistically significant based on the large population, the actual difference in blood pressure was too small to be of clinical importance.

Seltzer (55) studied 794 men selected for their initial good health and normal blood pressure (below 140 systolic and 90 diastolic) and followed them for changes in cigarette smoking habits, weight, and blood pressure. During the 5-year period of the study 104 men gave up smoking. For every age group except those over 55, there was a significantly greater weight gain (8 lb) among the "quitters" than among the continuing smokers (3.5 lb). Blood pressure increased 4 mm Hg systolic and 2.5 mm Hg diastolic in the quitters with no change in systolic and a slight reduction in diastolic (-1.1 mm Hg) in persons who continued to smoke. In order to examine blood pressure changes in relation to weight change, both continuing smokers and quitters were grouped according to their weight changes during the period of study (Table 1). The most significant finding was an increase in the systolic blood pressure (+1.77 mm Hg) among the quitters even in that group with significant weight loss. In contrast, the continuing smokers with significant weight loss had a decline in systolic blood pressure (-3.28 mm Hg). Diastolic blood pressure in quitters showed an increase with weight gain and no change with weight loss, while continuing smokers showed a decrease in diastolic pressure with weight loss and no change with weight gain. The data on subjects whose blood pressure had increased to hypertensive levels (systolic > 150 and diastolic > 95) were evaluated, and it was found that quitters had a much higher frequency of becoming hypertensive than continuing smokers (Table 2).

Seltzer, in interpreting these data, suggested that cigarette smoking tends to inhibit blood pressure increases, with only minimal pressure rises occurring even in instances of substantial weight gain. When this inhibiting effect of cigarette smoking is removed as in the case of the quitters, sharp rises in blood pressure become evident. He cautioned, however, that the development of hypertension in some quitters may have been responsible for decisions to lose weight and that his data do not allow an evaluation of the degree of blood pressure changes according to how recently cigarettes were given up.

The results of the ischemic heart disease study by Kahn, et al. (34) raise additional questions about Seltzer's data. Kahn followed 10,000 Israeli male civil service employees for 5 years to determine what factors were associated with an increased incidence of hypertension. He presented no data concerning persons who stopped smoking, but he did show that the incidence of hypertension increased with age and that the age-adjusted incidence of hypertension in smokers was over twice that of nonsmokers (76.9/1000 for smokers versus 35.4/1000 for nonsmokers). Seltzer reported no

TABLE 1. – Age-standardized blood pressure changes (mm Hg)¹ at followup for continuing cigarette smokers and quitters according to weight changes

Smoking Class	Weight Change (LB)							
	Significant Wt Loss		No Significant Wt Change		Moderate Wt Gain		Significant Wt Gain	
	No.	lb -25 to -5	No.	lb -4 to +4	No.	lb +5 to +12	No.	lb +13 to +30
<i>Mean systolic BP changes:</i>								
Continuing smokers	32	-4.00	84	-1.52	71	2.85	24	1.50
Quitters	13	1.77	27	2.22	27	4.04	32	3.69
<i>Mean diastolic BP changes:</i>								
Continuing smokers	32	-3.28	84	-2.04	71	0.73	24	-0.04
Quitters	13	-0.31	27	-1.96	27	4.30	32	3.94

¹Standardized on basis of age distribution of current cigarette smokers.

Source: Seltzer, C.C. (55).

TABLE 2. – Number of subjects who had developed hypertension at followup for continuing cigarette smokers and quitters

Blood pressure levels	Continuing cigarette smokers		Quitters	
	Number	Percent	Number	Percent
Systolic blood pressure 150+	6	2.8	9	8.7
Systolic blood pressure 160+	2	0.9	5	4.8
Diastolic blood pressure 95+	3	1.4	5	4.8

Source: Seltzer, C.C. (55).

data on the incidence of hypertension in nonsmokers, and the age distribution for his group of smokers (the original source of the quitters) is heavily weighted toward younger age groups (with only 33 of 214 men age 50 years or over). According to Kahn's data, this age group would be expected to have a lower incidence of hypertension, and, in fact, Seltzer found only small numbers of men who developed hypertension (eight with diastolic hypertension) (Table 2). Making interpretations based on such small numbers is hazardous; for example, the difference between current smokers and quitters in the incidence of diastolic hypertension could have been produced by only three men quitting smoking because they developed hypertension.

Coffee Drinking

The Boston Collaborative Drug Study (12) recently reported a correlation between coffee drinking (≥ 6 cups per day) and myocardial infarction that persisted after controlling for the effect of cigarette smoking. This was a retrospective study of 276 patients with a hospital discharge diagnosis of myocardial infarction and 1,104 age, sex, and hospital-matched controls discharged with other diagnoses. In addition to the usual limitations of retrospective studies, this study has several characteristics that make interpretation difficult. In controlling for the effect of cigarette smoking, the investigators divided the smokers into those who smoked one pack or less per day and those who smoked more than one pack per day. Because cigarette consumption is highly correlated with coffee consumption (29, 39), it can be expected that within such broad smoking categories those who were heavy coffee drinkers tended to be heavier smokers than those who consumed smaller amounts of coffee. It is also possible that the hospitalized controls represented persons who drank less coffee than the general population because of serious chronic illnesses. These characteristics of the study design do not allow firm conclusions to be made concerning the extent to which the relationship between coffee drinking and myocardial infarction is independent of the relationship of both variables to cigarette smoking.

The question of the independent nature of this relationship is also dealt with in a prospective study by Klatsky, et al. (39) of 464 patients with myocardial infarction who previously had had multiphasic health checkups. Both ordinary controls and CHD risk factor-matched controls were drawn from 250,000 people who had undergone the same multiphasic health checkups. The investigators did not find an independent correlation between coffee drinking and myocardial infarction when risk-matched controls were used.

The Framingham Study (18) recently published data on coffee drinking based on a 12-year followup of 5,209 men and women ages 30-62. An increased risk of death from all causes was demonstrated in coffee drinkers, but this relationship was accounted for by the association between coffee consumption and cigarette smoking. No association between coffee drinking and myocardial infarction or between coffee drinking and the development of CHD, stroke, or intermittent claudication was demonstrated. Heyden, et al. (29) also found no relationship between excessive coffee consumption (> 5 cups per day) and atherosclerotic vascular disease.

Ventricular Premature Beats

Ventricular premature beats have been shown to be a risk factor for sudden death from CHD. Vedin, et al. (69), in a study of 793 men in Goteborg, Sweden, examined the frequency of rhythm and conduction disturbances at rest and during exercise. They found no statistically significant correlation between cigarette smoking habits and the presence of supraventricular or ventricular premature beats at rest or during exercise.

CARBON MONOXIDE

Introduction

Carbon monoxide has long been recognized as a dangerous gas, but until recently concentrations which produced carboxyhemoglobin levels below 15 to 20 percent were thought to have little effect on humans. Currently there is considerable interest in determining the effect of chronic exposure to low levels of carbon monoxide (65, 66, 67, 68).

Carbon monoxide is present in concentrations of 1 to 5 percent of the gaseous phase of cigarette smoke (11, 45). The concentration varies with temperature of combustion as well as with factors which control the oxygen supply such as the porosity of the paper and packing of the tobacco. The amount of carbon monoxide produced increases as the cigarette burns down. Carboxyhemoglobin levels in smokers vary from 2 to 15 percent depending on the amount smoked, degree of inhalation, and the time elapsed since smoking the last cigarette.

Carbon monoxide, which has 230 times the affinity of oxygen for hemoglobin, impairs oxygen transportation in at least two ways:

First, it competes with oxygen for hemoglobin binding sites. Second, it increases the affinity of the remaining hemoglobin for oxygen, thereby requiring a larger gradient in P_{O_2} between the blood and tissue to deliver a given amount of oxygen; this increased gradient is usually produced by a lowering of the tissue P_{O_2} .

Carbon monoxide also binds to other heme-containing pigments, most notably myoglobin, for which it has even a greater affinity than for hemoglobin under conditions of low P_{O_2} . The significance of this binding is unclear, but may be important in tissues, such as the heart muscle, which have both high oxygen requirements and large amounts of myoglobin.

Sources of Carbon Monoxide Exposure and Human Absorption

Several researchers (13, 32, 35, 57, 60, 70) have estimated the relative contribution of cigarette smoking and air pollution to the human carbon monoxide burden as measured by carboxyhemoglobin levels (COHb). Kahn, et al. (35), in a study of 16,649 blood donors, determined that smoking was the most important contributing factor, followed by industrial work exposure. Nonsmoking industrial workers had COHb levels of 1.38 percent, and nonsmokers without industrial exposure had levels of .78 percent. Cigarette smokers, on the other hand, had very high levels. Smokers with industrial exposure had levels of 5.01 percent, while smokers without industrial exposure had levels of 4.44 percent (Tables 3 and 4). Stewart, et al. (57) found similar results in a nationwide survey of blood donors and noted marked variation in mean COHb levels in residents of different cities measured at different times of the year (Table 5). However, in all areas, smokers still had COHb levels two to three times higher than nonsmokers and had increasing COHb levels with increasing level of cigarette consumption (Table 6). Similar findings were reported by Torbati, et al. (60) in a study of 500 male Israeli blood donors.

Nonsmoking workers exposed to automobile exhaust – London taxi drivers (32) and garage and service station operators (13) – have higher baseline levels of carboxyhemoglobin than nonsmokers of the general population. But even in these high exposure occupations smokers have markedly higher COHb levels (8.1 and 10.8 percent) than nonsmokers (6.3 and 5.5 percent). An extreme is represented by New York City tunnel workers who are exposed to an average of 63 ppm CO with peak exposure levels as high as 217 ppm CO; cigarette smokers still maintained much higher COHb levels (5.01 percent) than nonsmokers (2.93 percent) (8).

TABLE 3. – Mean percent of carboxyhemoglobin saturation in smokers and nonsmokers by sex and race

	Total Sample		Nonsmokers		Smokers ¹	
	No.	$\bar{X} \pm S_{\bar{X}}$	No.	$\bar{X} \pm S_{\bar{X}}$	No.	$\bar{X} \pm S_{\bar{X}}$
Total Sample	16,649	2.30 ± 0.02	10,157	0.85 ± 0.01	6,492	4.58 ± 0.03
Male	10,542	2.66 ± 0.03	5,888	1.00 ± 0.01	4,654	4.76 ± 0.04
Female	6,107	1.68 ± 0.03	4,269	0.64 ± 0.01	1,838	4.10 ± 0.06
White	15,167	2.28 ± 0.02	9,474	0.85 ± 0.01	5,693	4.66 ± 0.04
Male	9,669	2.65 ± 0.03	5,508	1.00 ± 0.01	4,161	4.83 ± 0.04
Female	5,498	1.63 ± 0.03	3,966	0.64 ± 0.01	1,532	4.19 ± 0.06
Black	1,429	2.59 ± 0.06	641	0.86 ± 0.03	788	4.00 ± 0.08
Male	829	2.91 ± 0.10	347	1.07 ± 0.05	482	4.24 ± 0.10
Female	600	2.15 ± 0.09	294	0.62 ± 0.04	306	3.63 ± 0.12

¹Smokers are defined as those who smoked on the day of giving blood.

NOTE. – \bar{X} = mean percent; $S_{\bar{X}}$ = standard error of mean percent.

Source: Kahn, A., et al. (35).

TABLE 4. – Mean percent of carboxyhemoglobin saturation in smokers and nonsmokers by employment status

	Nonsmokers		Smokers ¹	
	No.	$\bar{X} \pm S_{\bar{X}}$	No.	$\bar{X} \pm S_{\bar{X}}$
Persons employed	8,478	0.89 ± 0.01	5,962	4.61 ± 0.03
Classed as industrial workers ¹	1,523	1.38 ± 0.04	1,738	5.01 ± 0.06
Classed as workers other than industrial	6,955	0.78 ± 0.01	4,224	4.44 ± 0.04
Persons not employed	1,678	0.63 ± 0.02	531	4.24 ± 0.11

¹Industrial workers are employed in either durable or nondurable goods manufacturing (craftsmen, operatives, or laborers). Smokers are defined as those who smoked on the day of giving blood.

NOTE. – \bar{X} = mean percent; $S_{\bar{X}}$ = standard error of mean percent.

Source: Kahn, A., et al. (35).

TABLE 5. – Median percent carboxyhemoglobin (COHb) saturation and 90 percent range for smokers and nonsmokers by location

Location	Cigarette Smokers		Nonsmokers	
	Median	Range	Median	Range
Anchorage	4.7	0.9 – 9.5	1.5	0.6 – 3.2
Chicago	5.8	2.0 – 9.9	1.7	1.0 – 3.2
Denver	5.5	2.0 – 9.8	2.0	0.9 – 3.7
Detroit	5.6	1.6 – 10.4	1.6	0.7 – 2.7
Honolulu	4.9	1.6 – 9.0	1.4	0.7 – 2.5
Houston	3.2	1.0 – 7.8	1.2	0.6 – 3.5
Los Angeles	6.2	2.0 – 10.3	1.8	1.0 – 3.0
Miami	5.0	1.2 – 9.7	1.2	0.4 – 3.0
Milwaukee	4.2	1.0 – 8.9	1.2	0.5 – 2.5
New Orleans	5.5	2.0 – 9.6	1.6	1.0 – 3.0
New York	4.8	1.2 – 9.1	1.2	0.6 – 2.5
Phoenix	4.1	0.9 – 8.7	1.2	0.5 – 2.5
St. Louis	5.1	1.7 – 9.2	1.4	0.9 – 2.1
Salt Lake City	5.1	1.5 – 9.5	1.2	0.6 – 2.5
San Francisco	5.4	1.6 – 9.8	1.5	0.8 – 2.7
Seattle	5.7	1.7 – 9.6	1.5	0.8 – 2.7
Vermont, New Hampshire	4.8	1.4 – 9.0	1.2	0.8 – 2.1
Washington, DC	4.9	1.2 – 8.4	1.2	0.6 – 2.5

Source: Stewart, R.D., et al. (57).

TABLE 6. – Mean percent carboxyhemoglobin (COHb) saturation in cigarette smokers 1 hour after last cigarette

Location	Nonsmoker	Packs of Cigarettes Smoked Per day				
		< ½	½-1	1	1½	2
Milwaukee	1.3	3.0	4.2	5.3	6.2	4.7
New Hampshire, Vermont	1.4	3.3	4.4	5.7	6.7	5.3
New York City	1.4	3.1	4.3	4.7	5.8	6.3
Washington, DC	1.4	3.8	4.6	5.2	5.8	6.6
Los Angeles	2.0	4.0	5.2	6.0	7.4	7.5
Chicago	2.0	4.8	5.4	6.3	7.1	7.7

Source: Stewart, R.D., et al. (57).

Studies on the CO burden of each cigarette have determined the body burden of CO per cigarette to be 7.10-8.66 ml (40), and the increase in COHb level produced by smoking one cigarette to be .94 to 1.6 percent after 12 hours of abstinence (40, 53). The half-life for the washout of CO in healthy college smokers (40) was calculated to be from 3 to 5 hours.

Effects on Healthy Individuals

Several studies have been published on the effects of carbon monoxide on healthy individuals. Small doses of CO (COHb levels 2.4-5.4 percent) were found to have no effect on heart rate (56). Raven, et al. (51), in a study of young men exposed during exercise on a treadmill to 50 ppm CO (COHb levels 2.5 percent in nonsmokers and 4.1 in smokers), found no decrease in maximum aerobic capacity when the subjects were tested at 25° C. In a similar experiment conducted at 35° C by the same researchers (20), there was a decrease in maximum aerobic capacity in nonsmokers exposed to 50 ppm CO, but not in smokers despite an increase in the carboxyhemoglobin levels of 1.5 percent in both groups. They postulated a possible physiologic adaptation of smokers to carbon monoxide. Ekblom and Huot (22) studied five young men who inhaled CO to reach given COHb levels. They reported that as COHb levels increased, there was a decrease in maximal oxygen uptake and lower heart rates at maximal treadmill exercise.

Sagone, et al. (54), in a study of 9 cigarette smokers and 18 nonsmokers ages 20-32, showed significantly higher values for COHb, red cell mass, hemoglobin, and hematocrit in the smokers. Levels of 2,3 DPG were unaltered while oxyhemoglobin affinity P50 and ATP levels were significantly lower in the smokers. The three smokers with highest red cell mass had normal arterial blood gases and one smoker had very high values of red cell mass which returned to normal after he stopped smoking. The authors interpret these data as evidence of tissue hypoxia.

Millar and Gregory (43), in a study of both fresh heparinized blood and ACD-stored blood from a blood bank, showed a reduction in the oxygen carrying capacity of up to 10 percent in the blood of cigarette smokers; this reduction persisted for the full 21-day storage life of blood bank blood.

Cole, et al. (16), in a study of pregnant women, found COHb levels in the fetus to be 1.8 times as great as those in the

simultaneously measured blood of the mother. Fetal blood was exposed to carbon monoxide in vitro, and fetal hemoglobin was found to have a shift of the oxyhemoglobin disassociation curve to the left as occurs with adult hemoglobin. The higher fetal COHb levels were attributed to the lower fetal P_{O_2} and a resultant decrease in the ability of oxygen to compete for the fetal hemoglobin. It was felt by the authors that the high COHb levels may be responsible for the lower birth weight of infants born to mothers who smoke.

Effects on Persons with Atherosclerotic Cardiovascular Disease

Aronow and Isbell (5) and Anderson, et al. (1) have shown a decrease in the mean duration of exercise before the onset of pain in patients with angina pectoris exposed to low levels of carbon monoxide (50 and 100 ppm). Carboxyhemoglobin levels were significantly elevated (2.9 percent after 50 ppm; 4.5 percent after 100 ppm) and the systolic blood pressure, heart rate, and product of systolic blood pressure times heart rate (a measure of cardiac work) were all significantly lower at onset of angina pectoris.

In a continuation of this work, Aronow, et al. (2, 3) studied eight patients during two separate cardiac catheterizations, one during which each patient smoked three cigarettes and one during which each patient inhaled carbon monoxide until the maximal coronary sinus COHb level equalled that produced by smoking during the first catheterization. All eight had angiographically demonstrated CHD (> 75 percent obstruction of at least one coronary artery). Smoking increased the systolic and diastolic blood pressure, heart rate, left ventricular end-diastolic pressure (LVEDP), and coronary sinus, arterial, and venous CO levels. No changes were noted in left ventricular contractility (dp/dt), aortic systolic ejection period, or cardiac index, and decreases were found in stroke index and coronary sinus, arterial, and venous P_{O_2} . When carbon monoxide was inhaled, increased LVEDP and coronary sinus, arterial, and venous CO levels were noted; there were no changes in systolic and diastolic blood pressure, heart rate, or systolic ejection period; and decreases in left ventricular dp/dt, stroke index, cardiac index and coronary sinus, arterial, and venous P_{O_2} were found. These data suggest that carbon monoxide has a negative inotropic effect on myocardial tissue resulting in the decrease in contractility (dp/dt) and stroke index. When the positive effect of nicotine on contractility and heart rate is added by cigarette smoking, the net effect is increased cardiac work for the same cardiac output. In the heart with

coronary artery disease there is a greatly restricted capacity to increase blood flow in response to this increase in cardiac work. The result is early cardiac decompensation manifested by elevation in LVEDP and angina pectoris.

Aronow, et al. have also shown decreased exercise time prior to onset of angina pectoris in persons exercised after riding for 90 minutes on the Los Angeles Freeway (4). In a related study, they demonstrated a decrease in exercise time before claudication in a group of patients with intermittent claudication who were exposed to 50 ppm CO (6).

Studies on the Pathogenesis of Cardiovascular Disease

In a review of some of their work on carbon monoxide, Astrup and Kjeldsen (7) noted that in cholesterol-fed rabbits exposed to 170 ppm carbon monoxide for 7 weeks (COHb 16 percent) and then to 340 ppm for 2 weeks, the cholesterol content of the aorta was 2.5 times higher than that of cholesterol-fed, air breathing controls. Groups of cholesterol-fed rabbits intermittently exposed to carbon monoxide for 12 or 4 hours per day produced three- to fivefold increases in the cholesterol content of their aortas. Cholesterol-fed rabbits made hypoxic at 10 and 16 percent oxygen had 3 to 3.5 times the aortic cholesterol content, while those exposed to 26 and 28 percent oxygen had a considerable decrease in cholesterol accumulation.

Theodore, et al. (58) studied the aortas of monkeys, baboons, dogs, rats, and mice fed a normal diet but exposed to very high levels of CO (COHb levels 33 percent) and found no atheromatous changes in their aortas.

Further work by Astrup and Kjeldsen (38) revealed that in rabbits fed normal diets but exposed to 180 ppm carbon monoxide for 2 weeks, there were local areas in their hearts of partial or total necrosis of myofibrils; in the arteries there was endothelial swelling, formation of subendothelial edema, and degeneration of the myocytes. When the aortas of these rabbits were examined (37), the luminal coats showed pronounced changes characterized by severe edematous reaction with extensive swelling and formation of subendothelial blisters and plaques. The authors postulate that carbon monoxide increases endothelial permeability to albumin which results in formation of edema leading to changes indistinguishable from early atherosclerosis.

Evidence that this mechanism may occur in humans is provided by the findings of Parving (50) who showed an increased transcapillary escape rate for ^{131}I -labeled albumin in humans exposed to .43 percent CO (COHb 20 percent) for 3 to 5 hours, but not in those made hypoxic to an altitude of 4300 meters (hemoglobin 75 percent saturated).

By exposing rabbits to different concentrations of carbon monoxide (50, 100, and 180 ppm) for varying periods (.5, 2, 4, 8, 24, and 48 hours), Thomsen and Kjeldsen (59) were able to show a threshold of 100 ppm of CO for myocardial damage. The demonstration of damage at this level of CO (COHb 8-10 percent) is possibly explained by the ratio of carboxymyoglobin to carboxyhemoglobin which is about 3 to 1 in myocardium at ambient Po_2 . Thus, a COHb level of 10 percent would be accompanied by a carboxymyoglobin level of 30 percent in heart muscle. This ratio is even greater under hypoxic conditions with a ratio of 6 to 1 when the arterial Po_2 is below 40 mm Hg (15).

Nicotine

In a study of the effects of smoking cigarettes with low and high nicotine content, Hill and Wynder (30) noted increasing serum epinephrine levels with increasing nicotine content of the smoke, but serum norepinephrine levels were unchanged. However, increasing serum epinephrine levels with increasing number of low nicotine content cigarettes smoked were also noted.

Acrolein

Egle and Hudgins (21) did inhalation studies with acrolein on rats. Inhalation of this aldehyde at concentrations below those encountered in cigarette smoke resulted in a significant increase in blood pressure and heart rate in rats.

CEREBROVASCULAR DISEASE

There has been conflicting evidence on whether there is an increased risk of cerebrovascular disease due to smoking (61, 62, 63, 64, 65, 66, 67, 68). A prospective study by Paffenbarger, et al. (48) of 3,991 longshoremen followed for 18 years showed no correlation between fatal strokes and smoking. However, both the Dorn study of

U.S. veterans (33) and Hammond's study of one million men and women (25) showed a small but significant increase in the death rates from cerebrovascular disease among cigarette smokers. The Framingham 18-year followup of men ages 45 to 54 (42) and Paffenbarger's study of men who entered Harvard between 1916 and 1940 (49) also showed an excess risk of cerebrovascular disease associated with cigarette smoking.

Two recent studies provided more data on this topic. Ostfeld, et al. (46, 47), in a study of 2,748 people ages 65-74 receiving old age assistance in Cook County, Illinois, were unable to find any relation between cigarette smoking habits at the start of the study and incidence of new strokes or prevalence of transient ischemic attacks. Nomura, et al. (44), in a study of the population of Washington County, Maryland, ages 25 and older, were unable to find any relation between cigarette smoking and either mortality or morbidity from stroke. Nomura noted that "in atherosclerotic strokes the Framingham study and Paffenbarger's investigation of former college students included a great percentage of stroke cases under the age of 55. Because these two studies found an association between cigarette smoking and atherosclerotic strokes and the present study did not, it may be that the association is age-dependent."

Hammond (25) provides some data which may clarify this relationship. Analysis of his data shows that the difference between cerebrovascular death rates in cigarette smokers and nonsmokers increases as persons get older except in males ages 75-84 (Table 7), indicating that the excess death rates associated with cigarette smoking increase with advancing age. The ratio of the death rates for smokers and nonsmokers (mortality ratio), however, decreases with age, reflecting the fact that cerebrovascular disease death rates attributable to other causes increase with age more rapidly than death rates attributable to smoking. Cigarette smoking may well be a risk factor for stroke at all ages, but other causes of strokes become proportionally so important in older age groups that in studies not based on very large populations the risk due to cigarette smoking is masked by the large total number of strokes due to other causes.

TABLE 7. — Age-standardized deaths rates and mortality ratios for cerebral vascular lesions for men and women by type of smoking (lifetime history) and age at start of study

Type of Smoking	Age Groups			
	45-54	55-64	65-74	75-84
CVL Death Rates per 100,000 Person-Years				
Men				
Never smoked regularly	28	92	349	1,358
Pipe, cigar	25	100	369	1,371
Cigarette and other	28	129	361	990
Cigarette only	42	130	477	1,168
Total	35	116	391	1,272
Women				
Never smoked regularly	18	57	228	1,082
Cigarette	38	88	315	1,277
Total	25	64	238	1,091
CVL Mortality Ratios				
Men				
Never smoked regularly	1.00	1.00	1.00	1.00
Pipe, cigar	0.89	1.09	1.06	1.01
Cigarette and other	1.00	1.40	1.03	0.73
Cigarette only	1.50	1.41	1.37	0.86
Women				
Never smoked regularly	1.00	1.00	1.00	1.00
Cigarette	2.11	1.54	1.38	1.18

NOTE. — CVL = Cerebral vascular lesions.
Source: Hammond, E.C. (25).

EFFECTS OF SMOKING ON THE COAGULATION SYSTEM

Several studies have contributed to an understanding of the role of smoking in thrombogenesis. Levine (41), in a controlled double blind study, showed that smoking a single cigarette increased the platelet's response to a standard aggregating stimulus (ADP). This phenomenon did not occur when lettuce leaf cigarettes were smoked and was independent of a rise in free fatty acids in the plasma. The author postulates that this may be due to increasing epinephrine levels.

These data may have relevance for two other studies. In the clinical trial of the possible prevention of heart attack by hyperlipidemic drugs in Newcastle, England, (19) it was found that cigarette smokers were at increased risk of sudden death. This increased risk was not present in smokers treated with clofibrate. However, the researchers were unable to relate this reduction in risk to any effect of clofibrate on serum lipids. Recently Carvalho, et al. (14) evaluated 29 patients with familial hyperbetalipoproteinemia and noted that their platelets had an increased sensitivity to aggregating stimuli (ADP). Treatment with clofibrate returned the ADP sensitivity to normal without significantly altering serum lipids. This demonstrated effect of clofibrate may provide some insight into the Newcastle study. The reduction in the excess risk of sudden death could be due to a clofibrate induced reversal of increased sensitivity to aggregating stimuli produced by smoking.

SUMMARY OF RECENT CARDIOVASCULAR FINDINGS

1. Data from one recent incidence study suggest that cigarette smokers are more likely to develop hypertension than are nonsmokers. There is some evidence that suggests that stopping smoking may be accompanied by a rise in blood pressure.

2. Cigarette smoking has been shown to be the major source of elevated carboxyhemoglobin levels, with occupational exposure and air pollution being far less important in most circumstances. Carboxyhemoglobin levels in cigarette smokers are two to three times the levels in nonsmokers and increase with the amounts smoked.

3. Elevated carboxyhemoglobin levels have been shown to decrease maximal oxygen uptake in healthy people as well as to decrease the exercise tolerance of persons with angina pectoris and intermittent claudication. The carboxyhemoglobin levels at which these effects take place are well within the range produced by cigarette smoking.

4. Carbon monoxide at levels of exposure commonly reached by cigarette smokers has been shown to decrease cardiac contractility in persons with coronary heart disease.

5. Carbon monoxide has been shown to produce changes like those of early atherosclerosis in the aortas of rabbits.

BIBLIOGRAPHY

- 1 ANDERSON, E. W., ANDELMAN, R. J., STRAUCH, J. M., FORTUIN, N. J., KNELSON, J. H. Effect of low level carbon monoxide exposure on onset and duration of angina pectoris. A study of ten patients with ischemic heart disease. *Annals of Internal Medicine* 79(1):46-50, July 1973.
- 2 ARONOW, W. S., CASSIDY, J., VANGROW, J. S., MARCH, H., KERN, J. C., GOLDSMITH, J. R., KHEMKA, M., PAGANO, J., VAWTER, M. Effect of cigarette smoking and breathing carbon monoxide on cardiovascular hemodynamics in anginal patients. *Circulation* 50(2):340-347, August 1974.
- 3 ARONOW, W. S., GOLDSMITH, J. R., KERN, J. C., JOHNSON, L. L. Effect of smoking cigarettes on cardiovascular hemodynamics. *Archives of Environmental Health* 28(6): 330-332, June 1974.
- 4 ARONOW, W. S., HARRIS, C. N., ISBELL, M. W., ROKAW, S. N., IMPARATO, B. Effect of freeway travel on angina pectoris. *Annals of Internal Medicine* 77(5): 669-676, November 1972.
- 5 ARONOW, W. S., ISBELL, M. W. Carbon monoxide effect on exercise-induced angina pectoris. *Annals of Internal Medicine* 79(3): 392-395, September 1973.
- 6 ARONOW, W. S., STEMMER, E. A., ISBELL, M. W. Effect of carbon monoxide exposure on intermittent claudication. *Circulation* 49(3): 415-417, March 1974.
- 7 ASTRUP, P., KJELDSEN, K. Carbon monoxide, smoking, and atherosclerosis. *Medical Clinics of North America* 58(2): 323-350, March 1974.
- 8 AYERS, S. M., EVANS, R., LICHT, D., GRIESBACH, J., REIMOLD, F., FERRAND, E. F., CRISCITIELLO, A. Health effects of exposure to high concentrations of automotive emissions. Studies in bridge and tunnel workers in New York City. *Archives of Environmental Health* 27(3): 168-178, September 1973.
- 9 BENGTTSSON, C. Smoking habits in a population sample of women and in women with ischaemic heart disease. *Acta Medica Scandinavica (Supplementum 549):* 60-64, 1973.
- 10 BENGTTSSON, C. Prevalence of multiple "risk factors" for ischaemic heart disease in women with and without known ischaemic heart disease. *Acta Medica Scandinavica (Supplementum 549):* 97-105, 1973.
- 11 BOKHOVEN, C., NIESSEN, H. J. Amounts of oxides of nitrogen and carbon monoxide in cigarette smoke, with and without inhalation. *Nature* 192(4801): 458-459, November 4, 1961.
- 12 BOSTON COLLABORATIVE DRUG SURVEILLANCE PROGRAM. Coffee drinking and acute myocardial infarction. *Lancet* 2(7790): 1278-1281, December 16, 1972.
- 13 BUCHWALD, H. Exposure of garage and service station operatives to carbon monoxide: A survey based on carboxyhemoglobin levels. *American Industrial Hygiene Association Journal* 30(6): 570-575, November-December 1969.
- 14 CARVALHO, A. C. A., COLMAN, R. W., LEES, R. S. Clofibrate reversal of platelet hypersensitivity in hyperbetalipoproteinemia. *Circulation* 50(3): 570-574, September 1974.
- 15 COBURN, R. F. The carbon monoxide body stores. *Annals of the New York Academy of Sciences* 174:11-22, October 5, 1970.

- 16 COLE, P. V., HAWKINS, L. H., ROBERTS, D. Smoking during pregnancy and its effects on the fetus. *Journal of Obstetrics and Gynaecology of the British Commonwealth* 79(9): 782-787, September 1972.
- 17 CORONARY DRUG PROJECT RESEARCH GROUP. Factors influencing long-term prognosis after recovery from myocardial infarction— Three-year findings of the coronary drug project. *Journal of Chronic Diseases* 27(6): 267-285, August 1974.
- 18 DAWBER, T. R., KANNEL, W. B., GORDON, T. Coffee and cardiovascular disease. Observations from the Framingham Study. *New England Journal of Medicine* 291(17): 871-874, October 24, 1974.
- 19 DEWAR, H. A. Trial of clofibrate in the treatment of ischaemic heart disease. Five-year study by a group of physicians of the Newcastle upon Tyne Region. *British Medical Journal* 4 (5790): 767-775, December 25, 1971.
- 20 DRINKWATER, B. L., RAVEN, P. B., HORVATH, S. M., GLINER, J. A., RUHLING, R. O., BOLDUAN, N. W., TAGUCHI, S. Air pollution, exercise, and heat stress. *Archives of Environmental Health* 28(4): 177-181, April 1974.
- 21 EGLE, J. L., Jr., HUDGINS, P. M. Dose-dependent sympathomimetic and cardio-inhibitory effects of acrolein and formaldehyde in the anesthetized rat. *Toxicology and Applied Pharmacology* 28: 358-366, 1974.
- 22 EKBLUM, B., HUOT, R. Response to submaximal and maximal exercise at different levels of carboxyhemoglobin. *Acta Physiologica Scandinavica* 86(4): 474-482, December 1972.
- 23 FRIBERG, L., CEDARLOF, R., LORICH, U., LUNDMAN, T., DEFAIRE, U. Mortality in twins in relation to smoking habits and alcohol problems. *Archives of Environmental Health* 27(5): 294-304, November 1973.
- 24 GYNTELBERG, F., MEYER, J. Relationship between blood pressure and physical fitness, smoking and alcohol consumption in Copenhagen males aged 40-59. *Acta Medica Scandinavica* 195(5): 375-380, May 1974.
- 25 HAMMOND, E. C. Smoking in relation to the death rates of one million men and women. *In: Haenszel, W. (Editor). Epidemiological Approaches to the Study of Cancer and Other Chronic Diseases.* Bethesda, Md., U.S. Public Health Service, National Cancer Institute Monograph No. 19, January 1966, pp. 127-204.
- 26 HELMERS, C. Prognosis for the first day after admission. *Acta Medica Scandinavica (Supplementum 555):* 14-26, 1974.
- 27 HELMERS, C. Prognosis for the hospital period from the second day after admission. *Acta Medica Scandinavica (Supplementum 555):* 31-41, 1974.
- 28 HELMERS, C. Long-term prognosis. *Acta Medica Scandinavica (Supplementum 555):* 54-65, 1974.
- 29 HEYDEN, S., BARTEL, A., CASSEL, J. C., HAMES, C. G., TYROLER, H. A., MEIER, R. Kaffeekonsum Gefässerkrankungen und Risikofaktoren in der Evans-County/Georgia-Studie. (Coffee consumption, vascular diseases, and risk factors in the Evans County, Georgia, study.) *Zeitschrift für Ernährungswissenschaft (Supplement 14):* 1-10, 1972.
- 30 HILL, P., WYNDER, E. L. Smoking and cardiovascular disease. Effect of nicotine on the serum epinephrine and corticoids. *American Heart Journal* 87(4): 491-496, April 1974.

- 31 INTERSOCIETY COMMISSION FOR HEART DISEASE RESOURCES. Atherosclerosis Study Group and Epidemiology Study Group. Primary prevention of the atherosclerotic diseases. *Circulation* 42(6): A-54-A-95, December 1970.
- 32 JONES, R. D., COMMINS, B. T., CERNIK, A. A. Blood lead and carboxyhemoglobin levels in London taxi drivers. *Lancet* 2(7772): 302-303, August 12, 1972.
- 33 KAHN, H. A. The Dorn study of smoking and mortality among U.S. veterans: Report on 8½ years of observation. *In*: Haenszel, W. (Editor). *Epidemiological Approaches to the Study of Cancer and Other Chronic Diseases*. Bethesda, Md., U.S. Public Health Service, National Cancer Institute Monograph No. 19, January 1966, pp. 1-125.
- 34 KAHN, H. A., MEDALIE, J. H., NEUFELD, H. N., RISS, E., GOLDBOURT, U. The incidence of hypertension and associated factors: The Israel ischemic heart disease study. *American Heart Journal* 84(2): 171-182, August 1972.
- 35 KAHN, A., RUTLEDGE, R. B., DAVIS, G. L., ALTES, J. A., GANTNER, G. E., THORNTON, C. A., WALLACE, N. D. Carboxyhemoglobin sources in the Metropolitan St. Louis population. *Archives of Environmental Health* 29(3): 127-135, September 1974.
- 36 KESTELOOT, H., VAN HOUTE, O. An epidemiologic survey of arterial blood pressure in a large male population group. *American Journal of Epidemiology* 99(1): 14-29, January 1974.
- 37 KJELDEN, K., ASTRUP, P., WANSTRUP, J. Ultrastructural intimal changes in the rabbit aorta after a moderate carbon monoxide exposure. *Atherosclerosis* 16(1): 67-82, July-August 1972.
- 38 KJELDEN, K., THOMSEN, H. K., ASTRUP, P. Effects of carbon monoxide on myocardium. Ultrastructural changes in rabbits after moderate, chronic exposure. *Circulation Research* 34(3): 339-348, March 1974.
- 39 KLATSKY, A. L., FRIEDMAN, G. D., SIEGELAUB, A. B. Coffee drinking prior to acute myocardial infarction. *Journal of the American Medical Association* 226(5): 540-543, October 29, 1973.
- 40 LANDAW, S. A. The effects of cigarette smoking on total body burden and excretion rates of carbon monoxide. *Journal of Occupational Medicine* 15(3): 231-235, March 1973.
- 41 LEVINE, P. H. An acute effect of cigarette smoking on platelet function. A possible link between smoking and arterial thrombosis. *Circulation* 48(3): 619-623, September 1973.
- 42 MCGEE, D. Section 28. The probability of developing certain cardiovascular diseases in eight years at specified values of some characteristics. *In*: Kannel, W. B., Gordon, T. (Editors). *The Framingham Study: An epidemiological investigation of cardiovascular disease*. U.S. Department of Health, Education, and Welfare, Public Health Service, National Institutes of Health, Publication No. (NIH) 74-618, May 1973, 152 pp.
- 43 MILLAR, R. A., GREGORY, I. C. Reduced oxygen content in equilibrated fresh heparinized and ACD-stored blood from cigarette smokers. *British Journal of Anaesthesia* 44(10): 1015-1019, October 1972.
- 44 NOMURA, A., COMSTOCK, G. W., KULLER, L. TONASCIA, J. A. Cigarette smoking and strokes. *Stroke* 5(4):483-486, July-August 1974.

- 45 OSBORNE, J. S., ADAMEK, S., HOBBS, M. E. Some components of gas phase of cigarette smoke. *Analytical Chemistry* 28(2): 211-215, February 1956.
- 46 OSTFELD, A. M., SHEKELLE, R. B., KLAWANS, H. L. Transient ischemic attacks and risk of stroke in an elderly poor population. *Stroke* 4(6): 980-986, November-December 1973.
- 47 OSTFELD, A. M., SHEKELLE, R. B., KLAWANS, H., TUFO, H. M. Epidemiology of stroke in an elderly welfare population. *American Journal of Public Health* 64(5): 450-458, May 1974.
- 48 PAFFENBARGER, R. S., Jr. Factors predisposing to fatal stroke in longshoremen. *Preventive Medicine* 1(4): 522-528, December 1972.
- 49 PAFFENBARGER, R. S., Jr., WING, A. L. Chronic disease in former college students, XI. Early precursors of nonfatal stroke. *American Journal of Epidemiology* 94(6): 524-530, December 1971.
- 50 PARVING, H. -H. The effect of hypoxia and carbon monoxide exposure on plasma volume and capillary permeability to albumin. *Scandinavian Journal of Clinical and Laboratory Investigation* 30(1): 49-56, September 1972.
- 51 RAVEN, P. B., DRINKWATER, B. L., RUHLING, R. O., BOLDUAN, N., TAGUCHI, S., GLINER, J., HORVATH, S. M. Effect of carbon monoxide and peroxyacetyl nitrate on man's maximal aerobic capacity. *Journal of Applied Physiology* 36(3): 288-293, March 1974.
- 52 REYNERTSON, R. H., TZAGOURNIS, M. Clinical and metabolic characteristics. Effects on mortality in coronary disease. *Archives of Internal Medicine* 132(5): 649-653, November 1973.
- 53 RUSSELL, M. A. H. Blood carboxyhaemoglobin changes during tobacco smoking. *Postgraduate Medical Journal* 49(576): 684-687, October 1973.
- 54 SAGONE, A. L., Jr., LAWRENCE, T., BALCERZAK, S. P. Effect of smoking on tissue oxygen supply. *Blood* 41(6): 845-851, June 1973.
- 55 SELTZER, C. C. Effect of smoking on blood pressure. *American Heart Journal* 87(5): 558-564, May 1974.
- 56 SHEPHARD, R. J. The influence of small doses of carbon monoxide upon heart rate. *Respiration* 29(5/6): 516-521, 1972.
- 57 STEWART, R. D., BARETTA, E. D., PLATTE, L. R., STEWART, E. B., KALBFLEISCH, J. H., VAN YSERLOO, B., RIMM, A. A. Carboxyhemoglobin levels in American blood donors. *Journal of the American Medical Association* 229(9): 1187-1195, August 26, 1974.
- 58 THEODORE, J., O'DONNELL, R. D., BACK, K. C. Toxicological evaluation of carbon monoxide in humans and other mammalian species. *Journal of Occupational Medicine* 13(5): 242-255, May 1971.
- 59 THOMSEN, H. K., KJELDSEN, K. Threshold limit for carbon monoxide-induced myocardial damage. An electron microscopic study in rabbits. *Archives of Environmental Health* 29(2): 73-78, August 1974.
- 50 TORBATI, I. D., HAR-KEDAR, I., BEN-DAVID, A. Carboxyhemoglobin levels in blood donors in relation to cigarette smoking and to occupational exposure to carbon monoxide. *Israel Journal of Medical Sciences* 10(3): 241-244, March 1974.

- 61 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.
- 62 U.S. PUBLIC HEALTH SERVICE. The Health Consequences of Smoking. A Public Health Service Review: 1967. U.S. Department of Health, Education, and Welfare. Washington, Public Health Service Publication No. 1696, Revised January 1968, 227 pp.
- 63 U.S. PUBLIC HEALTH SERVICE. The Health Consequences of Smoking. 1968. Supplement to the 1967 Public Health Service Review. U.S. Department of Health, Education, and Welfare. Washington, Public Health Service Publication 1696, 1968, 117 pp.
- 64 U.S. PUBLIC HEALTH SERVICE. The Health Consequences of Smoking 1969. Supplement to the 1967 Public Health Service Review. U.S. Department of Health, Education, and Welfare. Washington, Public Health Service Publication 1696-2, 1969, 98 pp.
- 65 U.S. PUBLIC HEALTH SERVICE. The Health Consequences of Smoking. A Report of the Surgeon General: 1971. U.S. Department of Health, Education, and Welfare. Washington, DHEW Publication No. (HSM) 71-7513, 1971, 458 pp.
- 66 U.S. PUBLIC HEALTH SERVICE. The Health Consequences of Smoking. A Report of the Surgeon General: 1972. U.S. Department of Health, Education, and Welfare. Washington, DHEW Publication No. (HSM) 72-6516, 1972, 158 pp.
- 67 U.S. PUBLIC HEALTH SERVICE. The Health Consequences of Smoking: 1973. U.S. Department of Health, Education, and Welfare. Washington, DHEW Publication No. (HSM) 73-8704, 1973, 249 pp.
- 68 U.S. PUBLIC HEALTH SERVICE. The Health Consequences of Smoking: 1974. U.S. Department of Health, Education, and Welfare. Washington, DHEW Publication No. (CDC) 74-8704, 1974, 124 pp.
- 69 VEDIN, J. A., WILHELMSSON, C. E., WILHELMSEN, L., BJURE, J., EKSTROM-JODAL, B. Relation of resting and exercise-induced ectopic beats to other ischemic manifestations and to coronary risk factors. Men born in 1913. *American Journal of Cardiology* 30(1): 25-31, July 11, 1972.
- 70 WALLACE, N. D., DAVIS, G. L., RUTLEDGE, R. B., KAHN, A. Smoking and carboxyhemoglobin in the St. Louis Metropolitan population. Theoretical and empirical considerations. *Archives of Environmental Health* 29(3): 136-142, September 1974.

CHAPTER 2
Cancer

CHAPTER 2

Cancer

CONTENTS

	<i>Page</i>
Introduction	43
Lung Cancer	44
Epidemiologic Studies	44
Smoking and Air Pollution	44
Exfoliative Cytology	47
Experimental Carcinogenicity	48
Carcinogens in Cigarette Smoke	48
Asbestos	49
Infection and Carcinogenicity	49
Other Cancers	50
Oral and Laryngeal Cancer	50
Genitourinary Cancer	50
Nasopharyngeal Cancer	50
Aryl Hydrocarbon Hydroxylase (AHH)	50
Summary of Recent Cancer Findings	54
Bibliography	55

List of Figures

	<i>Page</i>
Figure 1.—Production of aryl hydrocarbon hydroxylase (AHH) in macrophages from one person in response to cigarette smoking	52

List of Tables

	<i>Page</i>
Table 1.—Distribution by type of lung cancers in a composite series of nonsmokers and a representative hospital series	45
Table 2.—Distribution by type of lung cancer in populations with specific occupational exposures	46
Table 3.—Aryl hydrocarbon hydroxylase (AHH) inducibility in patients with lung cancer, with other tumors, and in healthy controls	53

INTRODUCTION

The major relationships between smoking and various cancers have been documented in previous reports on the health consequences of smoking (18, 19, 20, 21, 22, 23, 24, 25). Based on evaluations of detailed epidemiologic, clinical, autopsy, and experimental data accumulated over the last 30 years, cigarette smoking has been clearly identified as a causative factor for lung cancer. The risk of developing lung cancer increases directly with increasing cigarette smoke exposure as measured by number of cigarettes smoked per day, total lifetime number of cigarettes smoked, number of years of smoking, age at initiation of smoking, and depth of inhalation. Lung cancer death rates for women are lower than for men but have increased dramatically over the last 15 years coincident with the increasing number of women smokers. This increase has occurred in spite of the fact that women smokers use fewer cigarettes per day, more frequently choose cigarettes with filter tips and low tar and nicotine delivery, and tend to inhale less than men. A person who stops smoking has a decreased risk of developing lung cancer compared to the continuing smoker, but the risk remains greater than the nonsmoker's for as long as 10 to 15 years after the person stops smoking.

Cigarette smoking is a significant etiologic factor in the development of cancer of the larynx, oral cavity, pharynx, esophagus, and urinary bladder and is associated with cancer of the pancreas.

Certain occupational exposures have been found to be associated with an increased risk of dying from lung cancer. Cigarette smoking interacts with these exposures to produce a greater risk of developing lung cancer than from occupational exposure alone. Uranium mining and the asbestos industries are occupations which have only slightly increased lung cancer rates for nonsmokers but dramatically elevated rates for cigarette smokers.

Pipe and cigar smokers experience mortality rates from cancer of the oral cavity, larynx, pharynx, and esophagus approximately equal to those of cigarette smokers. Their risk of developing cancer of the lung is lower than the risk of cigarette smokers, but it is significantly above that of nonsmokers. This is probably due to the

fact that pipe, cigar, and cigarette smokers experience similar smoke exposure of the upper respiratory tract, while cigarette smokers (due to their greater tendency to inhale) have a greater exposure of their lungs to smoke than pipe or cigar smokers.

The bronchial epithelium of smokers often shows premalignant changes such as squamous metaplasia, atypical squamous metaplasia, and carcinoma *in situ*. The pathogenesis of these changes is related to the various carcinogenic and co-carcinogenic substances in cigarette smoke; the exact mechanism of these carcinogens remains under investigation.

LUNG CANCER

Epidemiologic Studies

Harris (3) has reviewed the reports of lung cancer in nonsmokers and compared them to a representative hospital series and has shown marked differences in the pathological types between the two groups (Table 1). When only nonsmokers are examined, the excess of squamous and oat cell carcinoma in men compared to women is not observed. Adenocarcinoma is by far the most common type of lung cancer in nonsmokers while squamous cell is by far the most common when smokers are included. The strength of the relationship between smoking and the development of lung cancer differs markedly with the type of lung tumor. Squamous and oat cell carcinoma are very closely related to smoking behavior while, according to this study, bronchiolar carcinoma shows no excess risk attributable to smoking. Harris also presented the percentages of different histologic types of cancer found in several industrial exposures (Table 2); these percent distribution patterns resembled those found in smokers far more closely than those found in nonsmokers.

Wynder, et al. (26), in a retrospective study of 350 lung cancer patients and hospitalized controls, noted that the relative risk of developing lung cancer was far less in those smokers who had smoked filter cigarettes for more than 10 years than in smokers of plain cigarettes (26.8 and 46.2, respectively). Even with smokers of filter cigarettes, the risk increased with increasing number of cigarettes smoked and was significantly greater than the risk of nonsmokers.

Smoking and Air Pollution

Because of the magnitude of the association between smoking and the development of epidermoid lung cancer, it is difficult to

TABLE 1. – Distribution by type of lung cancers in a composite series of nonsmokers and a representative hospital series

Type of cancer	Distribution (Percent)			
	Nonsmokers		All Patients	
	Men	Women	Men	Women
Squamous cell carcinoma	14	12	47	22
Oat cell carcinoma	4	4	17	11
Bronchiolar carcinoma	–	5	8	23
Adenocarcinoma	57	54	10	20
Large cell anaplastic carcinoma	8	8	17	19
Carcinoid	14	16	0.6	4
Other specific types	–	< 1	1	2
Undifferentiated ¹	4	2	–	–
Total number of cases	51	274	1,903	315

¹Includes oat cell carcinoma and large cell anaplastic carcinoma.

Source: Harris, C.C. (3).

TABLE 2. – *Distribution by type of lung cancer in populations with specific occupational exposures*

Type of cancer	Distribution (%) in populations with exposure to—				
	Arsenic	Nickel	Chromium	Hematite	Asbestos
Squamous cell carcinoma	40	57	48	33	44
Oat cell carcinoma	13	43	16	60	6
Adenocarcinoma	7	—	24	—	25
Oat cell or anaplastic carcinoma	40	—	—	—	24
Anaplastic	—	—	12	7	1

Source: Harris, C.C. (3).

evaluate the effects of other possible causes of lung cancer such as air pollution. Higgins (4) recently analyzed respiratory cancer mortality in Great Britain and the United States. In the United States, although the age-specific death rates for males continued to increase, the rate of increase was not as great as in the past. Female lung cancer mortality rates, by contrast, have increased steadily since about 1955. If these increases continue, the American Cancer Society estimates that lung cancer among women will move from fourth to third place in 1975 as the site responsible for the greatest number of deaths due to cancer among women (1). In England and Wales, Higgins noted that between 1940 and 1969 lung cancer rates for men declined in the age group under 55 and increased only in men over 65. After adjusting for cigarette smoking, an independent effect of air pollution was sought. It was found that the lung cancer death rates for men ages 25-64 in greater London decreased more than the rates in the rest of the country; he attributed this decrease to the greater decline in smoke pollution in London than elsewhere.

Exfoliative Cytology

Microscopic examination of respiratory epithelial cells shed into the sputum has become a useful aid in the diagnosis of lung cancer and has been employed in many lung cancer screening programs for selected high risk groups. Saccomanno, et al. (11) have conducted periodic cytologic examinations of the sputum of uranium miners and a group of nonmining controls. Many of these individuals developed abnormal squamous cell metaplasia that progressed in several cases to become invasive carcinoma. Both cigarette smoking and radiation exposure from uranium mining were associated with an increased prevalence of these cytologic changes. Of the two factors, cigarette smoking was noted to be the more important (in both miners and nonminers) for the development of atypia and carcinoma *in situ*. Neither cigarette smoking nor uranium mining could be correlated with the length of time it took for these changes to progress from one pathologic stage to the next.

Schreiber, et al. (15) studied exfoliative cytology of the lungs of hamsters treated with intratracheal injection of the carcinogen benzo(a)pyrene. They noted progression from mild atypia to squamous metaplasia, to moderate and marked atypia, to changes indicative of cancer. These cytologic changes in animals exposed to carcinogens are comparable to those found in humans who smoke cigarettes.

EXPERIMENTAL CARCINOGENICITY

Carcinogens in Cigarette Smoke

A great deal of effort has been expended to identify those substances in cigarette smoke that cause malignant changes. The hope is that, if these carcinogenic substances can be identified and removed from cigarette smoke, the risk of developing lung cancer as a result of smoking can be reduced. Carcinogenic substances which act as tumor initiators, accelerators, and promoters in experimental animal systems have been identified in cigarette smoke.

Hoffman and Wynder (6) conducted an extensive analysis of the tumorigenicity of tobacco smoke. Using the gas phase of cigarette smoke, they identified certain known carcinogens but were unable to induce carcinoma in the respiratory tract of experimental animals. They interpreted these results as indicating that the levels of carcinogens present in the gas phase alone are below the concentrations necessary for tumor activity.

In the same study, Hoffmann and Wynder examined the particulate phase of tobacco and identified several carcinogens. The majority of tumor initiators in the particulate phase were polynuclear aromatic hydrocarbons and alkylated polynuclear aromatic hydrocarbons. They found that a significant inhibition of pyrosynthesis of these substances leads to a significant reduction of the tumorigenicity of tobacco smoke. They also identified several tumor accelerators – substances which accelerate the carcinogenicity and tumor initiating activity of the polycyclic aromatic hydrocarbons. The tumor accelerators found were *trans*-4, 4'-dichlorostilbene, *N*-alkyl indoles, and *N*-alkyl carbazoles. They also reported that the tumor promoters in cigarette smoke occur in the acidic portion of the particulate matter but did not further characterize them.

Hoffmann, et al. (5) reported identifying the nitrosamine, *N*'-nitrosonornicotine, in concentrations of 1.9 to 6.6 micrograms per gram in unburned tobacco and levels of 88.6 $\mu\text{g/g}$ in one sample of finely cut chewing tobacco. This is one of the highest concentrations of an environmental nitrosamine (a family of compounds containing several organic carcinogens) yet identified; concentrations in food and drink rarely exceed 0.1 $\mu\text{g/g}$. This substance is readily extractable from tobacco by water and so would be present in high concentrations in the saliva of persons who chew

tobacco. As yet, *N*⁷-nitrosornicotine has not been established as carcinogenic, and even the known carcinogenic nitrosamines are not felt to act topically.

Asbestos

The combination of cigarette smoking and asbestos exposure has been shown to result in a particularly high risk of developing lung cancer. Selikoff, et al. (16) have shown that asbestos workers who smoke have 90 times greater risk of developing lung cancer than nonsmoking, nonexposed people. Shabad, et al. (17) recently studied the possible causes of the synergistic effect of cigarette smoke and asbestos. They studied the carcinogenic activity of different types of asbestos in the U.S.S.R. and noted that all samples of chrysotile asbestos had traces of benzo(a)pyrene (a polycyclic aromatic hydrocarbon carcinogen found in cigarette smoke). In addition, they noted that chrysotile asbestos had a high adsorption activity for benzo(a)pyrene. This was not found in the other types of asbestos tested (anthophyllite and magnesiarfvedsonite). In these animal studies, 20 percent of the rats exposed to chrysotile asbestos developed precancerous lesions; inhalation of chrysotile plus benzo(a)pyrene or of chrysotile plus cigarette smoke increased the frequency of the lesions to 57 and 38 percent, respectively. The synergism between asbestos and smoking may be the result of the adsorption of carcinogens onto asbestos, therefore prolonging their retention in the lung.

Infection and Carcinogenicity

There has been some discussion concerning the association between lung cancer and chronic bronchitis. Both diseases can be caused by cigarette smoking; however, chronic bronchitis may also influence the development of lung cancer by some independent mechanism. Schreiber, et al. (14) administered *N*-nitrosoheptamethyleneimine to germfree rats, specific-pathogen-free rats, and rats with chronic murine pneumonia. The incidence of lung neoplasms was 17 percent in germfree males, 37 percent in specific pathogen-free males, and 83 percent in infected males. An incidence of 90 to 100 percent occurred among females in all three experimental groups. They concluded that chronic respiratory infection may enhance the neoplastic response of the lungs to a systemic carcinogen.

OTHER CANCERS

Oral and Laryngeal Cancer

Schottenfeld, et al. (13) have studied the role of smoking on the development of multiple primary cancers of the upper digestive system, larynx, and lung. They followed 733 patients surviving a first primary epidermoid cancer of the oral cavity, pharynx, or larynx for 5 years. The average annual incidence for a second primary was higher in men (18.2/1000) than in women (15.4/1000). Both men and women who developed a second primary tumor had heavier tobacco exposure prior to their first cancer than those who did not develop a second malignancy. The authors were unable to show a significant relationship between smoking habits after removal of the first primary and development of a second primary. They postulate that this failure to show an association is due to the long induction period between presence of a carcinogen and occurrence of the cancer, and they expect that a relationship, if present, may become apparent after 7 or 8 years of followup.

Genitourinary Cancer

Schmauz and Cole (12) studied 43 persons with cancer of the renal pelvis or ureter and noted that smoking was only a risk factor at very high levels of consumption (over 2½ packs per day), despite its being related to cancer of the bladder at all levels of smoking. They postulate that, due to the rapid transit of urine through the renal pelvis and ureter, very high levels of exposure are required to have any effect whereas the bladder stores urine for some time and even small amounts of carcinogens in the urine may be sufficient to influence the bladder epithelium.

Nasopharyngeal Cancer

Lin, et al. (10), in a retrospective study of nasopharyngeal cancer in Taiwan using neighborhood controls, found smoking to be significantly associated with the development of nasopharyngeal carcinoma. A person smoking over 20 cigarettes per day had twice the risk of a nonsmoker of developing nasopharyngeal cancer.

ARYL HYDROCARBON HYDROXYLASE (AHH)

Due to the great variation in the amount of smoking exposure before the development of lung cancer, attempts have been made to

identify groups of people who may have a greater sensitivity to the carcinogenic effect of cigarette smoke. Interest has developed in the possibility that aryl hydrocarbon hydroxylase (AHH) may be a genetically determined enzyme that mediates such increased susceptibility to certain environmental carcinogens.

AHH is an enzyme system which metabolizes polycyclic aromatic hydrocarbons; some of the resulting metabolites are carcinogenic. It has been postulated that persons with high levels of this enzyme may be at greater risk of developing cancer from exposure to the polycyclic hydrocarbons in cigarette smoke than those with low levels.

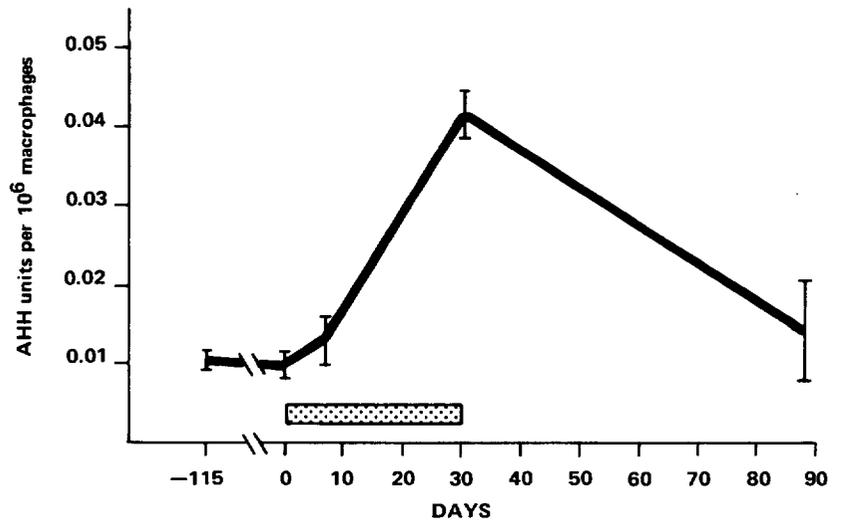
The amount of AHH produced in response to an inducing stimulus can be used to separate a population into three groups (those capable of being induced to produce high, medium, and low levels of AHH). Kellerman, et al. (8) studied the induction of AHH activity in 353 healthy subjects (67 families with 165 children). They felt that the enzyme was controlled by a single gene locus with two alleles (one able to be induced to produce high AHH levels with a gene frequency of .283 and one, to produce low levels with a gene frequency of .717). All six possible crossmatings were found in the families studied, and no deviations from the expected phenotypes were found in the children.

Cantrell, et al. (2), studied 19 healthy volunteers and found that cigarette smokers had higher levels of AHH in their pulmonary alveolar macrophages than nonsmokers. In one subject they showed an increase in AHH activity starting 1 week after he began to smoke 10 to 15 cigarettes per day (2, Fig. 1). Holt and Keast (7) also showed increased levels of AHH activity in homogenates of lung tissue from mice exposed to cigarette smoke.

Kellermann (9) also studied the inducibility of AHH in the lymphocytes of 50 patients with bronchogenic carcinoma and compared them to a healthy white population and to a group of patients with nonrespiratory malignancies (Table 3). They found that lung cancer patients had a statistically significant, higher percentage of persons homozygous for the high allele, i.e., able to be induced to high AHH levels, than either the healthy or tumor controls. They postulated that the reason for the greater frequency of persons homozygous for the high AHH inducibility allele in the lung cancer group was that this group was more susceptible to lung cancer due to their increased ability to convert polycyclic aromatic hydrocarbons into carcinogenic metabolites. The incidence of lung cancer,

however, does not show a markedly familial occurrence pattern; therefore, a single genetic locus can not be the major factor determining susceptibility. Persons with increased ability to metabolize polycyclic aromatic hydrocarbons may well be a group at increased risk of developing lung cancer if they smoke; however, prospective studies of random populations controlled for smoking and environmental factors will be necessary before this genetic susceptibility can be confirmed.

FIGURE 1.—Production of aryl hydrocarbon hydroxylase (AHH) in macrophages from one person in response to cigarette smoking



NOTE.—Shaded bar indicates duration of smoking; the vertical lines indicate the range of duplicate determinations at each time period.

Source: Cantrell, E.T., et al. (2).

TABLE 3. – Aryl hydrocarbon hydroxylase (AHH) inducibility in patients with lung cancer, with other tumors, and in healthy controls

GROUP	NUMBER IN GROUP	DISTRIBUTION OF GENOTYPES (PERCENT) ¹			GENE FREQUENCIES OF A AND B ALLELES	
		AA	AB	BB	A	B
Healthy control	85	44.7	45.9	9.4	0.676	0.324
Tumor control	46	43.5	45.6	10.9	0.663	0.337
Lung cancer	50	4.0	66.0	30.0	0.370	0.630

¹ AA = low inducibility; AB = intermediate inducibility; BB = high inducibility

Source: Kellerman, G., et al. (9).

SUMMARY OF RECENT CANCER FINDINGS

1. Filter cigarette smokers have a lower risk of developing lung cancer than nonfilter cigarette smokers, but that risk is still greater than the risk to nonsmokers and increases with increasing number of filtered cigarettes smoked.

2. Cigarette smoking and exposure to radioactivity by uranium mining have been related to cytologic changes in the respiratory tract epithelium including carcinoma *in situ*. Cigarette smoking has been more strongly related to these changes than mining exposure.

3. Crysotile asbestos has been shown to contain traces of the carcinogen benzo(a)pyrene, and the combination of the two has been shown to be a more potent carcinogen in rats than either alone.

4. Heavy smoking prior to a first primary oral or respiratory cancer has been shown to be related to the development of a second primary in the respiratory tract or oral cavity.

5. Results from one study have shown a greater proportion of lung cancer patients having high levels of aryl hydrocarbon hydroxylase activity than among either healthy persons or persons with other cancers. Persons with high levels of AHH may be a group which has a genetically determined increased risk of lung cancer if they smoke, but no excess risk if they do not smoke.

BIBLIOGRAPHY

- 1 AMERICAN CANCER SOCIETY. '75 Cancer Facts and Figures. New York, N.Y., 1974, 31 pp.
- 2 CANTRELL, E. T., MARTIN, R. R., WARR, G. A., BUSBEE, D. L., KELLERMANN, G., SHAW, C. Induction of aryl hydrocarbon hydroxylase in human pulmonary alveolar macrophages by cigarette smoking. Transactions of the Association of American Physicians, 86th Session, Atlantic City, New Jersey, May 1-2, 1973. 86: 121-130.
- 3 HARRIS, C. C. The epidemiology of different histologic types of bronchogenic carcinoma. Cancer Chemotherapy Reports 4(2, Part 3): 59-61, March 1973.
- 4 HIGGINS, I. T. T. Trends in respiratory cancer mortality: In the United States and in England and Wales. Archives of Environmental Health 28(3): 121-129, March 1974.
- 5 HOFFMANN, D., HECHT, S. S., ORNAF, R. M., WYNDER, E. L. *N*-nitrosonornicotine in tobacco. Science 186(4160): 265-267, October 18, 1974.
- 6 HOFFMANN, D., WYNDER, E. L. Chemical composition and tumorigenicity of tobacco smoke. In: Schmeltz, I. (Editor). The chemistry of tobacco and tobacco smoke. Proceedings of the symposium on the chemical composition of tobacco and tobacco smoke held during the 162nd National Meeting of the American Chemical Society in Washington, D.C., September 12-17, 1971. Plenum Press, New York, 1972, pp. 123-147.
- 7 HOLT, P. G., KEAST, D. Induction of aryl hydrocarbon hydroxylase in the lungs of mice in response to cigarette smoke. Experientia 29: 1004, August 15, 1973.
- 8 KELLERMANN, G., LUYTEN-KELLERMANN, M., SHAW, C. R. Genetic variation of aryl hydrocarbon hydroxylase in human lymphocytes. American Journal of Human Genetics 25: 327-331, 1973.
- 9 KELLERMANN, G., SHAW, C. R., LUYTEN-KELLERMANN, M. Aryl hydrocarbon hydroxylase inducibility and bronchogenic carcinoma. New England Journal of Medicine 289(18): 934-937, November 1, 1973.
- 10 LIN, T. M., CHEN, K. P., LIN, C. C., HSU, M. M., TU, S. M., CHIANG, T. C., JUNG, P. F., HIRAYAMA, T. Retrospective study on nasopharyngeal carcinoma. Journal of the National Cancer Institute 51(5): 1403-1408, November 1973.
- 11 SACCOMANNO, G., ARCHER, V. E., AUERBACH, O., SAUNDERS, R. P., BRENNAN, L. M. Development of carcinoma of the lung as reflected in exfoliated cells. Cancer 33(1): 256-270, January 1974.
- 12 SCHMAUZ, R., COLE, P. Epidemiology of cancer of the renal pelvis and ureter. Journal of the National Cancer Institute 52(5): 1431-1434, May 1974.
- 13 SCHOTTENFELD, D., GANTT, R. C., WYNDER, E. L. The role of alcohol and tobacco in multiple primary cancers of the upper digestive system, larynx, and lung: A prospective study. Preventive Medicine 3(2): 277-293, June 1974.

- 14 SCHREIBER, H., NETTESHEIM, P., LIJINSKY, W., RICHTER, C. B., WALBURG, H. E., Jr. Induction of lung cancer in germ-free specific-pathogen-free, and infected rats by *N*-nitrosoheptamethyleneimine: Enhancement by respiratory infection. *Journal of the National Cancer Institute* 49(4): 1107-1114, October 1972.
- 15 SCHREIBER, H., SACCOMANNO, G., MARTIN .D. H., BRENNAN, L. Sequential cytological changes during development of respiratory tract tumors induced in hamsters by benzo(a)pyrene-ferric oxide. *Cancer Research* 34(4): 689-698, April 1974.
- 16 SELIKOFF, I. J., HAMMOND, E. C., CHURG, J. Mortality experiences of asbestos insulation workers 1943-1968. *Pneumoconiosis. Proceedings of the International Conference on Pneumoconiosis, 3d, Johannesburg, 1969.* Oxford University Press, New York, 1970. Pp. 180-186.
- 17 SHABAD, L. M., PYLEV, L. N., KRIVOSHEEVA, L. V., KULAGINA, T. F., NEMENKO, B. A. Experimental studies on asbestos carcinogenicity. *Journal of the National Cancer Institute* 52(4): 1175-1187, April 1974.
- 18 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.
- 19 U.S. PUBLIC HEALTH SERVICE. *The Health Consequences of Smoking. A Public Health Service Review: 1967.* U.S. Department of Health, Education, and Welfare. Washington, Public Health Service Publication No. 1696, Revised January 1968, 227 pp.
- 20 U.S. PUBLIC HEALTH SERVICE. *The Health Consequences of Smoking. 1968. Supplement to the 1967 Public Health Service Review.* U.S. Department of Health, Education, and Welfare. Washington, Public Health Service Publication 1696, 1968, 117 pp.
- 21 U.S. PUBLIC HEALTH SERVICE. *The Health Consequences of Smoking. 1969. Supplement to the 1967 Public Health Service Review.* U.S. Department of Health, Education, and Welfare. Washington, Public Health Service Publication 1696-2, 1969, 98 pp.
- 22 U.S. PUBLIC HEALTH SERVICE. *The Health Consequences of Smoking. A Report of the Surgeon General: 1971.* U.S. Department of Health, Education, and Welfare. Washington, DHEW Publication No. (HSM) 71-7513, 1971, 458 pp.
- 23 U.S. PUBLIC HEALTH SERVICE. *The Health Consequences of Smoking: A Report of the Surgeon General: 1972.* U.S. Department of Health, Education, and Welfare. Washington, DHEW Publication No. (HSM) 72-6516, 1972, 158 pp.
- 24 U.S. PUBLIC HEALTH SERVICE. *The Health Consequences of Smoking: 1973.* U.S. Department of Health, Education, and Welfare. Washington, DHEW Publication No. (HSM) 73-8704, 1973, 249 pp.
- 25 U.S. PUBLIC HEALTH SERVICE. *The Health Consequences of Smoking: 1974.* U.S. Department of Health, Education, and Welfare. Washington, DHEW Publication No. (CDC) 74-8704, 1974, 124 pp.
- 26 WYNDER, E. L., MABUCHI, K., BEATTIE, E. J., Jr. The epidemiology of lung cancer. *Journal of the American Medical Association* 213(13): 2221-2228, September 28, 1970.

CHAPTER 3

Non-Neoplastic Bronchopulmonary Diseases

CHAPTER 3

Non-Neoplastic Bronchopulmonary Diseases _____

Contents

	<i>Page</i>
Introduction	61
Smoking and Respiratory Morbidity	62
Smoking and Air Pollution	63
Smoking and Occupational Disease	68
Mill Workers – Byssinosis	68
Firemen	68
Smoking and Pulmonary Function Tests	71
α_1 -Antitrypsin	72
Autopsy and Pathophysiologic Studies	74
Autopsy Studies	74
Pathophysiologic Studies in Humans	76
Pathophysiologic Studies in Animals	77
Summary of Recent Bronchopulmonary Findings	78
Bibliography	79

List of Figures

	<i>Page</i>
Figure 1.—Respiratory bronchiolitis in smokers and control groups	77

List of Tables

	<i>Page</i>
Table 1.—Levels of sulfur dioxide (SO ₂) and total suspended particulates (TSP) in four Utah communities, 1971, and in five Rocky Mountain communities, 1970	65
Table 2.—Mean annual levels of sulfur dioxide (SO ₂) and total suspended particulates (TSP) in four areas	66
Table 3.—Age-adjusted percentage of cigarette smokers and nonsmokers in each race-sex group responding positively to exposure to chemicals, fumes, sprays, and dusts	69-70
Table 4.—The α_1 -antitrypsin levels and frequency of protease inhibitor (Pi) phenotypes in healthy populations	73
Table 5.—Means of the numerical values given lung sections at autopsy of male current smokers and nonsmokers, standardized for age	75
Table 6.—Means of the numerical values given lung sections at autopsy of female current smokers and nonsmokers, standardized for age	75
Table 7.—Means of the numerical values given lung sections at autopsy of male former cigarette smokers, standardized for age	76

INTRODUCTION

Chronic non-neoplastic lung diseases are major causes of permanent and temporary disability in the United States. Chronic obstructive pulmonary disease (COPD) is the largest subgroup of these diseases and in this report refers to chronic bronchitis and/or emphysema. Relationships between smoking and non-neoplastic lung diseases have been reviewed in previous reports on the health consequences of smoking (36, 37, 38, 39, 40, 41, 42, 43).

Cigarette smoking is the most important cause of COPD. Cigarette smokers have higher death rates from chronic bronchitis and emphysema, more frequently report symptoms of pulmonary disease, and have poorer performance on pulmonary function tests than do nonsmokers. These differences become even more marked as the number of cigarettes smoked increases. The relationship between cigarette smoking and COPD has been demonstrated in many different national and ethnic groups and is more striking in men than in women. Pipe and cigar smokers have higher morbidity and mortality rates from COPD than do nonsmokers but are at lower risk than cigarette smokers. Cessation of cigarette smoking often results in improved pulmonary function tests, decreased pulmonary symptoms, and reduced COPD mortality rates.

In addition to an increased risk of COPD, cigarette smokers are more frequently subject to and require longer convalescence from other respiratory infections than nonsmokers. Also, if they require surgery, they are more likely to develop postoperative respiratory complications.

The relative importance of air pollution in the development of COPD remains controversial, but it is clearly less significant under most circumstances than cigarette smoking. The combination of cigarette smoking and polluted air, however, may produce higher rates of COPD than either factor alone.

Several occupational exposure groups incur an increased risk of COPD, and cigarette smoking adds significantly to this risk. In particular, exposure to cotton fiber and coal dust appears to act in concert with cigarette smoking to promote the development of pulmonary disease.

Autopsy studies have demonstrated a dose-related effect of cigarette smoking on the severity of macroscopic emphysema. Increased goblet cell density, alveolar septal rupture, bronchial epithelial thickening, and mucous gland hypertrophy are more commonly found in the lungs of smokers than in those of nonsmokers.

Many pathophysiologic mechanisms by which smoking may cause COPD have been proposed. Decreased overall pulmonary clearance, reduced ciliary motion, and impaired alveolar macrophage functions have all been related to cigarette smoking and probably play a role in the development of COPD. The exact mechanisms whereby cigarette smoking contributes to the development of COPD, however, remain only partially understood.

SMOKING AND RESPIRATORY MORBIDITY

An increased prevalence of respiratory symptoms in smokers from early teens to those past the age of 80 has been well established. Bewley, et al. (5), in a study in Derbyshire County, England, extended these findings to include younger children. In a questionnaire study of 7,115 schoolchildren ages 10 to 11½ years, he found that 6.9 percent of the boys and 2.6 percent of the girls smoked more than one cigarette per day. The boys who smoked reported more morning cough (21.5% to 6.1%), cough during the day or night (48.0% to 20%), and cough of 3-months duration (18.0% to 4.1%) than their nonsmoking schoolmates. The percentages for the girls were similar although based on smaller numbers of smokers. As in many studies of this type, it was impossible to control for air pollution, social class, or smoking habits of the parents; nevertheless, the results suggest that cigarette smoking even in this young age group produces respiratory symptoms.

Fridy, et al. (12), in a somewhat older population (average age 25 years), examined the effect of smoking on airway function during mild viral illness. They measured closing volumes for 22 subjects (9 cigarette smokers – average age 29.1, and 13 nonsmokers – average age 25.7) before onset and at weekly intervals from the beginning of a mild respiratory illness until all symptoms had subsided. The closing volumes for smokers prior to illness were higher than those for nonsmokers, but the difference was not statistically significant. In the tests done during the illness, the smokers had a statistically significant increase in the closing volumes (from 37.0 to 45.8 percent of their total lung capacity, while nonsmokers had no change, 32.7

and 31.7 percent). Smokers remained symptomatic more than twice as long as nonsmokers (35.7 and 16.5 days, respectively), and the mean duration of pulmonary function abnormalities in smokers was 29.7 days. Nonsmokers had no change in pulmonary function tests during illness.

SMOKING AND AIR POLLUTION

The relationships among air pollution, smoking, and COPD remain controversial. Reasons for this controversy include difficulties in controlling such variables as socioeconomic class, degree of crowding, ethnic differences, and age distribution as well as determining the exact type and amount of individual pollution exposure. Measuring individual pollution exposure even within a small area is difficult since both amount and type can vary dramatically from street to street (e.g., proximity of a street to a heavily traveled expressway).

In an effort to control as many of these variables as possible, two basic approaches in study design have been tried. The first approach is to find areas where pollution levels have been well measured and then to select study populations that are as similar as possible in areas with different pollution levels. Thus, effects on a population in a low pollution area can be compared to those on a similar population in a high pollution area. The second approach is to select a population that is as uniform as possible, for example, twins, and then measure individual responses to different pollution exposures. Both approaches have drawbacks as will be evident from the following studies.

Using the first approach, the Community Health and Environmental Surveillance System of the Environmental Protection Agency (6, 11), has conducted surveys in areas with different types and levels of pollution in four different parts of the United States (Chicago, New York City, the Salt Lake Basin, and the Rocky Mountain area). Within each part of the country, the researchers identified communities of similar socioeconomic status but different pollution levels. They then administered a questionnaire through the school systems to determine the frequency of lower respiratory tract infection in the children and their families. They reported an increased incidence of lower respiratory tract illness in children in high pollution communities compared to children in low pollution communities. This difference was demonstrable only in children whose families had lived in the high pollution communities for more than 3 years. They also reported an increased prevalence of chronic bronchitis in parents

who lived in high pollution communities compared to parents from low pollution communities. They calculated the excess risk of chronic bronchitis produced by air pollution to be one-third of that produced by smoking but to be additive with smoking.

Several major problems in these surveys make it difficult to evaluate the results. The authors describe the areas as having different kinds of pollution. The Salt Lake Basin and Rocky Mountain areas were felt to be high in sulfur dioxide (SO₂) and low in total suspended particles (TSP), while New York and Chicago were high in both these pollutants. As a result, in the Salt Lake Basin and Rocky Mountain areas, communities were separated into low and high pollution communities only on the basis of their SO₂ levels. Many communities classified as low pollution communities on the basis of their SO₂ levels had higher levels of total suspended particles than the communities classified as high pollution communities by SO₂ level (Table 1). In fact, the average total suspended particles level for the low pollution communities in the Salt Lake Basin was higher than that for the high pollution communities (Table 2) in the Salt Lake Basin. These differences exemplify the difficulties of using only one pollutant as a marker of total pollution exposure.

Additional problems with these studies were the differences in socioeconomic class measurements between low and high pollution communities in some of the regions. In the Rocky Mountain area, the percentage of fathers who completed high school varied from 91 percent in one of the low communities to 58 percent in one of the high pollution communities. There were also major differences between high and low pollution communities in the percentage of families with more than one person per room in the Salt Lake Basin (59.6% to 51.2%), Rocky Mountain area (87.0% to 68.0%), and New York (85.0% to 72.0%). Residential stability (percentage of families living in the community for more than 3 years) was different in the high and low pollution communities in New York (58.0% to 36.0%) and Chicago (56.0% to 46.0%). The percentage of parents who currently smoke also differed for high and low pollution communities in New York (53% to 45% for the fathers and 47% to 37% for the mothers). These differences raise questions as to whether the high and low pollution communities were really similar enough populations to justify the claim that differences in incidence of respiratory tract illness could be attributable to differences in air pollution.

TABLE 1. – Levels of sulfur dioxide (SO₂) and total suspended particulates (TSP) in four Utah communities, 1971, and in five Rocky Mountain communities, 1970

Area	Community Pollution Classification	Pollution levels in $\mu\text{g}/\text{m}^3$	
		SO ₂	TSP
Utah (Salt Lake Basin)	Low	8	78
	Intermediate 1	15	81
	Intermediate 2	22	45
	High	62	66
Rocky Mountain Area	Low 1	10	50
	Low 2	26	68
	Low 3	46	110
	High 1	109	43
	High 2	186	102

Source: Chapman, R.S., et al. (6).

TABLE 2. – Mean annual levels of sulfur dioxide (SO₂) and total suspended particulates (TSP) in four areas

Area	Pollution levels in $\mu\text{g}/\text{m}^3$							
	SO ₂				TSP			
	During Study		Decade Preceding Study		During Study		Decade Preceding Study	
	Low	High	Low	High	Low	High	Low	High
Five Rocky Mountain Areas	10	275	10	263	45	110	50	101
Salt Lake Basin	9	65	< 20	144	78	66	82	62
New York	23	63	< 30	431	34	104	40	201
Chicago	57	106	109	250	111	151	121	165

NOTE. – Area includes highest- and lowest-polluted communities.
Source: French, J.G., et al. (11).

Increased prevalence of COPD has also been demonstrated in areas of high pollution in the Netherlands (44), Yokkaichi, Japan (25), and Cracow, Poland (30). Again, however, these studies were poorly controlled for socioeconomic status.

Several recently published studies have used the second major method of investigating the relationship between smoking, air pollution, and COPD, i.e., to select a uniform population and then to measure individual differences to pollution exposure. Comstock, et al. (8), in an attempt to control for occupational exposure and socioeconomic class, studied three separate, uniform populations of telephone workers and used as a measure of pollution the location of the place of work and residence. The populations studied were telephone installers and repairmen in Baltimore, New York City, Washington, D.C., and rural Westchester County in 1962 (survey 1) and in 1967 (survey 2); and telephone installers and repairmen in Tokyo in 1967 (survey 3). They were unable to find any relation between pulmonary symptoms and degree of urbanization of place of work or place of residence (either current or past). They were, however, able to establish a strong correlation between smoking habits and pulmonary symptoms. Given the crude estimation of pollution exposure used in this study (all workers in each city were treated as though they received the same exposure), a small difference in symptoms due to air pollution could have been missed, whereas the difference due to smoking could be detected both because it was larger and because it was possible to determine individual exposure more exactly.

Hrubec, et al. (15), in a study of twins from the U.S. Veterans Registry, were unable to show a difference in respiratory symptoms either between individuals with different exposure to air pollution or between members of twin pairs with different air pollution exposures. However, they too used a crude measure of air pollution exposure (by each zip code area), and so could have missed a small difference due to air pollution despite being able to relate respiratory symptoms to smoking, socioeconomic status, and alcohol intake.

Colley, et al. (7), in a study of 3,899 persons (20-year-olds born during the last week of March 1946 in the United Kingdom), were also unable to show a relation between COPD and air pollution. They used as their estimates of air pollution exposure the domestic coal consumption in the towns where the subjects lived. This method of estimating air pollution exposure is subject to the same limitation cited for the previous two studies – limited sensitivity to small risks due to air pollution.

In summary, if an increased risk of COPD due to air pollution exists, it is small compared to that due to cigarette smoking under conditions of air pollution to which the average person is exposed. The possibility remains that the two different kinds of exposure may interact to increase the total effect beyond that contributed by each exposure.

SMOKING AND OCCUPATIONAL DISEASE

Friedman, et al. (13), in a study of 70,289 men and women who had had Kaiser-Permanente multiphasic health checkups, noted that smokers were more likely to report occupational exposure on a questionnaire (Table 3) than nonsmokers. The differences are small but statistically significant and need to be considered when investigating the relationship of smoking to occupational diseases. They were not able to determine whether smokers' responses reflect actual differences in exposure or an increased awareness of and sensitivity to occupational exposure.

Exposure to coal and granite dust and cotton fiber carries an increased risk of COPD. This risk is further increased by cigarette smoking. Other new data have been published which clarify the risk in certain occupational groups.

Mill Workers – Byssinosis

Berry, et al. (4), in a study of 595 workers in the Lancashire cotton mills over a 3-year period, found that the decline in forced expiratory volume in one second (FEV_1) was 19 ml/year greater in smokers than in nonsmokers (59 ml/year compared to 40 ml/year, $P > .02$) but they could not demonstrate a dose-response relationship.

Firemen

Sidor and Peters (32, 33), in a cross-sectional study of 1,768 Boston firemen, were unable to show a significant relationship between severity of fire exposure and impairment of pulmonary function tests or prevalence of COPD; there was a clear harmful effect of cigarette smoking on both. They postulate that they were unable to show an increased prevalence of COPD in this cross-sectional study because firemen who developed COPD were no longer capable of meeting the physical demands of the job and had retired, thus removing them from the study population. They were able, however, to show a higher incidence of COPD in men under the age of 35 years who had been on the force more than 6 months when compared to persons of the same age who had just been hired.

TABLE 3. — Age-adjusted percentage of cigarette smokers and nonsmokers in each race-sex group responding positively to exposure to chemicals, fumes, sprays, and dusts

Exposure	Time period ¹	Smoking status	Whites		Blacks		Yellows	
			% Men	% Women	% Men	% Women	% Men	% Women
Chemicals, cleaning fluids or solvents (or chemical sprays) ²	Before 1 year ago	Smokers	24.0	6.4	26.0	11.8	16.7	4.1
		Nonsmokers	18.9	5.1	19.2	6.7	12.9	5.1
	In the past year	Smokers	12.1	3.0	14.2	5.1	13.1	3.5
		Nonsmokers	9.7	2.6	11.6	4.5	9.4	3.8
Insect or plant sprays	Before 1 year ago	Smokers	4.0	1.0	6.6	2.1	3.8	0.3
		Nonsmokers	3.5	0.9	5.1	1.9	2.5	1.0
	In the past year	Smokers	2.9	2.1	4.8	2.9	3.0	1.3
		Nonsmokers	2.9	1.8	4.8	3.0	3.6	1.8
Ammonia, chlorine, ozone or nitrous gases (nitrous oxides or other irritating gases) ²	Before 1 year ago	Smokers	7.9	2.3	10.3	4.8	6.2	0.9
		Nonsmokers	6.2	1.9	7.0	3.2	4.5	1.7
	In the past year	Smokers	5.4	1.9	7.6	3.9	8.0	0.5
		Nonsmokers	3.7	1.5	5.8	3.1	3.5	1.7
Engine or exhaust fumes (more than 2 hours a day) ²	Before 1 year ago	Smokers	11.8	1.0	17.6	1.9	4.0	0.0
		Nonsmokers	6.9	0.5	13.1	0.6	3.6	0.1
	In the past year	Smokers	8.7	0.7	17.6	1.0	4.3	0.5
		Nonsmokers	5.2	0.5	13.3	1.2	3.9	0.2

TABLE 3. — Age-adjusted percentage of cigarette smokers and nonsmokers in each race-sex group responding positively to exposure to chemical, fumes, sprays, and dusts — Continued

Exposure	Time period ¹	Smoking Status	Whites		Blacks		Yellows	
			% Men	% Women	% Men	% Women	% Men	% Women
Plastic or resin fumes	Before 1 year ago	Smokers	5.1	1.1	3.3	1.2	3.1	0.1
		Nonsmokers	3.5	0.8	3.0	0.6	2.2	0.3
	In the past year	Smokers	3.3	0.8	3.9	0.9	3.0	0.1
		Nonsmokers	2.5	0.6	4.3	0.6	1.3	0.3
Lead fumes or metal fumes (leaded sprays or paint sprays) ²	Before 1 year ago	Smokers	8.2	0.9	9.1	1.5	4.1	0.1
		Nonsmokers	4.3	0.5	5.8	0.6	2.6	0.1
	In the past year	Smokers	5.5	0.7	7.7	1.3	3.3	0.5
		Nonsmokers	3.1	0.5	6.8	0.8	2.4	0.4
Asbestos, cement or grain (or flour) dusts ²	Before 1 year ago	Smokers	7.1	0.6	11.5	1.2	2.7	0.0
		Nonsmokers	4.4	0.3	8.8	0.8	1.6	0.1
	In the past year	Smokers	2.8	0.4	7.5	1.0	2.7	0.1
		Nonsmokers	1.8	0.3	6.2	0.8	0.3	0.8
Silica, sandblasting, grinding or rock drilling dust (sand or coal) ²	Before 1 year ago	Smokers	6.9	0.6	10.5	1.3	3.5	0.3
		Nonsmokers	4.0	0.5	6.8	0.7	2.9	0.0
	In the past year	Smokers	3.9	0.5	8.0	1.0	3.3	0.4
		Nonsmokers	2.3	0.4	6.6	0.9	3.5	0.4
Total number of subjects		Smokers	14,485	16,059	2,609	2,869	654	446
		Nonsmokers	8,282	18,526	1,116	3,218	712	1,313

¹With a few slight variations, the questions were worded as follows:

Before 1 year ago: "Before 1 year ago have you ever worked in a place where you were often or daily around _____?"

In the past year: "In the past year have you worked in a place where you were often or daily around _____?"

²Material in parentheses appears in "past year" question but not in "before 1 year ago" question.

SMOKING AND PULMONARY FUNCTION TESTS

It is recognized that smokers as a group have poorer pulmonary function tests than nonsmokers. The standard pulmonary function tests generally only become abnormal late in the pathologic process of COPD and usually only after irreversible changes in the lungs have occurred. As a result, tests are needed that will identify persons at risk of developing COPD before they have irreversible loss of lung function. Standard tests of pulmonary resistance are inadequate for this purpose because they measure predominately resistance in the large airways while the first changes of COPD occur in bronchioles that are 2 mm and smaller. Small airway resistance may be measured through evaluating frequency dependent compliance, but this is often cumbersome to perform. Closing volume and maximum expiratory flow rates at 25 and 50 percent of vital capacity have the advantage of being relatively easy to perform, yet are still able to measure changes in the small airways. Closing volume is the lung volume at which the alveoli in the dependent portions of the lung begin to close, and it is usually expressed as a percent of vital capacity. Elevated closing volume is considered evidence of small airway dysfunction. Maximum expiratory flow rates at 25 and 50 percent of vital capacity measure air flow at low lung volumes where the resistance of the small airways makes up a much larger proportion of the measured resistance.

Several recently published studies contain data on small airway dysfunction in smokers. Lim (20) studied 50 smoking and 50 nonsmoking high school students and found in smokers a statistically significant reduction in the forced expiratory volume in one second when the test was started at normal end expiration (i.e., low lung volumes). Stanescu, et al. (34) noted elevated closing volumes in 16 healthy asymptomatic smokers when compared to 16 nonsmokers, but were unable to show any difference in maximum expiratory flow rates at 25 and 50 percent vital capacity. Ruff, et al. (28) studied 50 subjects ages 18 to 82 and showed increasing closing volumes with age and smoking. Martin, et al. (21), in a study of 50 subjects ages 12 to 68, found that 25 percent of the smokers had abnormal closing volumes, and Oxhoj, et al. (26) noted elevated closing volumes for 50-year-old smokers compared to nonsmokers. Dirksen, et al. (10) reported higher closing volumes in smokers and noted no change with cessation of smoking. Hoepfner, et al. (14) also showed elevated closing volumes in healthy smokers ages 16 to 61, but found these to be closely related to decreases in the static transpulmonary pressure. They postulate that the elevated closing volumes may be related to decreased elastic recoil rather than changes in small airway resistance.

The data have established the fact that a greater percentage of smokers than nonsmokers have elevated closing volumes, but the number of smokers with elevated closing volumes who will develop COPD remains to be determined.

Stebbing (35), in a further analysis of Densen's data (9) on the changes in pulmonary function test values in male postal workers and transit workers in New York City, noted significantly less decline in FEV₁ among Black smokers when compared to White smokers. This difference persisted even when corrections were made for differences in amount smoked, age at which smoking began, inhalation patterns, and smaller initial lung volumes in Blacks. Black and White nonsmokers did not differ in the rate of decline in FEV₁. By age 60 years, Blacks who smoked one pack per day had a .34 liter smaller cumulative decrease in FEV₁ than Whites who smoked the same amount.

α_1 -ANTITRYPSIN

It would be useful to identify the populations at excessive risk of developing COPD from smoking. They then might be made aware of the hazard before they develop symptomatic lung disease. Persons with α_1 -antitrypsin deficiency may be such a population.

α_1 -antitrypsin deficiency is a rare homozygous recessive genetic defect which occurs in approximately one out of every 3,600 people and results in an increased susceptibility to and premature development of COPD. There is some evidence that smoking hastens the development of COPD in these people. The heterozygous state (producing intermediate levels of the α_1 -antitrypsin in serum) is far more common than the homozygous state and is found in approximately 10 percent of the population. It is uncertain whether the heterozygous deficiency state predisposes to COPD.

α_1 -antitrypsin inheritance patterns suggest multiple codominant alleles at one gene locus, some of which (most notably the S and Z alleles) produce lower serum protease levels than the normal M-allele (Table 4). The pathophysiologic mechanism of the deficiency state is felt to be the inability to inhibit the proteases found in the granulocytes and pulmonary macrophages which go on to damage essential constituents of lung tissue. Several recent reviews of the enzyme and the clinical syndrome produced by its deficiency have been published (16, 17, 18).

TABLE 4. – The α_1 -antitrypsin levels and frequency of protease inhibitor (Pi) phenotypes in healthy populations

Protease inhibitor (Pi) type	Healthy populations	
	α_1 -antitrypsin concentration (% normal)	Expected frequency of Pi types (per 1,000 people)
MM	100	898
(FM,FF,IM,MV,MX)	100	28
MW	80	– ^a
MP	80	1
MS	80	41
(FS,IS)	80	1
MZ	60	29
(FZ)	60	1
SS	55	1
SZ	40	1
ZZ	15	< 1

^a Seen rarely in Spanish populations.
Source: Mittman, C., Lieberman, J. (22).

In most studies of patients with COPD, investigators have found an increased prevalence of the partially deficient heterozygote phenotypes when compared to healthy control populations. In the few studies not finding this relationship, only α_1 -antitrypsin levels were measured. Because α_1 -antitrypsin is an acute phase protein and increases with infection, it is difficult to separate out the partially deficient heterozygote phenotypes by measuring only α_1 -antitrypsin levels. It is necessary to identify the products of each allele electrophoretically in order to identify the deficient phenotypes.

Two recent studies using this technique showed an increased prevalence of deficient phenotypes in patients with COPD but not among control populations. Mittman, et al. (23) studied 240 patients with COPD admitted to LaVina Hospital in Altadena, California, and found that 19.1 percent had deficient phenotypes compared to only 7.1 percent of a control Scandinavian population. Keuppers and Donhardt (19) found prevalence rates for deficient phenotypes of 3.5 percent in healthy controls, 12.9 percent in persons retired from work because of COPD, and 15.7 percent in patients hospitalized for COPD.

Additional population studies have been done to determine the effect of the heterozygous state on the development of COPD. Webb, et al. (47) studied 500 persons visiting a multiphasic screening clinic in Monroe County, New York, and found that 11.6 percent had deficient phenotypes. He was unable to show differences in symptoms or in pulmonary function test values between persons with normal and deficient phenotypes. In a study of 451 randomly selected adults from the same county (31), pulmonary function studies were done on 40 deficient heterozygote phenotypes (20 MS and 20 MZ) and on normal phenotype (MM) controls matched for age, sex, and smoking habits. When total pulmonary resistance was measured by a forced oscillometric technique, the nonsmoking MZ subjects had significant impairment compared to their normal phenotype controls. All cigarette smokers, regardless of phenotype, had abnormal values.

Although the data are still inconclusive, it may well be that heterozygous deficient persons are a group at excessive risk of developing COPD especially if they smoke.

AUTOPSY AND PATHOPHYSIOLOGIC STUDIES

Autopsy Studies

Auerbach, et al. (3) have previously shown dose-related macroscopic emphysematous changes in the lungs of smokers. Now in an autopsy study (2) of 1,582 men and 388 women, they have examined microscopic lung parenchymal changes in relation to cigarette smoking. They were able to show that rupture of alveolar septa (emphysema) and fibrosis and thickening of the small arteries and arterioles are far greater in smokers than nonsmokers and increase with increasing amount smoked (Tables 5 and 6).

When these researchers examined former cigarette smokers, they found that those who had stopped more than 10 years prior to death had fewer pathologic changes than those who had stopped less than 10 years before death. But even in those who had stopped for more than 10 years, there was a greater degree of pathologic change in those who had been smoking more than one pack per day than in those who had been smoking less than one pack per day (Table 7).

Niewoehner, et al. (24), in an autopsy study of 39 men who died suddenly from various causes and who were below 40 years of age (20 nonsmokers and 19 smokers), observed a respiratory

TABLE 5. — Means of the numerical values given lung sections at autopsy of male current smokers and nonsmokers, standardized for age

	Subjects Who Never Smoked Regularly	Current Pipe or Cigar Smokers	Current Cigarette Smokers			
			< .5 Pk.	.5–1 Pk.	1–2 Pk.	> 2 Pk.
Number of Subjects	175	141	66	115	440	216
Emphysema	0.09	0.90	1.43	1.92	2.17	2.27
Fibrosis	0.40	1.88	2.78	3.73	4.06	4.28
Thickening of arterioles	0.10	1.11	1.35	1.66	1.82	1.89
Thickening of arteries	0.02	0.23	0.42	0.68	0.83	0.90

NOTE. — Numerical values were determined by rating each lung section on scales of 0–4 for emphysema and thickening of arterioles, 0–7 for fibrosis, and 0–3 for thickening of the arteries.

Source: Auerbach, O., et al. (2).

TABLE 6. — Means of the numerical values given lung sections at autopsy of female current smokers and nonsmokers, standardized for age

	Subjects Who Never Smoked Regularly	Current Cigarette Smokers	
		< 1 Pk.	≥ 1 Pk.
Number of Subjects	252	33	64
Emphysema	0.05	1.37	1.70
Fibrosis	0.37	2.89	3.46
Thickening of arterioles	0.06	1.26	1.57
Thickening of arteries	0.01	0.40	0.64

NOTE. — Numerical values were determined by rating each lung section on scales of 0–4 for emphysema and thickening of the arterioles, 0–7 for fibrosis, and 0–3 for thickening of the arteries.

Source: Auerbach, O., et al. (2).

TABLE 7. — Means of the numerical values given lung sections at autopsy of male former cigarette smokers, standardized for age

Formerly Smoked	Stopped \geq 10 yr.		Stopped < 10 yr.	
	<1 Pk.	Pk.	<1 Pk.	Pk.
Number of Subjects	35	66	51	131
Emphysema	0.24	0.70	1.08	1.69
Fibrosis	1.14	1.74	2.44	3.30
Thickening of arterioles	0.57	0.93	1.25	1.59
Thickening of arteries	0.04	0.16	0.36	0.61

NOTE. — Numerical values for each finding were determined by rating each lung section on scales of 0–4 for emphysema and thickening of the arterioles, 0–7 for fibrosis, and 0–3 for thickening of the arteries.

Source: Auerbach, O., et al. (2).

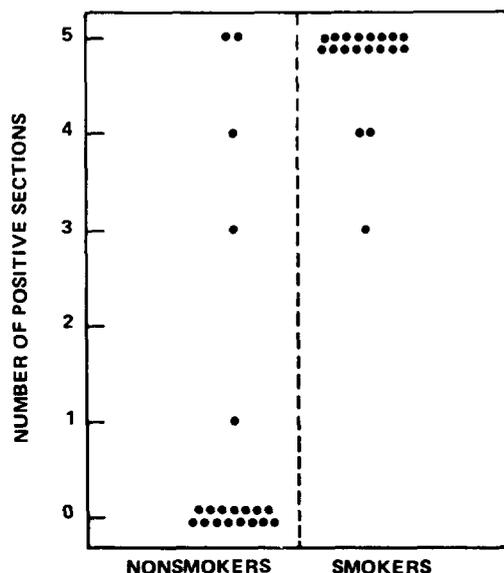
bronchiolitis associated with clusters of pigmented alveolar macrophages in the lungs of smokers. They found these changes only rarely in the lungs of nonsmokers (Fig. 1). The smokers were young (average age 25.7 years), were a heavy smoking population (average 20.1 pack years), but did not differ significantly from the nonsmokers in age, social class, or pollution exposure. However, 12 of the 19 smokers had had productive cough or frequent cold compared to only 3 of the 20 nonsmokers. These authors postulated that bronchiolitis may be responsible for the abnormalities in the tests of small airway function of smokers.

Pathophysiologic Studies in Humans

Yeager, et al. (48) showed decreased pinocytosis in human alveolar macrophages obtained from asymptomatic cigarette smoking volunteers when compared to those obtained from nonsmoking controls.

Warr and Martin (46) studied alveolar macrophages lavaged from four healthy smokers and four healthy nonsmokers. Only two members of each group were reactive to delayed hypersensitivity skin tests for *Candida albicans*. Macrophages from nonsmokers responded to Migration Inhibitory Factor (MIF) by a depression in migration of at least 30 percent, whereas macrophages from smokers did not respond to MIF. The cells from smokers were noted to migrate three times faster than those from nonsmokers. When *Candida* antigen was added to the medium, cells from the nonreactive subjects (both

FIGURE 1.—Respiratory bronchiolitis in smokers and control group



NOTE.—The position of each symbol represents the number of sections per case in which bronchiolitis was identified.

Source: Niewoehner, D.E., et al. (24).

smokers and nonsmokers) were not inhibited, the cells from the reactive nonsmokers were inhibited, but the cells from reactive smokers were not inhibited. Thus, macrophages from smokers did not respond normally to either MIF or antigenic challenge.

Pathophysiologic Studies in Animals

Roszman and Rogers (27) noted that either the nicotine or the water soluble fraction of whole cigarettes smoked suppressed the immunoglobulin response of lymphoid cell cultures. When concentrations of over 200 micrograms per milliliter of nicotine of the water soluble fraction were added, they were able to completely suppress the immunoglobulin response and to observe this suppression even in cells exposed for 2 hours prior to the antigenic challenge.

Guinea pigs (29) exposed to the smoke of five cigarettes and then lavaged 2 hours later had fewer pulmonary macrophages and leukocytes in the lavage fluid than did controls not exposed to smoke. The decrease in the number of macrophages was highly correlated with acetaldehyde, tar, nicotine, hydrogen cyanide, and

acrolein concentrations in the cigarette smoke. The decrease in the number of leukocytes was more closely correlated with pH of the particulate phase and concentrations of acetaldehyde and tar.

Tracheal mucous velocity has been shown to be decreased in purebred beagle dogs (45) exposed to 100 cigarettes per week for 13.5 months. In donkeys (1) low level exposure to whole cigarette smoke accelerated tracheobronchial clearance, whereas at intermediate and high levels of exposure, clearance was decreased. At high exposure levels whole cigarette smoke had twice the effect of filtered smoke in decreasing clearance.

SUMMARY OF RECENT BRONCHOPULMONARY FINDINGS

1. Cigarette smokers with mild viral respiratory illnesses have been shown to develop abnormal but reversible changes in certain pulmonary function tests while nonsmokers show no changes in these tests. Cigarette smokers have also been shown to have a significantly longer duration of respiratory symptoms following mild viral illness than nonsmokers.

2. Cigarette smoking is more closely related to COPD than is air pollution under the conditions of air pollution encountered by the average person. The possibility remains that the two kinds of exposure may interact to increase the total effect beyond that contributed by each exposure.

3. Cigarette smokers without respiratory symptoms have evidence of small airway dysfunction (elevated closing volumes) more frequently than do nonsmokers without respiratory symptoms.

4. Autopsy studies have shown a dose-response relationship between cigarette smoking and the microscopic changes of COPD. Data from one study indicate that bronchiolitis may be a far more common finding in cigarette smokers than in nonsmokers.

5. Pulmonary macrophages from cigarette smokers' lungs have a decreased ability to respond to in vitro antigenic stimuli as compared to macrophages from smokers.

BIBLIOGRAPHY

- 1 ALLBERT, R. E., BERGER, J., SANBORN, K., LIPPMANN, M. Effects of cigarette smoke components on bronchial clearance in the donkey. *Archives of Environmental Health* 29 (2): 96-101, August 1974.
- 2 AUERBACH, O., GARFINKEL, L., HAMMOND, E. C. Relation of smoking and age to findings in lung parenchyma: A microscopic study. *Chest* 65(1): 29-35, January 1974.
- 3 AUERBACH, O., HAMMOND, E. C., GARFINKEL, L., BENANTE, C. Relation of smoking and age to emphysema: Whole-lung section study. *New England Journal of Medicine* 286(16): 853-857, April 20, 1972.
- 4 BERRY, G., McKERROW, C. B., MOLYNEUX, M. K. B., ROSSITER, C. E.; TOMBLESON, J. B. L. A study of the acute and chronic changes in ventilatory capacity of workers in Lancashire cotton mills. *British Journal of Industrial Medicine* 30 (1): 25-36, January 1973.
- 5 BEWLEY, B. R., HALIL, T., SNAITH, A. H. Smoking by primary schoolchildren – prevalence and associated respiratory symptoms. *British Journal of Preventive and Social Medicine* 27 (3): 150-153, August 1973.
- 6 CHAPMAN, R. S., SHY, C. M., FINKLEA, J. F., HOUSE, D. E., GOLDBERG, H. E., HAYES, C. G. Chronic respiratory disease in military inductees and parents of schoolchildren. *Archives of Environmental Health* 27(3): 138-142, September 1973.
- 7 COLLEY, J. R. T., DOUGLAS, J. W. B., REID, D. D. Respiratory disease in young adults: Influence of early childhood lower respiratory tract illness, social class, air pollution, and smoking. *British Medical Journal* 3(5873): 195-198, July 28, 1973.
- 8 COMSTOCK, G. W., STONE, R. W., SAKAI, Y., MATSUYA, T., TONASCIA, J. A. Respiratory findings and urban living. *Archives of Environmental Health* 27(3): 143-150, September 1973.
- 9 DENSEN, P. M., JONES, E. W., BASS, H. E., BREUER, J., REED, E. A survey of respiratory disease among New York City postal and transit workers. 2. Ventilatory function test results. *Environmental Research* 2(4): 277-296, July 1969.
- 10 DIRKSEN, H., JANZON, L., LINDELL, S. E. Influence of smoking and cessation of smoking on lung function. *Scandinavian Journal of Respiratory Diseases (Supplementum 85)*: 266-274, 1974.
- 11 FRENCH, J. G., LOWRIMORE, G., NELSON, W. C., FINKLEA, J. F., ENGLISH, T., HERTZ, M. The effect of sulfur dioxide and suspended sulfates on acute respiratory disease. *Archives of Environmental Health* 27(3): 129-133, September 1973.
- 12 FRIDY, W. W., Jr., INGRAM, R. H., Jr., HIERHOLZER, J. C., COLEMAN, M. T. Airways function during mild viral respiratory illnesses. The effect of rhinovirus infection in cigarette smokers. *Annals of Internal Medicine* 80(2): 150-155, February 1974.

- 13 FRIEDMAN, G. D., SIEGELAUB, A. A., SELTZER, C. C. Cigarette smoking and exposure to occupational hazards. *American Journal of Epidemiology* 98(3): 175-183, September 1973.
- 14 HOEPPNER, V. H., COOPER, D. M., ZAMEL, N., BRYAN, A. C., LEVISON, H. Relationship between elastic recoil and closing volume in smokers and non-smokers. *American Review of Respiratory Disease* 109(1): 81-86, January 1974.
- 15 HRUBEC, Z., CEDERLOF, R., FRIBERG, L., HORTON, R., OZOLINS, G. Respiratory symptoms in twins. *Archives of Environmental Health* 27(3): 189-195, September 1973.
- 16 HUTCHISON, D. C. S. Alpha-1-antitrypsin deficiency and pulmonary emphysema: The role of proteolytic enzymes and their inhibitors. *British Journal of Diseases of the Chest* 67(3): 171-196, July 1973.
- 17 KUEPPERS, F. α_1 -antitrypsin and its deficiency. *American Journal of Human Genetics* 25(6): 677-686, 1973.
- 18 KUEPPERS, F., BLACK, L. F. α_1 -antitrypsin and its deficiency. *American Review of Respiratory Disease* 110(2): 176-194, August 1974.
- 19 KUEPPERS, F., DONHARDT, A. Obstructive lung disease in heterozygotes for alpha₁-antitrypsin deficiency. *Annals of Internal Medicine* 80(2): 209-212, February 1974.
- 20 LIM, T. P. K. Airway obstruction among high school students. *American Review of Respiratory Disease* 108(4): 985-988, October 1973.
- 21 MARTIN, R. R., LEMELIN, C., ZUTTER, M., ANTHONISEN, N. R. Measurement of "closing volume": Application and limitations. *Bulletin de Physio-Pathologie Respiratoire* 9(4): 979-995, July-August 1973.
- 22 MITTMAN, C., LIEBERMAN, J. Screening for α_1 -antitrypsin deficiency. *Israel Journal of Medical Science* 9(9/10): 1311-1318, September-October 1973.
- 23 MITTMAN, C., LIEBERMAN, J., RUMSFELD, J. Prevalence of abnormal protease inhibitor phenotypes in patients with chronic obstructive lung disease. *American Review of Respiratory Disease* 109(2): 295-296, February 1974.
- 24 NIEWOEHNER, D. E., KLEINERMAN, J., RICE, D. B. Pathologic changes in the peripheral airways of young cigarette smokers. *New England Journal of Medicine* 291(15): 755-758, October 10, 1974.
- 25 OSHIMA, H., IMAI, M., KAWAGISHI, T. Effects of air pollution on the respiratory symptoms in Yokkaichi, Central Japan. *Mie Igaku* 16(1): 25-29, June 1972.
- 26 OXHOJ, H., BAKE, B., WILHELMSSEN, L. Closing volume in 50- and 60-year-old men. A preliminary report. *Scandinavian Journal of Respiratory Diseases (Supplementum 85)*: 259-265, 1974.
- 27 ROSZMAN, T. L., ROGERS, A. S. The immunosuppressive potential of products derived from cigarette smoke. *American Review of Respiratory Disease* 108(5): 1158-1163, November 1973.
- 28 RUFF, F., SALEM, A., BUSY, F., de VERNEJOU, P., EVEN, P., BROUET, G. La fermeture des voies aeriennes peripheriques. Son augmentation chez les fumeurs. (Closing of the peripheral airways. Its increase in smokers.) *Revue de Tuberculose et de Pneumologie* 36(2): 308-311, March 1972.

- 29 RYLANDER, R. Toxicity of cigarette smoke components: Free lung cell response in acute exposures. *American Review of Respiratory Disease* 108(5): 1279-1282, November 1973.
- 30 SAWICKI, F. Air pollution and prevalence of chronic nonspecific respiratory diseases. *In: Brzezinski, Z., Kopczynski, J., Sawicki, F. (Editors). Ecology of chronic nonspecific respiratory diseases, International Symposium, September 7-8, 1971, Warsaw, Poland, Panastwowy Zaklad Wydawnictw Lekarskich, Warsaw, 1972, pp. 3-13.*
- 31 SCHWARTZ, R. H. Alpha-1-antitrypsin deficiency and chronic respiratory disease. Annual Report June 28, 1972-June 20, 1973. University of Rochester, Rochester, N.Y. Prepared for Respiratory Diseases Branch, National Heart and Lung Institute, National Institutes of Health, Bethesda, Maryland.
- 32 SIDOR, R., PETERS, J. M. Fire fighting and pulmonary function. An epidemiologic study. *American Review of Respiratory Disease* 109(2): 249-254, February 1974.
- 33 SIDOR, R., PETERS, J. M. Prevalence rates of chronic nonspecific respiratory disease in fire fighters. *American Review of Respiratory Disease* 109(2): 255-261, February 1974.
- 34 STANESCU, D. C., VERITER, C., FRANS, A., BRASSEUR, L. Maximal expiratory flow rates and "closing volume" in asymptomatic healthy smokers. *Scandinavian Journal of Respiratory Diseases* 54: 264-271, 1973.
- 35 STEBBINGS, J. H., JR. A survey of respiratory disease among New York City postal and transit workers. IV. Racial differences in the FEV₁. *Environmental Research* 6: 147-158, June 1973.
- 36 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.
- 37 U.S. PUBLIC HEALTH SERVICE. The Health Consequences of Smoking. A Public Health Service Review: 1967. U.S. Department of Health, Education, and Welfare. Washington, Public Health Service Publication No. 1696, Revised January 1968, 227 pp.
- 38 U.S. PUBLIC HEALTH SERVICE. The Health Consequences of Smoking. 1968. Supplement to the 1967 Public Health Service Review. U.S. Department of Health, Education, and Welfare. Washington, Public Health Service Publication 1696, 1968, 117 pp.
- 39 U.S. PUBLIC HEALTH SERVICE. The Health Consequences of Smoking. 1969. Supplement to the 1967 Public Health Service Review. U.S. Department of Health, Education, and Welfare. Washington, Public Health Service Publication 1696-2, 1969, 98 pp.
- 40 U.S. PUBLIC HEALTH SERVICE. The Health Consequences of Smoking. A Report of the Surgeon General: 1971. U.S. Department of Health, Education, and Welfare. Washington, DHEW Publication No. (HSM) 71-7513, 1971, 458 pp.
- 41 U.S. PUBLIC HEALTH SERVICE. The Health Consequences of Smoking. A Report of the Surgeon General: 1972. U.S. Department of Health, Education, and Welfare. Washington, DHEW Publication No. (HSM) 72-6516, 1972, 158 pp.

- 42 U.S. PUBLIC HEALTH SERVICE. The Health Consequences of Smoking: 1973. U.S. Department of Health, Education, and Welfare. Washington, DHEW Publication No. (HSM) 73-8704, 1973, 249 pp.
- 43 U.S. PUBLIC HEALTH SERVICE. The Health Consequences of Smoking: 1974. U.S. Department of Health, Education, and Welfare. Washington, DHEW Publication No. (CDC) 74-8704, 1974, 124 pp.
- 44 VAN DER LENDE, R., DE KROON, J. P. M., TAMMELING, G. J., VISSER, B. F., DE VRIES, K., WEVER-HESS, J., ORIE, N. G. M. Prevalence of chronic nonspecific lung disease in a nonpolluted and air-polluted area of the Netherlands. In: Brzezinski, Z., Kopczynski, J., Sawicki, F. (Editors). Ecology of chronic nonspecific respiratory diseases, International Symposium, September 7-8, 1971, Warsaw, Poland, Panstwowy Zaklad Wydawnictw Lekarskich, Warsaw, 1972, pp. 27-33.
- 45 WANNER, A., HIRSCH, J. A., GREENELTCH, D. E., SWENSON, E. W., FORE, T. Tracheal mucous velocity in beagles after chronic exposure to cigarette smoke. Archives of Environmental Health 27(6): 370-371, December 1973.
- 46 WARR, G. A., MARTIN, R. R. In vitro migration of human alveolar macrophages: Effects of cigarette smoking. Infection and Immunity 8(2): 222-227, August 1973.
- 47 WEBB, D. R., HYDE, R. W., SCHWARTZ, R. H., HALL, W. J., CONDEMI, J. J., TOWNES, P. L., Serum α_1 -antitrypsin variants. Prevalence and clinical spirometry. American Review of Respiratory Disease 108(4): 918-925, October 1973.
- 48 YEAGER, H., JR., ZIMMET, S. M., SCHWARTZ, S. L. Pinocytosis by human alveolar macrophages. Comparison of smokers and nonsmokers. Journal of Clinical Investigation 54(2): 247-251, August 1974.

CHAPTER 4.
Involuntary Smoking

CHAPTER 4

Involuntary Smoking _____

Contents

	<i>Page</i>
Introduction	87
Constituents of Tobacco Smoke	88
Carbon Monoxide	90
Nicotine	97
Other Substances	98
Effects of Exposure to Cigarette Smoke	98
Cardiovascular Effects of Involuntary Smoking	98
Effects of Carbon Monoxide on Psychomotor Tests	99
Pathologic Effects of Exposure to Cigarette Smoke	99
Summary of Involuntary Smoking Findings	108
Bibliography	109

List of Tables

	<i>Page</i>
Table 1.—Comparison of mainstream and sidestream cigarette smoke	89
Table 2.—Measurements of constituents released by the combustion of tobacco products in various situations	91-94
Table 3.—Median percent carboxyhemoglobin (COHb) saturation and 90 percent range for nonsmoker by location	96
Table 4.—Effects of carbon monoxide on psychomotor functions	100-101
Table 5.—Admission rates (per 100 infants) by diagnosis, birth weight, and maternal smoking	104
Table 6.—Pneumonia and bronchitis in the first 5 years of life by parents' smoking habit and morning phlegm	106

INTRODUCTION

The effects of smoking on the smoker have been extensively studied, but the effects of tobacco smoke on nonsmokers have received much less attention. The 1972 Health Consequences of Smoking (49) reviewed the effects of public exposure to the air pollution resulting from tobacco smoke. This exposure has been called "passive smoking" by many authors, but will be referred to in this report as "Involuntary Smoking." The term involuntary smoking will be used to mean the inhalation of tobacco combustion products from smoke-filled atmospheres by the nonsmoker. This type of exposure is, in a sense, "smoking" because it provides exposure to many of the same constituents of tobacco smoke that voluntary smokers experience. It is also "involuntary" because the exposure occurs as an unavoidable consequence of breathing in a smoke-filled environment.

The chemical constituents found in an atmosphere filled with tobacco smoke are derived from two sources — mainstream and sidestream smoke. Mainstream smoke emerges from the tobacco product after being drawn through the tobacco during puffing. Sidestream smoke rises from the burning cone of tobacco. Mainstream and sidestream smoke contribute different concentrations of many substances to the atmosphere for several reasons: Different amounts of tobacco are consumed in the production of mainstream and sidestream smoke; the temperature of combustion differs for tobacco during puffing or while smouldering; and certain substances are partially absorbed from the mainstream smoke by the smoker. The amount of a substance absorbed by the smoker depends on the characteristics of the substance and the depth of inhalation by the smoker. As discussed in the 1972 Report, when the smoker does not inhale the smoke into his lungs, the smoke he exhales contains less than half its original amount of water-soluble volatile compounds, four-fifths of the original nonwater-soluble compounds and particulate matter, and almost all of the carbon monoxide (15). When the smoker inhales the mainstream smoke, he exhales into the atmosphere less than one-seventh of the amount of volatile and particulate substances that were originally present in the smoke and also reduces the exhaled CO to less than half its original concentration (16). As a result, different concentrations of substances are found in exhaled mainstream smoke depending on the tobacco product, composition of the tobacco, and degree of inhalation by the smoker.

Several minor symptoms (conjunctival irritation, dry throat, etc.) are caused by levels of cigarette smoke encountered in everyday life, and serious allergic-like reactions to cigarette smoke may occur in some sensitive individuals. A major concern, however, about atmospheric contamination by cigarette smoke has been due to the production of significant levels of carbon monoxide. Cigarette smoking in poorly ventilated enclosed spaces may generate carbon monoxide levels above the acceptable 8-hour industrial exposure limits (50 ppm) – set by the American Conference of Government Industrial Hygienists (1). Exposure to this level of carbon monoxide even for short periods of time has been shown to reduce significantly the exercise tolerance of some persons with symptomatic cardiovascular disease. There is also some evidence that prolonged exposure to this level of carbon monoxide in combination with a high cholesterol diet can enhance experimental atherosclerosis in animals (Chapter 1, Cardiovascular Diseases).

In the present chapter, the effects of cigarette smoke on the environment and on the nonsmoker in that environment will be examined by reviewing data on (1) the constituents of cigarette smoke measured under various conditions, and (2) the physiologic effects of this “involuntary smoking” on individuals.

CONSTITUENTS OF TOBACCO SMOKE

In a recent workshop on the effects of environmental tobacco smoke on the nonsmoker (41), Corn (14) presented a compilation adapted from Hoegg (32) of some of the substances in mainstream cigarette smoke and the ratio of sidestream to mainstream levels for some of these substances (Table 1). The actual numerical value of the sidestream to mainstream concentration ratio will vary with different types of tobacco tested, but Table 1 gives values generally consistent with those found by others (34, 42). Many of these substances including nicotine and carbon monoxide are found in much higher concentrations in sidestream smoke than in mainstream smoke, establishing that the smoke exposure received by both the smoker and nonsmoker due to breathing in a smoke-filled environment differs qualitatively as well as quantitatively from the smoke exposure received by the smoker who inhales through a lighted cigarette. A more comprehensive recent review of the constituents of mainstream and sidestream smoke has also been provided by Schmeltz, et al. (42) and Johnson, et al. (34).

TABLE 1. - Comparison of mainstream and sidestream cigarette smoke^{1,2}

Compound	Mainstream (mg/cig)	Sidestream (mg/cig)	Ratio Sidestream/ Mainstream	Comment
A	General characteristics			
Duration of smoke production	20 sec	550 sec	27	
Tobacco burnt	347	411	1.2	
Particulates, no. per cigarette	1.05×10^{12}	3.5×10^{12}	3.3	
B	Particulate phase			
² Tar (chloroform extract)	20.8	44.1	2.1	
	10.2	34.5	3.4	Filter cigarette
Nicotine	0.92	1.69	1.8	
	0.46	1.27	2.8	Filter cigarette
Benzo(a)pyrene	3.5×10^{-5}	13.5×10^{-5}	3.7	
Pyrene	13×10^{-5}	39×10^{-5}	3.0	
Total phenols	0.228	0.603	2.6	
Cadmium	12.5×10^{-5}	45×10^{-5}	3.6	
C	Gases and vapors			
Water	7.5	298	39.7	3.5 mg of Mainstream and 5.5 mg of Sidestream in particulate phase, rest in vapor phase
Ammonia	0.16	7.4	46	
Carbon monoxide	31.4	148	4.7	
Carbon dioxide	63.5	79.5	1.3	
Oxides of Nitrogen	0.014	0.051	3.6	

¹ Adapted from Hoegg, U.R. (31, 32).

² For 35 ml puff volume, 2 sec puff duration, one puff per minute and 23 or 30 mm butt length and 10 percent tobacco moisture.
Source: Corn, M. (14).

A number of other researchers have attempted to measure the levels of some of the substances in cigarette smoke encountered in everyday situations (Table 2). They have also tried to determine the factors controlling the atmospheric concentrations of these substances as well as the amount absorbed by nonsmokers under these conditions. Carbon monoxide, nicotine, benzo(a)pyrene, acrolein, and acetaldehyde have been of particular concern.

Carbon Monoxide

Levels of carbon monoxide (CO), a major product of tobacco combustion, have been studied in a variety of situations, and concentrations ranging from 2 to 110 ppm have been measured (Table 2). The major determinants of the CO levels in these situations are size of the space in which the smoking occurs (dilution of CO), the number and type of tobacco products smoked (CO production), and the amount and effectiveness of ventilation (CO removal).

The type of tobacco product smoked is important as a determinant of CO exposure because it has been found that mainstream smoke from regular and small cigars contains more CO pre puff and per gram of tobacco burned than filtered or unfiltered cigarettes (8). This greater production of CO by cigars was confirmed by Harke (23). He measured the CO produced by 42 cigarettes, 9 cigars, and 9 pipefuls of tobacco, each product evaluated separately but under the same room conditions. The cigars produced the highest CO level (60 ppm).

In addition to the effect of type of tobacco product on CO levels, data on the effects of room size, amount of tobacco burned, and ventilation are included in Table 2. Only under conditions of unusually heavy smoking and poor ventilation did CO levels exceed the maximum permissible, 8-hour industrial exposure limit of 50 ppm CO (1); however, even in cases where the ventilation was adequate, the measured CO levels did exceed the maximum acceptable ambient level of 9 ppm (18).

Harke (27) also showed that in small enclosed ventilated spaces (an automobile) the CO level is determined more by the number of cigarettes being smoked at one given time than by the cumulative number of cigarettes that have been smoked; also the CO level decreases rapidly once the smoking stops.

TABLE 2. — *Measurements of constituents released by the combustion of tobacco products in various situations*
 [Cig = cigarettes; — = unknown; TPM = total particulate matter]

Reference, Location, and Dimensions If Known	Ventilation	Amount of Tobacco Burned	Constituents
Harke, H.-P., et al. (27) Mid-size European car, engine off, in wind tunnel at 50 km/hr wind speed	None	9 cig	30 ppm CO
	Air jets open & blower off	6 cig	20 ppm CO
	Air jets open & blower on	6 cig	10 ppm CO
	None	9 cig	110 ppm CO
	None	6 cig	80 ppm CO
	Air jets open & blower on	6 cig	8-10 ppm CO
Harke, H.-P., Peters, H. (28) Car in traffic	None	4 cig	21.4 ppm CO
Srch, M. (45) Car, engine off— 2.09 m ³	None	10 cig in 1 hr	90 ppm CO, Smokers 10% COHb Nonsmokers 5% COHb
Seiff, H.E. (44) Intercity buses	15 air changes per hr	23 cig (burning continuously)	33 ppm CO (at driver's seat)
		3 cig (burning continuously)	18 ppm CO (at driver's seat)

TABLE 2. – Measurements of constituents released by the combustion of tobacco products in various situations – Continued
 [Cig = cigarettes; – = unknown; TPM = total particulate matter]

Reference, Location, and Dimensions If Known	Ventilation	Amount of Tobacco Burned	Constituents
U.S. Dept. Transportation, et al. (48)			
Airplane flights:			
Overseas–100% filled	15-20 air changes per hr	–	2-5 ppm CO, <.120 mg/m ³ TPM
Domestic–66% filled	do.	–	<2 ppm CO, <.120 mg/m ³ TPM
Cano, J.P., et al. (11)			
Submarines–66 m ³	Yes	157 cig per day 94-103 cig per day	<40 ppm CO, 32 µg/m ³ Nicotine <40 ppm CO, 15-35 µg/m ³ Nicotine
Godin, G., et al. (21)			
Ferry boat compartments:			
Smoking	–	–	18.4 ± 8.7 ppm CO
Nonsmoking	–	–	3.0 ± 2.4 ppm CO
Theater:			
Foyer	–	–	3.4 ± 0.8 ppm CO
Auditorium	–	–	1.4 ± 0.8 ppm CO
Bridge, D.P., Corn, M. (7)			
Party rooms:			
145 m ³	7 air changes per hr	50 cig & 17 cigars in 1.5 hr	7 ppm CO
101 m ³	10.6 air changes per hr	63 cig & 10 cigars in 1.5 hr	9 ppm CO

TABLE 2. -- Measurements of constituents released by the combustion of tobacco products in various situations -- Continued
[Cig = cigarettes; -- = unknown; TPM = total particulate matter]

Reference, Location, and Dimensions If Known	Ventilation	Amount of Tobacco Burned	Constituents
Harke, H.-P., et al. (25) Room - 38.2 m ³	None	30 cig per 13 min (by machine)	64 ppm CO, 510 µg/m ³ Nicotine .46 mg/m ³ Acrolein 6.5 mg/m ³ Acetaldehyde
		5 cig per 13 min (by machine)	11.5 ppm CO, 60 µg/m ³ Nicotine, .07 mg/m ³ Acrolein, 1.3 mg/m ³ Acetaldehyde
Harke, H.-P. (24) Office Bldg Office Bldg Room - 78.3 m ³	Air conditioned	-	<5 ppm CO
	Not air conditioned	-	<5 ppm CO
	-	3 smokers	15.6 ppm CO
Harke, H.-P., (23) Room - 57 m ³	None	42 cig (by machine)	50 ppm CO, 530 µg/m ³ Nicotine
	7.2 air changes per hr	42 cig do.	10 ppm CO, 120 µg/m ³ Nicotine
	8.4 air changes per hr	42 cig do.	<10 ppm CO, <100 µg/m ³ Nicotine
	None	9 cigars do.	60 ppm CO, 1040 µg/m ³ Nicotine
	7.2 air changes per hr	9 cigars do.	20 ppm CO, 420 µg/m ³ Nicotine
	None	9 pipes do.	10 ppm CO, 520 µg/m ³ Nicotine
	7.2 air changes per hr	9 pipes do.	<10 ppm CO, <100 µg/m ³ Nicotine

TABLE 2. – *Measurements of constituents released by the combustion of tobacco products in various situations – Continued*
 [Cig = cigarettes; – = unknown; TPM = total particulate matter]

Reference, Location, and Dimensions If Known	Ventilation	Amount of Tobacco Burned	Constituents
Harke, H.-P. (23) Room–170 m ³	None	105 cig	30 ppm CO, Smokers 7.5% COHb Nonsmokers 2.1% COHb
	1.2 air changes per hr	107 cig	5 ppm CO, Smokers 5.8% COHb Nonsmokers 1.3% COHb
	2.3 air changes per hr	101 cig	75 ppm CO, Smokers 5.0% COHb Nonsmokers 1.6% COHb
Anderson, G., Dalhamn, T. (3) Room–80 m ³	6.4 air changes per hr	46 cig & 3 pipefuls	4.5 ppm CO, 377 µg/m ³ Nicotine, 3.0 mg/m ³ TPM
Russell, M.A.H., et al. (40) Room–43 m ³	None	80 cig & 2 cigars per hr	38 ppm CO, Smokers 9.6% COHb Nonsmokers 2.6% COHb
Harmsen, H., Effenberger, E. (30) Room–93 m ³	None	62 cig in 2 hrs	80 ppm CO, 5200 µg/m ³ Nicotine
Hoegg, U.R. (31, 32) Sealed test chamber–25 m ³	None	4 cig	12.2 ppm CO, 2.28 mg/m ³ TPM
		8 cig	25.6 ppm CO, 5.39 mg/m ³ TPM
		16 cig	47.0 ppm CO, 11.41 mg/m ³ TPM
		24 cig	69.8 ppm CO, 16.65 mg/m ³ TPM

One must be careful when using the levels recorded in Table 2 as measures of individual exposure because the CO levels were usually measured at points several feet from the nearest smoker and probably would have been higher if measured at points corresponding to the position of a person sitting next to someone actively smoking (17, 35). In addition, it is the CO absorbed by the body that causes the harmful effects and not that which is measured in the atmosphere. This absorption can vary from individual to individual, depending on factors such as duration of exposure, volume of air breathed per minute, and cardio-respiratory function.

Several investigators have tried to determine the amount of carbon monoxide absorbed in involuntary smoking situations by measuring changes in carboxyhemoglobin levels in nonsmokers exposed to cigarette smoke-filled environments. Anderson and Dalhamn (3) were unable to find any change in the COHb levels of nonsmokers in a well ventilated room where the CO level was 4.5 ppm. When Harke (23) studied nonsmokers under similar conditions (good ventilation and less than 5 ppm CO), he was able to show an increase in COHb level from 1.1 to 1.6 percent; without ventilation the CO levels rose to 30 ppm and the COHb level increased from .9 to 2.1 percent in 2 hours. Russell, et al. (40) also found that COHb levels increased from 1.6 to 2.6 percent in nonsmokers exposed to a smoke-filled room where the CO level was measured at 38 ppm; however, he cautioned that nearly all persons in the room felt that the conditions were worse than those experienced in most social situations.

Stewart, et al. (46) measured COHb levels in a group of nonsmoking blood donors from several cities and found that 45 percent exceeded the Clean Air Act's Quality Standard of 1.5 percent with the 90 percent range as high as 3.7 percent for individual cities (Table 3). These levels represent the total CO exposure from all sources, involuntary smoking, and other sources of pollution as well as establishing the levels which would be added to any new involuntary smoking exposure.

Increases in the COHb levels of this magnitude are probably functionally insignificant in the healthy adult, but in persons with angina pectoris, any reduction of oxygen-carrying capacity is of great importance. In this disease, the volume of blood able to be pumped through the diseased coronary artery is already unable to meet the demands of the heart muscle under exercise stress. Aronow, et al. (4) examined the effect of exposure to carbon monoxide on persons with angina pectoris. They exercised persons with angina

TABLE 3. — Median percent carboxyhemoglobin (COHb) saturation and 90 percent range for nonsmokers by location

Location	Nonsmokers		No. of Nonsmokers	Percent of Nonsmokers With COHb >1.5%
	Median	Range		
Anchorage	1.5	0.6 – 3.2	152	56
Chicago	1.7	1.0 – 3.2	401	74
Denver	2.0	0.9 – 3.7	744	76
Detroit	1.6	0.7 – 2.7	1,172	42
Honolulu	1.4	0.7 – 2.5	503	39
Houston	1.2	0.6 – 3.5	240	30
Los Angeles	1.8	1.0 – 3.0	2,886	76
Miami	1.2	0.4 – 3.0	398	33
Milwaukee	1.2	0.5 – 2.5	2,720	26
New Orleans	1.6	1.0 – 3.0	159	59
New York	1.2	0.6 – 2.5	2,291	35
Phoenix	1.2	0.5 – 2.5	147	24
St. Louis	1.4	0.9 – 2.1	671	35
Salt Lake City	1.2	0.6 – 2.5	544	27
San Francisco	1.5	0.8 – 2.7	660	61
Seattle	1.5	0.8 – 2.7	535	55
Vermont, New Hampshire	1.2	0.8 – 2.1	959	18
Washington, D.C.	1.2	0.6 – 2.5	850	35

Source: Stewart, R.D., et al. (46).

pectoris before and after exposure to carbon monoxide. The average amount of exercise that was able to be performed before a person developed chest pain was significantly shortened from 226.7 seconds before exposure to 187.6 seconds after CO exposure. This change occurred after a 2-hour exposure to 50 ppm CO and with an increase in COHb level from 1.03 percent to 2.68 percent; these COHb levels are within the range produced by involuntary smoking.

These data indicate that exposure to CO at levels found in some involuntary smoking situations may well have a significant impact on the functional capacity of persons with angina pectoris. Carbon monoxide has also been shown to decrease cardiac contractility in persons with coronary heart disease at COHb levels similar to those produced due to involuntary smoking situations (5). It is reasonable to assume that any significant CO exposure to the diseased heart reduces its functional reserve.

Nicotine

Nicotine in the atmosphere differs from CO in that it tends to settle out of the air with or without ventilation (thereby decreasing its atmospheric concentration), whereas the CO level will remain constant until the CO is removed. The concentrations of both substances are decreased substantially by ventilation. As can be seen from data in Table 2, under conditions of adequate ventilation neither exceeds the maximum threshold limit values for industrial exposure (nicotine, 500 $\mu\text{g}/\text{m}^3$; CO, 50 ppm, 1); whereas in conditions without ventilation, smoking produces very high concentrations of both (nicotine, up to 1,040 $\mu\text{g}/\text{m}^3$; CO, 110 ppm).

Nicotine in the environment is of concern because nicotine absorbed by cigarette smokers is felt to be one factor contributing to the development of atherosclerotic cardiovascular disease. Several researchers have attempted to measure the amount of nicotine absorbed by nonsmokers in involuntary smoking situations. Cano, et al. (11) studied urinary excretion of nicotine by persons on a submarine. Despite very low levels measured in the air (15 to 32 $\mu\text{g}/\text{m}^3$), nonsmokers did show a small rise in nicotine excretion; however, the amount excreted was still less than 1 percent of the amount excreted by smokers. Harke (23) measured nicotine and its metabolite cotinine in the urine of smokers and nonsmokers exposed to a smoke-filled environment and reported that nonsmokers excreted less than 1 percent of the amount of nicotine and cotinine excreted by smokers. He feels that at this low level of absorption nicotine is unlikely to be a hazard to the nonsmoker.

Other Substances

In two studies environmental levels of the experimental carcinogen benzo(a)pyrene were measured. Galuskinova (20) found levels of benzo(a)pyrene from 2.82 to 14.4 mg/m³ in smoky restaurants, but it is not clear how much of this was due to cooking and how much was due to smoking. In a study of the concentration of benzo(a)pyrene in the atmosphere of airplanes (48), only a fraction of a microgram per cubic meter was detected. The effect of chronic exposure to very low levels of this carcinogen has not been established for humans.

Acrolein and acetaldehyde have also been measured in smoke-filled rooms (25, Table 2) and may contribute to the eye irritation commonly experienced in these situations.

EFFECTS OF EXPOSURE TO CIGARETTE SMOKE

Cardiovascular Effects of Involuntary Smoking

The effects of cigarette smoking on the cardiovascular system of the smoker are well established, but very little is known about the cardiovascular response of the nonsmoker to cigarette smoke. Harke and Bleichert (26) studied 18 adults (11 smokers and 7 nonsmokers) in a room 170 m³ large in which 150 cigarettes were smoked or allowed to burn in ashtrays for 30 minutes. They noted that the subjects who smoked during the experiment had a significant lowering of skin temperature and a rise in blood pressure. Nonsmokers who were exposed to the same smoke-contaminated environment showed no change in either of these parameters. Luquette, et al. (36) performed a similar experiment with 40 children exposed alternately to smoke-contaminated and clean atmospheres, but otherwise under identical experimental conditions. They found that exposure to the smoke caused increases in heart rate (5 beats per minute) and in systolic (4 mm Hg) and diastolic (5 mm Hg) blood pressure. The differences in results between these studies may be due, in part, to the age of the subjects – i.e., children may be more sensitive to the cardiovascular effects of involuntary smoking than adults, or the increase in heart rate and blood pressure may be due to a difference between children and adults in the psychologic response to being in a smoke-filled atmosphere.

Effects of Carbon Monoxide on Psychomotor Tests

Carbon monoxide from tobacco smoke, automobile exhaust, and industrial pollution is an important component of air pollution. There has been some concern over the effect of relatively low levels of carbon monoxide on psychomotor functions (the ability to perceive and react to stimuli), especially those functions related to driving an automobile (Table 4).

Carbon monoxide levels occasionally reached in some involuntary smoking situations result in measurable cognitive and motor effects, but these effects generally are measurable only at the threshold of stimuli perception. One study (Wright, et al., (50)) found that the safe driving habits measured on a driving simulator did not improve as much with practice in a group exposed to CO as did the habits of a control group. Another study (37) with a different experimental design but at the same levels of CO did not find any effect on complex psychomotor activity such as driving a car. Thus, the role of CO alone in motor vehicle accidents remains unclear. The effect on judgement and reactions of CO in combination with factors such as fatigue and alcohol, conditions known to influence judgement and reaction time, has not been determined.

Pathologic Effects of Exposure to Cigarette Smoke

The effect of involuntary smoking on an individual is determined not only by the qualitative and quantitative aspects of the smoke-filled environment, but also largely by the characteristics of the individual. Reactions may vary with age as well as with the sensitivity of an individual to the components of tobacco smoke. The severity of possible effects range from minor eye and throat irritations experienced by most people in smoke-filled rooms, to the anginal attacks of some persons with cardiovascular disease.

The minor symptomatic irritation experienced by nonsmokers in a smoke-filled environment is influenced by the humidity of the air as well as the concentration of irritating substances found in the atmosphere. Johansson and Ronge (33) have shown that irritation due to cigarette smoke is maximal in warm, dry air and decreases with a small rise in relative humidity. A change from acceptable to unpleasant was reported at 4.7 mg/m^3 of particulate matter for nonsmokers and eye irritation was noted at 9 mg/m^3 for both smokers and nonsmokers. The authors concluded that a ventilation rate of $12 \text{ m}^3/\text{hr}/\text{cig}$ was necessary to avoid eye irritation and $50 \text{ m}^3/\text{hr}/\text{cig}$ was necessary to avoid unpleasant odors.

TABLE 4. – *Effects of carbon monoxide on psychomotor functions*

Reference	Test or Measurement	CO level (ppm)	COHb level (Percent)	Effect
McFarland, R.A. (37)	Ability of drivers to stay between two-lane markers while being permitted only brief glimpses of the road		6	None
			11	None
			17	None
Ray, A.M., Rockwell, T.H. (39)	Reaction time to car taillights		10	Prolonged
McFarland, R.A. (38)	Performance of two tasks at same time	700	17	None
	Dark adaptation and glare recovery	700	17	None
	Peripheral vision at 10° and 30°	700	17	None
	Peripheral vision at 20°	700	17	Decreased
	Depth perception	700	17	None
Stewart, R.D., et al. (47)	Time perception	500	20	None

TABLE 4. — *Effects of carbon monoxide on psychomotor junctions — Continued*

Reference	Test or Measurement	CO level ppm	COHb level (Percent)	Effect
Fodor, G.G., Winneke, G. (19)	Attentiveness to auditory stimuli	50 x 5 hrs.	2-5	Decreased
	Flicker fusion	50 x 5 hrs.	2-5	No change
	Speed of motor performance	50 x 5 hrs.	2-5	No change
	Perception of complex visual patterns	50 x 5 hrs.	2-5	Improved
Schulte, J.H. (43)	Cognitive function	100	5	Decreased
	Reaction time		20	No change
Bender, W., et al. (6)	Threshold for temporal resolution of visual stimuli	100	7.25	Raised
	Manual dexterity	100	7.25	Decreased
	Learning meaningless syllables	100	7.25	Decreased
	Retention of 10 syllables for 1 hr	100	7.25	No change
Groll-Knapp, E., et al. (22)	Attentiveness to auditory stimuli	50		Deterioration at 50 ppm, worse at 100 ppm, worst at 150 ppm
		100		
		150		
Wright, G., et al. (50)	Reaction time		6.3	Prolonged
	Glare recovery		6.3	Prolonged
	Careful driving habits		6.3	Failure to improve with practice

Two government sponsored studies have attempted to evaluate the degree of minor irritation due to cigarette smoke experienced by bus and plane passengers. The U.S. Department of Transportation (44) studied the environment on two ventilated buses – one with simulated unrestricted smoking and another with simulated smoking limited to the rear 20 percent of the seats. In one bus, lighted cigarettes were placed at every other seat (23 cigarettes) to simulate a bus filled with smokers. In the other bus, cigarettes were placed only in the rear 20 percent of the bus (five cigarettes) to simulate a bus where smoking was limited to the rear 20 percent of the seats. When smoking was limited, the CO level at the driver's seat was only 18 ppm (ambient air 13 ppm) compared to the level of 33 ppm (ambient air 7 ppm) measured in the unrestricted smoking situation. Four of the six subjects seated in the bus reported eye irritation during the unrestricted smoking simulation. None of the six subjects reported any eye irritation in the restricted smoking situation (not even those seated in the rear 20 percent of the bus).

Several Federal agencies (48) cooperated to survey the symptoms experienced by travelers on both military and commercial aircraft. They distributed a questionnaire to passengers on 20 military and 8 commercial flights; 57 percent of the passengers on the military flights and 45 percent of the passengers on the commercial flights were smokers. The planes were well ventilated and CO levels were always below 5 ppm with low levels of other pollutants as well. In spite of the low level of measurable pollution, over 60 percent of the nonsmoking passengers and 15 to 22 percent of the smokers reported being annoyed by the other passengers' smoking. Seventy-three percent of the nonsmoking passengers on the commercial flights and 62 percent of the nonsmoking passengers on the military flights suggested that some remedial action be taken; 84 percent of those suggesting remedial action felt that segregating the smokers from nonsmokers would be a satisfactory solution. These feelings were even more prevalent among those nonsmokers who had a history of respiratory disease.

Children have been found to have a higher incidence of respiratory infections than adults and are thought to be more sensitive to the effects of air pollution due to their greater minute ventilation per body weight than adults. Several researchers have investigated the effects of parental smoking on the health of children. Cameron, et al. conducted two telephone surveys of Detroit families to determine the relationship between children's respiratory illness and parental smoking habits. In the first survey (9) they found a statistically significant relationship between the prevalence of

children's respiratory infection and parental smoking habits only when all children under 16 were considered (not when only those under 9 or under 5 were considered). In a larger survey of the same city (10) they found a relationship between parental smoking and prevalence of respiratory illness in the 10- to 16-year age group and in the birth to 5-year age group. Neither study controlled for smoking by the children which might be a factor in the 10- to 16-year age group or for socioeconomic status which has an effect on both smoking habits and illness. However, the data were consistent with a higher prevalence of respiratory disease in families where there are smokers than in nonsmoking families.

Colley (12) also found a relationship between parental smoking habits and the prevalence of respiratory illness in the children. He found an even stronger relationship between parental cough and phlegm production and respiratory infections in children. He postulates this latter relationship to result from the greater infectivity of these parents due to their cough and phlegm production. The relationship between parental cigarette smoking and respiratory infection in their children would then occur because cigarette smoking caused the parents to cough and produce phlegm and would not be indicative of a direct effect of cigarette smoke-filled air on the children.

Harlap and Davies (29) studied infant admissions to Hadassah Hospital in West Jerusalem and found a relationship between admissions for bronchitis and pneumonia in the first year of life and maternal smoking habits during pregnancy. Data on maternal smoking habits after the birth of the child were not obtained, but it can be assumed that most of the mothers who smoked during pregnancy continued to smoke during the first year of the infant's life. A relationship between infant admission and maternal smoking habits was demonstrable only between the sixth and ninth months of infant life and was more pronounced during the winter months (when the effect of cigarette smoke on the indoor environment would be greatest). Mothers who smoke during pregnancy are known to have infants with a lower average birth weight than the infants of nonsmoking mothers. The relationship between maternal smoking and their infants' admission to the hospital found in this study was greater for low birth weight infants, but was also found for normal birth weight infants (Table 5) (29). Harlap and Davies (29) demonstrated a dose-response relationship for maternal smoking and infant admission for bronchitis and pneumonia; however, they also found a relationship between maternal smoking and infant admissions for poisoning and injuries. This may indicate a bias in the study

TABLE 5. – Admission rates (per 100 infants) by diagnosis, birth weight, and maternal smoking

Diagnosis	Birth weight (g)						Total (including unknown)	
	≤2,999		3,000 - 3,499		3,500+		S (986)	NS (9,686)
	S (297)	NS (2,326)	S (415)	NS (4,098)	S (264)	NS (3,195)		
Bronchitis and pneumonia	19.2	12.3	9.6	8.2	12.1	9.0	13.1	9.5
All other	22.6	19.9	14.5	14.6	15.2	13.3	16.9	15.5
Total	41.8	32.2	24.1	22.8	27.3	22.3	30.0	24.9

NOTE. – S=Smokers; NS=Nonsmokers.

Source: Harlap, S., Davies, A.M. (29).

due to relationships which may exist between smoking and factors such as parental neglect or socioeconomic class. In addition, hospital admission rates may not be an accurate index of infant morbidity.

Colley, et al. (13) studied the incidence of pneumonia and bronchitis in 2,205 children over the first 5 years of life in relation to the smoking habits of both parents. They found that a relationship between parental smoking habits and respiratory infection in children occurred only during the first years of life (Table 6). They also showed a relationship between parental cough and phlegm production and infant infection (Table 6) which was found to be independent of the effect of parental smoking habits. The relationship between parental smoking and infant infection was greater when both parents smoked and increased with increasing number of cigarettes smoked per day. The relationship persisted after social class and birth weight had been controlled for.

Thus, respiratory infections during the first year of life are closely related to smoking habits independent of parental symptoms, social class, and birth weight. Because of the dose-response relationship between parental smoking and infant respiratory infection established by Colley, et al. (13), it is reasonable to suspect that cigarette smoke in the atmosphere of the home may be the cause of these infections; however, other factors such as parental neglect may also play a role.

The above studies examined the effects of involuntary smoking on relatively healthy people. A substantial proportion of the U.S. population suffers from chronic cardiovascular and pulmonary diseases, however, and they represent the segment of the population most seriously jeopardized by conditions found in involuntary smoking situations. In Chapter 1 of this report (Cardiovascular Diseases) evidence was presented which showed that levels of CO sometimes experienced in smoke-filled environments (50 ppm) are capable of significantly decreasing the exercise tolerance of persons with angina pectoris and intermittent claudication. In addition, these levels of CO have been shown to decrease cardiac contractility and to raise left ventricular end-diastolic pressure (an indication of heart failure) in persons with cardiovascular disease.

Persons with chronic bronchitis and emphysema have considerable excess mortality under conditions of severe air pollution. In smoke-filled environments levels of CO and several other pollutants may be as high or higher than occur during air pollution emergencies. The effects of short-term exposure of persons with chronic obstruc-

TABLE 6. – Pneumonia and bronchitis in the first 5 years of life by parents' smoking habit and morning phlegm

Year of Followup	Annual incidence of pneumonia and bronchitis per 100 children (Absolute numbers in parentheses)									
	Both nonsmokers		One smoker		Both smokers		Both ex-smokers or one ex-smoker or smoking habit changed		All	
	N	O/B	N	O/B	N	O/B	N	O/B	N	O/B
1	7.6 (343)	10.3 (29)	10.4 (424)	14.8 (128)	15.3 (339)	23.0 (139)	8.2 (546)	13.2 (129)	10.1 (1,652)	16.7 (425)
2	8.1 (322)	8.3 (36)	7.1 (365)	15.5 (129)	8.7 (286)	9.2 (152)	6.5 (599)	10.7 (159)	7.4 (1,572)	11.3 (476)
3	6.9 (305)	8.1 (37)	10.5 (353)	9.4 (107)	7.9 (242)	11.0 (154)	8.2 (661)	11.6 (173)	8.4 (1,561)	10.6 (471)
4	8.0 (287)	11.1 (36)	7.5 (306)	10.8 (102)	7.6 (236)	11.6 (121)	8.2 (695)	9.1 (187)	7.9 (1,524)	10.3 (446)
5	6.7 (285)	14.7 (34)	5.6 (267)	9.4 (107)	3.9 (208)	10.6 (132)	6.4 (737)	7.3 (219)	5.9 (1,497)	9.1 (492)

NOTE. – N=neither with winter morning phlegm. O/B=one or both with winter morning phlegm.
Source: Colley, J.R.T., et al. (13).

tive bronchopulmonary disease (COPD) to these conditions have not been evaluated. Persons with COPD are also possibly at increased risk to CO exposure because of their low alveolar P_{O_2} . Due to the reduced amount of oxygen available to compete with the CO for hemoglobin binding sites, these persons might experience a carboxy-hemoglobin to oxyhemoglobin ratio higher than those in healthy subjects under the same conditions of CO exposure. The retention of CO may also be prolonged due to both this increased binding of CO to hemoglobin under low alveolar P_{O_2} and decreased ventilatory capacity to excrete CO.

In summary, the effects of cigarette smoke on healthy nonsmokers consists mainly of minor eye and throat irritation. However, people with certain heart and lung diseases (angina pectoris, COPD, allergic asthma) may suffer exacerbations of their symptoms as a result of exposure to tobacco smoke-filled environments. These effects are dependent on the degree of individual exposure to cigarette smoke which is determined by proximity to the source of the tobacco smoke, the type and amount of tobacco product smoked, conditions of room size and ventilation as well as the amount of time the individual spends in the smoke-filled environment, and his physiologic condition at the time of exposure.

SUMMARY

1. Tobacco smoke can be a significant source of atmospheric pollution in enclosed areas. Occasionally under conditions of heavy smoking and poor ventilation, the maximum limit for an 8-hour work exposure to carbon monoxide (50 ppm) may be exceeded. The upper limit for CO in ambient air (9 ppm) may be exceeded even in cases where ventilation is adequate. For an individual located close to a cigarette that is being smoked by someone else, the pollution exposure may be greater than would be expected from atmospheric measurements.

2. Carbon monoxide, at levels occasionally found in cigarette smoke-filled environments, has been shown to produce slight deterioration in some tests of psychomotor performance, especially attentiveness and cognitive function. It is unclear whether these levels impair complex psychomotor activities such as driving a car. The effects produced by CO may become important when added to factors such as fatigue and alcohol which are known to have an effect on the ability to operate a motor vehicle.

3. Unrestricted smoking on buses and planes is reported to be annoying to the majority of nonsmoking passengers, even under conditions of adequate ventilation.

4. Children of parents who smoke are more likely to have bronchitis and pneumonia during the first year of life, and this is probably at least partly due to their being exposed to cigarette smoke in the atmosphere.

5. Levels of carbon monoxide commonly found in cigarette smoke-filled environments have been shown to decrease the exercise tolerance of patients with angina pectoris.

BIBLIOGRAPHY

- 1 AMERICAN CONFERENCE OF GOVERNMENT INDUSTRIAL HYGIENISTS. TLVs® threshold limit values for chemical substances in workroom air adopted by the American conference of government industrial hygienists for 1973. *Journal of Occupational Medicine* 16(1): 39-49, January 1974.
- 2 ANDERSON, E. W., ANDELMAN, R. J., STRAUCH, J. M., FORTUIN, N. J., KNELSON, J. H. Effect of low-level carbon monoxide exposure on onset and duration of angina pectoris. A study of ten patients with ischemic heart disease. *Annals of Internal Medicine* 79(1): 46-50, July 1973.
- 3 ANDERSON, G., DALHAMN, T. The risks to health of passive smoking. *Lakartidningen* 70: 2833-2836, August 15, 1973.
- 4 ARONOW, W. S., CASSIDY, J., VANGROW, J. S., MARCH, H., KERN, J. C., GOLDSMITH, J. R., KHEMKA, M., PAGANO, J., VAWTER, M. Effect of cigarette smoking and breathing carbon monoxide on cardiovascular hemodynamics in anginal patients. *Circulation* 50(2): 340-347, August 1974.
- 5 ARONOW, W. S., ISBELL, M. W. Carbon monoxide effect on exercise-induced angina pectoris. *Annals of Internal Medicine* 79(3): 392-395, September 1973.
- 6 BENDER, W., GOTHERT, M., MALORNY, G. Effect of low carbon monoxide concentrations on psychological functions. *Staub Reinhaltung der Luft* 32(4): 54-60, April 1972.
- 7 BRIDGE, D. P., CORN, M. Contribution to the assessment of exposure of nonsmokers to air pollution from cigarette and cigar smoke in occupied spaces. *Environmental Research* 5:192-209, 1972.
- 8 BRUNNEMANN, K. D., HOFFMANN, D. Chemical studies on tobacco smoke. XXIV. A quantitative method for carbon monoxide and carbon dioxide in cigarette and cigar smoke. *Journal of Chromatographic Science* 12(2): 70-75, February 1974.
- 9 CAMERON, P., KOSTIN, J. S., ZAKS, J. M., WOLFE, J. H., TIGHE, G., OSELETT, B., STOCKER, R., WINTON, J. The health of smokers' and nonsmokers' children. *Journal of Allergy* 43(6): 336-341, June 1969.
- 10 CAMERON, P., ROBERTSON, D. Effect of home environment tobacco smoke on family health. *Journal of Applied Psychology* 57(2): 142-147, 1973.
- 11 CANO, J. P., CATALIN, J., BADRE, R., DUMAS, C., VIALA, A., GUILLERME, R. Determination de la nicotine par chromatographie en phase gazeuse. II - Applications *Annales Pharmaceutiques Francaises* 28(11): 633-640, 1970.
- 12 COLLEY, J. R. T. Respiratory symptoms in children and parental smoking and phlegm production. *British Medical Journal* 2: 201-204, April 27, 1974.
- 13 COLLEY, J. R. T., HOLLAND, W. W., CORKHILL, R. T. Influence of passive smoking and parental phlegm on pneumonia and bronchitis in early childhood. *Lancet* 2(7888): 1031-1034, November 2, 1974.
- 14 CORN, M. Characteristics of tobacco sidestream smoke and factors influencing its concentration and distribution in occupied spaces. *Scandinavian Journal of Respiratory Diseases (Supplementum 91)*: 21-36, 1974.
- 15 DALHAMN, T., EDFORS, M., RYLANDER, R. Mouth absorption of various compounds in cigarette smoke. *Archives of Environmental Health* 16(6): 831-835, June 1968.

- 16 DALHAMN, T., EDFORS, M., RYLANDER, R. Retention of cigarette smoke components in human lungs. *Archives of Environmental Health* 17(5): 746-748, November 1968.
- 17 DUBLIN, W.B. Secondary smoking: A problem that deserves attention. *Pathology* 26(9):244-245, September 1972.
- 18 ENVIRONMENTAL PROTECTION AGENCY. National primary and secondary ambient air quality standards. *Federal Register* 36(84-Part II):8186-8201, April 30, 1971.
- 19 FODOR, G. G., WINNEKE, G. Effect of low CO concentrations on resistance to monotony and on psychomotor capacity. *Staub Reinhaltung der Luft* 32(4):46-54, April 1972.
- 20 GALUSKINOVA, V. 3,4 - Benzpyrene determination in the smoky atmosphere of social meeting rooms and restaurants. A contribution to the problems of so-called passive smoking. *Neoplasma* 11:465-468, 1964.
- 21 GODIN, G., WRIGHT, G., SHEPHARD, R. J. Urban exposure to carbon monoxide. *Archives of Environmental Health* 25(5):305-313, November 1972.
- 22 GROLL-KNAPP, E., WAGNER, H., HAUCK, H., HAIDER, M. Effects of low carbon monoxide concentrations on vigilance and computer-analyzed brain potentials. *Staub Reinhaltung der Luft* 32(4):64-68, April 1972.
- 23 HARKE, H. -P. The problem of "passive smoking." *Munchener Medizinische Wochenschrift* 112(51): 2328-2334, December 18, 1970.
- 24 HARKE, H. -P. The problem of passive smoking. I. The influence of smoking on the CO concentration in office rooms. *Internationales Archiv fur Arbeitsmedizin* 33(3): 199-206, 1974.
- 25 HARKE, H. -P., BAARS, A., FRAHM, B., PETERS, H., SCHLUTZ, C. Zum Problem des Passivrauchens (The problem of passive smoking.) *Internationales Archiv fur Arbeitsmedizin* 29:323-339, 1972.
- 26 HARKE, H. -P., BLEICHERT, A. Zum Problem des Passivrauchens (The problem of passive smoking.) *Internationales Archiv fur Arbeitsmedizin* 29:312-322, 1972.
- 27 HARKE, H. -P., LIEDL, W., DENKER, D. The problem of passive smoking. II. Investigations of CO level in the automobile after cigarette smoking. *Internationales Archiv fur Arbeitsmedizin* 33(3):207-220, 1974.
- 28 HARKE, H. -P., PETERS, H. The problem of passive smoking III. The influence of smoking on the CO concentration in driving automobiles. *Internationales Archiv fur Arbeitsmedizin* 33(3):221-229, 1974.
- 29 HARLAP, S., DAVIES, A. M. Infant admissions to hospital and maternal smoking. *Lancet* 1(7857):529-532, March 30, 1974.
- 30 HARMSEN, H., EFFENBERGER, E. Tobacco smoke in transportation vehicles, living and working rooms. *Archiv fur Hygiene and Bakteriologie* 141(5):383-400, 1957.
- 31 HOEGG, U. R. The significance of cigarette smoking in confined spaces. Thesis, University of Cincinnati, Division of Graduate Studies, Department of Environmental Health. 1972, 137 pp.
- 32 HOEGG, U. R. Cigarette smoke in closed spaces. *Environmental Health Perspectives* 2:117-128, October 1972.

- 33 JOHANSSON, C. R., RONGE, H. Acute irritation effects of tobacco smoke in the room atmosphere. *Nordisk Hygienist Tidskrift* 46:45-50, 1965.
- 34 JOHNSON, W. R. HALE, J. W., NEDLOCK, J. W., GRUBBS, H. J., POWELL, D. H. The distribution of products between mainstream and sidestream smoke. *Tobacco* 175(21):43-46, October 12, 1973.
- 35 LAWThER, P. J., COMMINS, B. T. Cigarette smoking and exposure to carbon monoxide. *Annals of the New York Academy of Sciences* 174:135-147, October 5, 1970.
- 36 LUQUETTE, A. J., LANDISS, C. W., MERKI, D. J. Some immediate effects of a smoking environment on children of elementary school age. *The Journal of School Health* 40(10):533-536, December 1970.
- 37 McFARLAND, R. A. A study of the effects of low levels of carbon monoxide upon humans performing driving tasks at the Harvard School of Public Health. 1973 Automotive Air Pollution Research Symposium, Washington, D.C., March 7-9, 1973.
- 38 McFARLAND, R. A. Low level exposure to carbon monoxide and driving performance. *Archives of Environmental Health* 27(6):355-359, December 1973.
- 39 RAY, A. M., ROCKWELL, T. H. An exploratory study of automobile driving performance under the influence of low levels of carboxyhemoglobin. *Annals of the New York Academy of Sciences* 174:396-408, October 5, 1970.
40. RUSSELL, M. A. H., COLE, P. V., BROWN, E. Absorption by non-smokers of carbon monoxide from room air polluted by tobacco smoke. *Lancet* 1(7803):576-579, March 17, 1973.
- 41 RYLANDER, R. (Editor). Environmental tobacco smoke effects on the non-smoker. *Scandinavian Journal of Respiratory Diseases (Supplementum 91)*: 1-90, 1974.
- 42 SCHMELTZ, I., HOFFMANN, D., WYNDER, E. L. The influence of tobacco smoke on indoor atmospheres. I. An overview. *Preventive Medicine* 4:66-82, 1975.
- 43 SCHULTE, J. H. Effects of mild carbon monoxide intoxication. *Archives of Environmental Health* 7(5):30-36, November 1963.
- 44 SEIFF, H. E. Carbon monoxide as an indicator of cigarette-caused pollution levels in intercity buses. U.S. Department of Transportation, Federal Highway Administration, Bureau of Motor Carrier Safety, April 1973, 11 pp.
- 45 SRCH, M. Uber die Bedeutung des Kohlenoxyds beim Zigarettenrauchen im Personenkraftwageninnern. *Deutsche Zeitschrift fur gerichtliche Medizin* 60:80-89, 1967.
- 46 STEWART, R. D., BARETTA, E. D., PLATTE, L. R., STEWART, E. B., KALBFLEISCH, J. H., VAN YSERLOO, B., RIMM, A. A. Carboxyhemoglobin levels in American blood donors. *Journal of the American Medical Association* 229(9):1187-1195, August 26, 1974.
- 47 STEWART, R. D., NEWTON, P. E., HOSKO, J. J., PETERSON, J. E. Effect of carbon monoxide on time perception. *Archives of Environmental Health* 27(3):155-160, September 1973.

- 48 U.S. DEPARTMENT OF TRANSPORTATION, FEDERAL AVIATION ADMINISTRATION, U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE. NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH. Health aspects of smoking in transport aircraft. Rockville, Md. AD-736097, December 1971, 85 pp.
- 49 U.S. PUBLIC HEALTH SERVICE. The Health Consequences of Smoking. A Report of the Surgeon General: 1972. U.S. Department of Health, Education, and Welfare. Washington, DHEW Publication No. (HSM) 72-6516, 1972, 158 pp.
- 50 WRIGHT, G., RANDELL, P., SHEPHARD, R. J. Carbon monoxide and driving skills. Archives of Environmental Health 27(6): 349-354, December 1973.

INDEX 1975

- Acetaldehyde
levels, effects of room size, amount of tobacco burned, and ventilation, 90, 93, 98
- Acrolein
effects of inhalation of, in rats, 29
levels, effects of room size, amount of tobacco burned, and ventilation, 90, 93, 98
- AHH activity
see Aryl hydrocarbon hydroxylase activity
- Air pollution
effects of exposure levels on respiratory symptoms in twins, 67
exposure levels and coal consumption, 67
and human CO burden, 20
levels, exposure of telephone workers and pulmonary symptoms, 67
and smoking, in COPD development, 63-68
and smoking, in lung cancer development, 44, 47
summary of recent findings, 108
survey data for four U.S. locations, 63-66
- Airways
dysfunction of, in smokers, 71
function during viral illness, in smokers vs. nonsmokers, 62, 63
- Alveolar macrophages
decrease in pinocytosis, in smokers vs. nonsmokers, 76
response to migration inhibition factor or antigens, in smokers vs. nonsmokers, 76, 77
- Angina pectoris
effects of increased carboxyhemoglobin levels, in passive smokers, 95, 97
- Antigens
effect on alveolar macrophages, in smokers vs. nonsmokers, 76, 77
- Antitrypsin deficiency
and smoking, in COPD etiology, 72-74
- Arteries
thickening of, in smokers vs. nonsmokers, 74-76
- Arterioles
thickening of, in smokers vs. nonsmokers, 74-76
- Aryl hydrocarbon hydroxylase activity
role in lung cancer development, 50-53
- Asbestos
chrysotile, effects on lungs, 49
- Atherosclerosis, coronary
see Coronary heart disease
- Autopsy findings
and smoking, 74-76
- Benzo(a)pyrene
levels, effects of room size, amount of tobacco burned, and ventilation, 91-94, 98
- Birth weight
effects of maternal smoking, 27
- Bladder cancer
see Genitourinary cancer
- Blood pressure
levels, in smokers, nonsmokers, and ex-smokers, 15-17
- Body weight
and hypertension, in smokers, nonsmokers, and ex-smokers, 15-17
- Bronchiolitis
autopsy studies, in male smokers vs. nonsmokers, 74, 76, 77
- Bronchitis
chronic, incidence of, in high pollution areas, 63, 64
chronic, and lung cancer development, 49
chronic, summary of previous findings, 5, 7, 61, 62
development in infants of maternal smokers, 103
incidence in children of smokers, 105, 106
in passive smokers, summary of recent findings, 108
- Bronchopulmonary diseases, chronic obstructive
see also Emphysema, Bronchitis
air pollution and smoking in etiology of, 63-68
effects of antitrypsin deficiency in smokers vs. nonsmokers, 72-74
effects of partially deficient heterozygote phenotypes, 73, 74
incidence in firemen, 68
summary of previous findings, 61, 62
summary of recent findings, 78
- Byssinosis
development in cotton mill workers, in smokers vs. nonsmokers, 68
- Cancer
see also specific site, e.g., Lung cancer
summary of previous findings, 3-8
summary of recent findings, 43, 54
- Carbon monoxide
cholesterol levels in aorta of rabbits, after exposure to, 28
and decrease in exercise time before claudication, 18
effects on aortas in animals, 28
effects on healthy smokers vs. nonsmokers, 26
exposure to, and human absorption, 21-28
levels, effects of room size, amount of tobacco burned, and ventilation, 90-95
levels, effects on exercise performance, 97
levels, from smokers in buses and planes, 102

- myocardial effects on rabbits, 29
- summary of previous findings on relationship to passive smoking, 87, 88, 108
- summary of recent findings, 33
- from tobacco smoke, effects of psychomotor performance, including attentiveness and cognition function, 99-101
- Carboxyhemoglobin levels
 - in cigarette smokers, one hour after last cigarette, 25-26
 - and CO burden in smokers vs. nonsmokers, 21, 26-29
 - effects on CO absorption, in passive smoking, 95, 96
 - effects on exercise performance, 97
 - in fetuses, 26, 27
 - in smokers vs. nonsmokers, by sex, race, employment status, or urban location, 22-24
 - summary of recent findings, 33
 - in workers exposed to exhaust gases, 21
- Carcinogenesis
 - aryl hydrocarbon hydroxylase activity, and susceptibility to carcinogens, 50-53
 - experimental, 48-50
 - summary of previous findings, 43
- Carcinogens
 - benzo(a)pyrene, and exfoliative cytology of hamster lungs, 47
 - benzo(a)pyrene and chrysotile asbestos, in animals, 49
 - in cigarette smoke, 49, 50
- Cardiovascular diseases
 - see also* Coronary heart disease, Cerebrovascular disease
 - atherosclerotic, effects of CO, 27, 28
 - pathogenesis of, 28, 29
- Cerebrovascular disease
 - epidemiological studies, 29, 30
 - mortality by age, sex, and smoking habit, 31
- CHD
 - see* Coronary heart disease
- Chemicals
 - exposure to, in smokers vs. nonsmokers, by race and sex, 69, 70
- Children
 - of smokers, incidence of pneumonia and bronchitis, 105, 106
 - of smokers, prevalence of respiratory symptoms, 102, 103
- Cholesterol levels
 - after CO exposure, in rabbits, 28
 - and hypertension, in smokers vs. nonsmokers, 15
- Chronic bronchitis
 - see* Bronchitis
- Chronic obstructive bronchopulmonary disease
 - see* Bronchopulmonary disease, chronic obstructive
- Cigar smoking
 - autopsy studies, in smokers with emphysema, fibrosis, or thickening of arterioles or arteries, 75
 - CO levels in mainstream smoke, 90
 - relationship to cancer, 43, 44
- summary of previous findings on effects on smokers, 4, 13
- Cigarette smoke
 - see* Smoke, cigarette
- Cigarettes, filter
 - decrease in lung cancer risk, 44
 - summary of previous findings, 4
- Clofibrate
 - and reduction in risk of sudden death in cigarette smokers, 32
- Closing volume abnormalities
 - as indicator of small airways disease, in smokers vs. nonsmokers, 71, 72
- CO
 - see* Carbon monoxide
- Coffee drinking
 - and myocardial infarction in smokers vs. nonsmokers, 19, 20
- COPD
 - see* Bronchopulmonary disease, chronic obstructive
- Coronary heart disease
 - see also* Angina pectoris, myocardial infarction
 - effects of coffee drinking and cigarette smoking, 20
 - epidemiological studies, 14, 15
 - summary of previous findings, 4, 7
- Cough
 - of parental smokers, and respiratory symptoms in children, 103, 105
 - in school-age smokers vs. nonsmokers, 62
- Cytologic studies
 - exfoliative, and lung cancer diagnosis, 47
- Dust exposure
 - in smokers vs. nonsmokers, by race and sex, 69, 70
 - and smoking as risk factors in byssinosis development, among mill workers, 68
- Emphysema
 - autopsy studies, in smokers vs. nonsmokers, 74-76
 - summary of previous findings, 5, 7, 61, 62
- Epidemiological studies
 - cerebrovascular disease and smoking, 29, 30
 - CHD and smoking, 14, 15
 - lung cancer and smoking, 44
- Epinephrine levels
 - effects of nicotine, 29
- Epithelium
 - bronchial, and premalignancy in smokers, 44
- Exercise performance
 - effects of CO exposure and increased carboxyhemoglobin levels, 95, 97
- Ex-smokers
 - decrease in risk of developing lung cancer, 43
 - effects of cessation on body weight, blood pressure, and hypertension, development, 16-19
 - effects of cessation on closing volume abnormalities, 71

- effects of cessation on pathologic changes, 74
- summary of previous findings on health consequences of cessation, 6
- summary of previous findings on relationship to COPD, 61
- Eye irritation
 - effects of exposure to cigarette smoke, in passive smokers, 99, 100
- Fibrosis
 - autopsy studies, in smokers vs. non-smokers, 74-76
- Forced expiratory volume
 - decline in smokers, by race, 72
- Framingham Study
 - effect of coffee drinking on mortality in smokers vs. nonsmokers, 20
- Fume exposure
 - in smokers vs. nonsmokers, by race and sex, 69, 70
- Genetics
 - role of antitrypsin deficiency and smoking in COPD development, 72-74
- Genitourinary cancer
 - smoking as risk factor, 50
- Histological studies
 - lung cancer and smoking, 44-46
- Humidity
 - and pathologic effects of exposure to cigarette smoke, 99
- Hypertension
 - effects of smoking, 15-19
 - summary of recent findings, 33
- Infants
 - maternal smoking, and development of bronchitis and pneumonia, 103
- Inhalation patterns
 - summary of previous findings, 4
- Immune system
 - suppression of immunoglobulin response, by nicotine or water-soluble fraction of cigarettes, 77
- Intermittent claudication
 - decrease in exercise time after exposure to CO, 28
 - effects of coffee drinking and cigarette smoking, 20
- Involuntary smoking
 - see Passive smoking
- Laryngeal cancer
 - incidence of second primary, in smokers vs. nonsmokers, 50
- Leukocytes
 - effects of cigarette smoke, in guinea pigs, 77, 78
- Lung cancer
 - decreased risk of, in ex-smokers, 43
 - and development of chronic bronchitis, 49
 - effects of air pollution and smoking, 44, 47
 - effects of asbestos exposure and smoking, 49
 - epidemiological studies, 44
 - histological types, in smokers vs. non-smokers, 44-46
 - increase in mortality of, in female smokers, 47
 - summary of previous findings, 3, 5-8
 - summary of recent findings, 43
- Mainstream smoke
 - see Smoke streams
- Migration inhibition factor
 - effects of alveolar macrophages, in smokers vs. nonsmokers, 76, 77
- Morbidity
 - from respiratory symptoms, 62, 63
- Mortality
 - from cerebrovascular disease by age, sex, and smoking habit, 31
 - from CHD, 14
 - from lung cancer, of female smokers, 47
 - from myocardial infarction, 14
 - summary of previous findings, 3-8, 13
- Myocardial infarction
 - damage to rabbits after exposure to carbon monoxide, 29
 - effects of coffee drinking and cigarette smoking, 19, 20
 - mortality, in smokers vs. nonsmokers, 14
 - summary of previous findings, 4, 13
 - in Swedish women, smokers vs. non-smokers, 14
- Nasopharyngeal cancer
 - in smokers vs. nonsmokers, in Taiwan, 50
- Nicotine
 - effects on epinephrine and norepinephrine levels, 29
 - excretion, by passive smokers, 97
 - levels, effects of room size, amount of tobacco burned, and ventilation, 91-94, 97
 - suppression of immunoglobulin response, in cell cultures, 77
- N-Nitrosamines
 - N'-nitrosornicotine, in tobacco, 48, 49
- N-Nitrosoheptamethyleneimine
 - incidence of lung neoplasms, in rats, 49
- Norepinephrine
 - effects of nicotine, 29
- Occupational diseases
 - byssinosis in cotton mill workers, 68
 - COPD, in firemen, 68
 - effects of asbestos exposure and smoking on lung cancer development, 49
 - lung cancer, in uranium miners, 47
 - and risk of cancer, 43
 - smoking and, 68-70
- Occupational hazards
 - carboxyhemoglobin levels in workers exposed to exhaust gases, 21

- exposure to chemicals, fumes, sprays, and dusts, in smokers vs. nonsmokers, by race and sex, 69, 70
 - higher reporting of exposure to, by smokers vs. nonsmokers, 68
- Oral cancer
 - incidence of second primary, in smokers vs. nonsmokers, 50
- Parents
 - cough and phlegm production, and respiratory symptoms in children, 103
 - incidence of pneumonia and bronchitis in children of smokers, 105, 106
 - prevalence of respiratory symptoms in children of smokers, 102, 103
- Particulate matter
 - pollution levels in four U.S. locations, 65, 66
- Passive smoking
 - CO, nicotine, benzo(a)pyrene, acrolein, and acetaldehyde levels, 90-95
 - effects on bus and plane passengers, 102
 - effects of carboxyhemoglobin levels, in persons with angina pectoris, 95, 97
 - effects of carboxyhemoglobin levels on CO absorption, 95, 96
 - effects of CO in tobacco smoke on psychomotor performance, 99-101
 - effects of tobacco smoke constituents, 88-98
 - excretion of nicotine, 97
 - exposure to cigarette smoke, and development of eye and throat irritations, 99, 100
 - incidence of pneumonia and bronchitis in children of parental smokers, 105, 106
 - maternal smoking, and development of bronchitis and pneumonia in infants, 103, 104
 - parental cough and phlegm production, and respiratory symptoms in children, 103
 - pathological studies, 99
 - prevalence of respiratory symptoms in children of smokers, 102, 103
 - summary of previous findings, 87, 88
 - summary of recent findings, 107, 108
- Pathological studies
 - effects of exposure to cigarette smoke, in passive smokers, 99
- Pathophysiological studies
 - alveolar macrophages and smoking, 76, 77
 - effects of cigarette smoke on leukocytes, in guinea pigs, 77, 78
 - effects of cigarette smoke on pulmonary macrophages, in guinea pigs, 77, 78
 - effects of smoking on tracheal mucous velocity, in dogs, 78
 - suppression of immunoglobulin response by nicotine or water-soluble fraction of cigarettes, 77
- Pharyngeal cancer
 - incidence of second primary, in smokers vs. nonsmokers, 50
- Phenotypes
 - partially deficient heterozygote, in COPD etiology, 73, 74
- Phlegm
 - production by parental smokers, and development of respiratory symptoms in children, 103
 - production by parental smokers, and incidence of pneumonia and bronchitis in children, 105, 106
- Pinocytosis
 - decrease in alveolar macrophages, in smokers vs. nonsmokers, 76
- Pipe smoking
 - autopsy studies, in smokers with emphysema, fibrosis, or thickening of arterioles or arteries, 75
 - summary of previous findings on effects, 4, 13
 - relationship to cancer, 43, 44
- Pneumonia
 - incidence in children of smokers, 105, 106
 - maternal smoking, and development in infants, 103
 - in passive smokers, summary of recent findings, 108
- Polynuclear aromatic hydrocarbons
 - tumor initiators in tobacco, 48
- Pregnancy
 - carboxyhemoglobin levels in fetuses, 26, 27
 - maternal smoking, and development of bronchitis and pneumonia in infants, 103, 104
 - summary of previous findings, 5, 6
- Psychomotor performance
 - effects of CO in tobacco smoke, 99-101
 - in passive smokers, summary of recent findings, 108
- Public transportation
 - effects of passive smoking on bus and plane passengers, 102
- Pulmonary function
 - abnormalities, during viral illness, in smokers vs. nonsmokers, 63
 - closing volume abnormalities as indicator of small airways disease, 71, 72
 - decline in forced expiratory volume, in smokers by race, 72
 - prevalence of deficient heterozygote phenotypes, in smokers vs. nonsmokers, 74
 - small airways disease, smoking and, 71, 72
 - summary of recent findings, 78
- Pulmonary macrophages
 - effects of cigarette smoke, in guinea pigs, 77, 78
 - summary of recent findings, 78
- Pulmonary symptoms
 - effects of air pollution exposure levels on telephone workers, 67
- Respiratory symptoms
 - see also* Cough, Phlegm

- in smokers vs. nonsmokers, 62, 63
- summary of previous findings, 5
- summary of previous findings on relationship to passive smoking, 88
- summary of recent findings, 78

Sidestream smoke
see Smoke streams

Smoke streams
CO levels in mainstream cigar smoke, 90
constituents of tobacco smoke, 88-98
summary of previous findings, 87, 88

Smoke, cigarette
carcinogenic content of, 48
and decrease in pulmonary macrophages, in guinea pigs, 77, 78
effects on tracheobronchial clearance, in donkeys, 78
suppression of immunoglobulin response, in cell cultures, 77

Smoke, tobacco
effects of constituents on passive smokers, 88-98
summary of recent findings, 108
summary of previous findings on relationship to passive smoking, 87, 88

Smoking, maternal
during pregnancy, and development of bronchitis and pneumonia in infants, 103, 104

Sudden death
reduction of risk of, in cigarette smokers, using clofibrate, 32

Sulfur dioxide
pollution levels in four U.S. locations, 65, 66

Tars, cigarette
summary of previous findings on effects on smokers, 5

Throat irritation
effects of exposure to cigarette smoke, in passive smokers, 99

Thrombogenesis
effects of smoking, 32

Tracheal mucous velocity
effects of smoking, in dogs, 78

Tracheobronchial clearance
effects of cigarette smoke, in donkeys, 78

Tumorigenic activity
in experimental animals, 48
of polynuclear hydrocarbons and tumor accelerators, 48

Twins
air pollution exposure levels and respiratory symptoms, 67
mortality from CHD, in smokers vs. nonsmokers, 14, 15

Ventilation
effects on constituents of tobacco smoke, 90-95

Ventricular premature beats
effect of cigarette smoking, 20

Water
soluble fraction of cigarettes, suppression of immunoglobulin response, 77

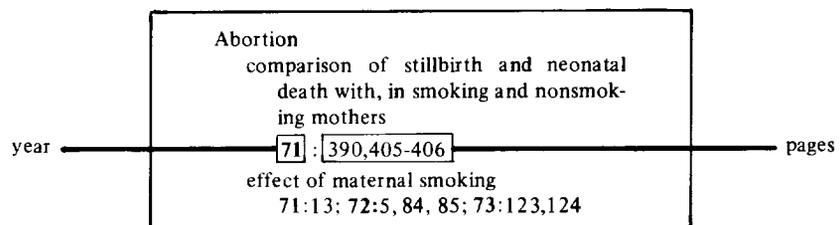
Women
autopsy studies, in smokers vs. nonsmokers with emphysema, fibrosis, or thickening of arterioles or arteries, 75
exposure to chemicals, fumes, sprays, and dusts, in smokers vs. nonsmokers, 69, 70
incidence of lung cancer in, 43
increase in mortality from lung cancer, 47
myocardial infarction, in Swedish smokers vs. nonsmokers, 14
summary of previous findings on effects of smoking, 5-7

CUMULATIVE INDEX 1964—1975

Since the original report on the health consequences of smoking in 1964 entitled *Smoking and Health, Report of the Advisory Committee to the Surgeon General of the Public Health Service*, eight additional reports on the topic have been prepared for the U.S. Congress. The nine reports are for the years 1964, 1967, 1968, 1969, 1971, 1972, 1973, 1974, and 1975.

To facilitate use of this accumulated scientific evidence on the health consequences of smoking, the following cumulative index of the nine reports was prepared. It should be noted that before this cumulative index, the 1964 and 1968 Reports had not been indexed; thus, this compilation provides the only indexes for these two reports. The concept headings in this index are essentially the same as those used in the individual report indexes. However, an effort was made to use only one term per concept and to select the most commonly used terminology in the scientific literature for the concept.

The user of this index is referred to information in the different reports by the report year followed by the page numbers in that report. The year of the report is set in boldface type to stand out from the page numbers. The following excerpt from the index exemplifies this:



71:390,405-406 (This entry refers the user to the 1971 Report, pages 390, 405, and 406.)

71:13; 72:5,84,85; 73:123-124 (This entry refers the user to the 1971 Report, page 13; to the 1972 Report, pages 5, 84, and 85; and to the 1973 Report, pages 123 and 124.)

INDEX
(Cumulative 1964-1975)

- Abortion
 comparison of stillbirth and neonatal death with, in smoking and nonsmoking mothers
 71:390, 405-406
 effect of maternal smoking
 71:13; 72:5, 84, 85; 73:123, 124
 frequency, and cigarette consumption
 72:85
- Absenteeism
 smoking and
 67:19
- Abstinence syndrome
 64:352
- Academic underachievement
 64:372, 373
- Acenaphthylene
 in cigar, pipe, and cigarette smoke
 73:178
- Acenaphthene
 64:55
- Acetaldehyde
 64:52, 60, 61
 as ciliatotoxic agent in cigarette smoke
 73:51
 levels, effects of room size, amount of tobacco burned and ventilation
 75:91-94, 98
 as suspected contributor to health hazards of smoking
 72:145
- Acetic acid
 as ciliatotoxic agent
 67:107-108
 in tobacco smoke
 67:107-108
- Acetone
 64:52, 60
 as suspected contributor to health hazards of smoking
 72:145
- Acetonitrile
 as suspected contributor to health hazards of smoking
 72:145
- Acetylcholine
 effect on nicotine pharmacology
 67:60
 sensitivity to
 64:69
- Acetylene
 64:60
- Acidosis
 metabolic, maternal smoking effect on infant
 71:407
- Acinus
 smoke clearance from
 64:267, 269
- Acrolein
 64:60, 61, 266, 268
- ciliastatic effect from
 64:266, 267, 268
 as ciliatotoxic agent
 67:107-108
 effect on *Dunaliella bioculata*
 69:42
 effect on respiratory tract
 64:266, 267
 effect on respiratory tract, in rats
 74:104
 effects of inhalation of, in rats
 75:29
 as irritant in tobacco smoke
 72:101
 levels, effects of room size, amount of tobacco burned and ventilation
 75:91-94, 98
 as probable contributor to health hazards of smoking
 72:144
- Acrylonitrile
 as suspected contributor to health hazards of smoking
 72:145
- Additives, tobacco
 see Tobacco additives
- Adenocarcinoma
 beryllium induced
 64:166
 classification of
 64:173
 hydrocarbon induced
 64:228
 increased frequency of
 64:35, 174, 175, 231
 kidney, smoking and
 69:60
 nonsmokers incidence of
 64:160
 prevalence in male and female smokers and nonsmokers
 71:250
 relationship of cigarette smoking to
 71:246-249, 296
 risk ratio of smokers
 69:56
 smoking and
 64:159; 67:107-108
 smoking and, for men
 69:57
- Adenoma
 papillary, induction in rats by exposure to cigarette tars
 71:348
 pulmonary
 64:34, 165
 pulmonary, genetic factors in
 64:34, 167
 pulmonary, induction in mice by cigarette smoke inhalation
 71:349

pulmonary, induction of
 64:143
 renal, relationship of smoking to
 71:296
 Adipose tissue
 effect of nicotine, in rats
 74:13
 Adrenalectomy
 effect on nicotine pharmacology
 67:60
 Adrenal glands
 catecholamine release from, nicotine ef-
 fects on
 71:36
 epinephrine discharge from
 64:318
 nicotine effect on
 64:69
 Advertising
 curtailment of
 64:8
 Advisory Committee on Smoking and
 Health
 64:13, 14, 173
 establishment and conclusions of study
 by
 71:3
 evaluation of studies by
 64:8, 9, 14, 15, 19
 formation of
 64:7, 8, 9
 members of
 64:9, 10
 report on cigarette smoke and conden-
 sates effects on oral cavity of animals
 71:288
 Aerobic capacity
 effect of cessation of smoking
 73:243
 effect of exercise and smoking
 73:243, 244
 Aerosol
 irritation by
 64:295
 tobacco smoke as
 64:263
 Aflatoxins
 64:145
 Age
 atypical nuclei in esophageal epithelium
 arranged by smoking and
 71:379-380
 bed days by, and smoking history
 67:20-21
 bladder neoplasm mortality rates by
 67:154
 bronchitis mortality rates by
 67:29, 92
 bronchitis mortality ratios by
 67:94
 cerebrovascular disease mortality ratios
 by
 67:66-68
 coronary disease excess morbidity rates
 by
 67:54
 coronary disease incidence rates and
 smoking history by
 69:13-14, 17
 coronary disease incidence rates by
 67:54, 58
 coronary disease morbidity ratios by
 67:54
 coronary disease mortality rates by
 67:25-26, 50
 coronary disease mortality ratios by
 67:26, 47, 49, 51-52; 69:13, 18
 coronary thrombosis mortality by
 67:26
 current cigarette smokers by sex and
 71:6
 effects on CHD
 71:27-39
 emphysema mortality rates by
 67:29, 92
 emphysema mortality ratios by
 67:94
 esophageal neoplasm mortality rates by
 67:150
 esophageal neoplasm mortality ratios by
 67:150
 expiratory flow rate by
 64:291
 forced expiratory volume by
 64:291
 increased smoking by
 64:361, 362
 laryngeal neoplasm mortality rates by
 67:148-149
 laryngeal neoplasm mortality ratios by
 67:148-149
 liver cirrhosis mortality rates by
 67:184
 liver cirrhosis mortality ratios by
 67:184
 lung functions for smokers vs. non-
 smokers by
 67:100
 lung neoplasm mortality rates by
 67:134-138, 140
 lung neoplasm mortality ratios by
 67:134-136, 138, 140
 mortality ratios by
 64:36, 87
 mouth neoplasm mortality rates by
 67:146
 mouth neoplasm mortality ratios by
 67:145-146
 nonsmokers by
 64:117
 pancreatic neoplasm mortality rates by
 67:158-159
 pancreatic neoplasm mortality ratios by
 67:158-159
 peptic ulcer mortality rates by
 67:181
 peptic ulcer mortality ratios by
 67:181
 peptic ulcer mortality ratios for smokers
 vs. ex-smokers by
 67:181
 pharyngeal neoplasm mortality rates by
 67:146

pharyngeal neoplasm mortality ratios by
 67:146
 pulmonary fibrosis by
 64:274
 respiratory symptoms in smokers vs.
 nonsmokers by
 67:96-98, 100
 restricted activity days by, and smoking
 history
 67:20-21
 smokers by
 64:117
 smoking and, effect on clinical labora-
 tory tests in healthy male veterans
 73:11
 statistics, errors in
 64:117, 118
 stomach neoplasm mortality rates by
 67:157
 stomach neoplasm mortality ratios by
 67:157
 stroke mortality rates by
 69:13, 17
 stroke mortality ratios by
 69:13
 urinary tract neoplasm mortality rates
 by
 67:154
 urinary tract neoplasm mortality ratios
 by
 67:154
 urogenital neoplasm mortality ratios by
 67:154
 work-loss days by, and smoking history
 67:20, 21
Age-adjusted death rates
 64:31, 36, 82, 84, 100, 101
 by country
 64:127
 in heavy smokers
 64:100
 in males
 64:95, 101, 127
 in nonrespondents
 64:114
 sex ratios in
 64:133
 in survey respondents
 64:114
 in United States
 64:127
 variables affecting
 64:100
 weighting of
 64:114
 in white males
 64:95
Aged
 prevalence of COPD in, smokers vs.
 nonsmokers
 74:78
Age started smoking
 64:89, 111, 361, 362, 368, 371-374,
 376
 lung neoplasm association with
 64:158, 230
 mortality rates and
 64:29, 158
 mortality rates in Japanese by
 73:7, 8
 socioeconomic factors in
 64:368
Agricultural workers
 64:290
Air pollution
 64:150, 177, 186, 195, 232, 295, 296,
 297, 298
 arsenic in
 64:61
 and bronchitis, in smokers vs. nonsmok-
 ers
 73:36, 37
 bronchopulmonary effects on smokers
 vs. nonsmokers
 68:69
 carbon monoxide from cigarette smoke
 72:7, 121-123, 125
 as cause of chronic bronchopulmonary
 disease
 67:29, 108-110
 as cause of COPD
 71:152, 175, 216-217
 in chronic bronchitis
 64:297, 298
 ciliastasis from
 64:268
 effect of exposure levels on respiratory
 symptoms in twins
 75:67
 effect on mortality rates from lung
 cancer
 73:73
 effect on nonsmokers
 72:121-125
 effect on smokers
 67:108-110
 and emphysema
 64:297
 in etiology of bronchitis
 67:108-110
 in etiology of emphysema
 67:108-110
 in etiology of lung neoplasms
 64:172; 67:140; 68:98, 99; 71:11,
 276; 73:72, 73
 exposure levels and coal consumption
 75:67
 exposure magnitude in
 64:296, 297, 298
 and human CO burden
 75:20
 levels, exposure of telephone workers
 and pulmonary symptoms
 75:67
 lung damage from
 64:301
 in Osaka, Japan
 73:44
 prevalence of respiratory diseases and
 73:44
 relationship of lung neoplasms, smoking
 and place of residence
 71:252-255
 respiratory diseases in
 64:295-298

- smoking and, in COPD development
 - 74:82, 83; 75:63-68
- smoking and, in lung neoplasms development
 - 74:45, 46; 75:44, 47
- smoking and, in military and civilian aircraft
 - 73:45
- sulfur dioxide in
 - 64:295
- summary of recent findings
 - 75:108
- survey data for four U.S. locations
 - 75:63-66
- tobacco smoke as a factor
 - 72:7, 121-124
- "Tokyo-Yokohama asthma" from
 - 64:276
- urban-rural effects of
 - 64:298
- Air quality
 - standards for carbon monoxide
 - 72:128
- Airway conductance
 - 64:292
- Airway obstruction
 - emphysema in
 - 64:297
 - measurement of
 - 64:292
 - ozone induction of
 - 64:296
 - smoking effect on
 - 64:292, 293, 297, 300
 - sulfur dioxide effect on
 - 64:295
- Airway resistance
 - to smoke inhalation in guinea pigs
 - 68:72
- Airways, large
 - effect of smoking one nonfilter cigarette
 - 74:99
- Airways, small
 - abnormalities, in smokers vs. nonsmokers, autopsy studies
 - 74:97, 98
 - dysfunction of, in smokers
 - 75:71
 - effect of smoking one nonfilter cigarette
 - 74:99
 - function during viral illness, in smokers vs. nonsmokers
 - 75:62, 63
- Albany prospective studies
 - 64:323, 325
- Alcohol
 - ethanol, penetrability of dissolved benzo(a)pyrene in mice esophageal epithelium
 - 71:293
- Alcohol consumption
 - 64:91, 101, 224, 302, 385
 - effect on esophageal neoplasms in smokers
 - 71:289, 293
 - effect on laryngeal neoplasms in tobacco users
 - 71:280
 - effect on mortality rates from esophageal neoplasms in Japanese males
 - 72:71
 - effect on tobacco amblyopia
 - 71:435-436
 - in esophageal neoplasms
 - 64:213, 217, 218
 - in heavy smokers
 - 64:342
 - and heavy smoking, effect on oral neoplasms
 - 71:288
 - interaction with smoking and other risk factors in CHD
 - 73:10
 - in laryngeal neoplasms
 - 64:210, 211
 - in liver cirrhosis
 - 64:342
 - in oral neoplasms
 - 64:204
 - smoking and, in esophageal neoplasm etiology
 - 67:152; 71:3, 68, 70, 71; 73:76, 200
 - smoking and, in laryngeal neoplasm etiology
 - 73:197
 - smoking and, in neoplasm development
 - 73:76, 200
 - smoking and, in oral neoplasm etiology
 - 68:100, 101; 73:193; 74:53-55
 - smoking and, in relation to cirrhosis of liver
 - 67:40, 185
 - in tuberculosis
 - 64:277; 71:172
 - see also* Alcoholism
- Alcoholic beverage workers, neoplasm risk ratios in
 - 64:134
- Alcoholics Anonymous
 - 64:354
- Alcoholism
 - mortality in, relation to smoking
 - 67:10, 184
 - patients, smoking and ventilatory function in
 - 71:213
- Alcohols, aliphatic
 - 64:51
- Aldehydes
 - 64:52, 296
- Aldrin
 - 64:62, 145
- Alkaline dusts
 - 64:298
- Alkaloids
 - 64:54
- Alkaloids, tobacco
 - and experimental bladder neoplasms
 - 69:64
- N-Alkanes
 - 64:51
- Alkylbenzenes
 - 64:55
- Alkylphenols
 - 64:54
- Allergy
 - effect on cardiovascular abnormalities
 - 72:111

tests of
 64:276
 tobacco and
 72:7, 103-11
 tobacco-induced
 64:276, 301, 319
 tobacco smoke irritants and
 72:110
 Alpha-1-antitrypsin deficiency
 COPD predisposition from
 71:150
 determination using immunoelectrophoresis
 71:151
 in emphysema etiology
 71:10-11; 72:110
 smoking and
 72:110
 smoking and, in COPD etiology
 74:87-90; 75:72-74
 Altitude
 effect on arterial oxygen tension
 72:22
 Aluminum
 in main stream smoke
 64:55
 Alveolar bone loss
 smoking and
 69:85-87
 Alveolar macrophages
 see Macrophages, alveolar
 Alveoli
 see Pulmonary alveoli
 Amblyopia, tobacco
 64:39, 73, 341, 342
 alcohol consumption effect on
 71:435-436
 characterization of
 71:435
 and cigar smoking
 67:39
 development: from cyanide component
 of tobacco smoke
 71:14; 72:6
 diet and
 72:6
 effect on optic pathways
 67:183
 incidence of
 71:435
 pathogenesis
 67:183
 and pipe smoking
 67:39
 potentiation of cyanide toxicity by vitamin B-12 deficiency in
 67:183
 smoking and
 72:6
 vitamin B deficiency and tobacco smoke
 in
 67:40, 183
 American Cancer Society
 64:6, 7, 81, 93, 96, 101, 363
 American College of Chest Physicians
 64:8
 American Heart Association
 64:6, 7
 pooling project on CHD
 71:23, 28, 30, 39
 American Medical Association
 64:8
 American Thoracic Society
 64:275, 278, 279
 Amino acids
 64:54
 Aminoazo dyes
 activity in placenta of smoking mothers
 71:410
 o-Aminophenols
 concentration in urine of cancer patients
 and smokers
 69:64
 experimental bladder neoplasm induction
 67:156
 Ammonia
 64:60, 61
 ciliastatic effect of
 64:268
 as suspected contributor to health hazards of smoking
 72:145
 Amphetamine
 64:71
 Anabasine
 64:49
 Analytic methods
 arsenic determination
 64:61, 62
 fluorescence properties
 64:51
 mass spectrometry
 64:51
 paper chromatography
 64:51
 ultraviolet absorption
 64:51
 Anger
 personality traits, smokers
 64:326
 Angina pectoris
 64:275, 319, 320, 323, 325
 carbon monoxide exposure and
 74:11, 12
 carbon monoxide inhalation and
 73:17, 18
 coffee drinking, smoking, and
 74:8
 and coronary disease incidence
 67:53
 effects of increased carboxyhemoglobin
 levels, in passive smokers
 75:95, 97
 Health Insurance Plan Study and incidence in males
 68:19, 20
 and heavy cigarette smoking, findings of Framingham Heart Study
 68:19
 incidence in Norwegian men
 68:19
 incidence in pipe and cigar smokers
 73:215
 incidence rates and smoking history
 69:21-22

- morbidity ratios
 - 67:59
- morbidity ratios among persons 30-59 years old
 - 68:20
- smoking and
 - 69:18; 74:8
- smoking and, in twins
 - 67:59; 69:25; 72:18
- Aniline dyes
 - 64:222
- Animals
 - esophageal neoplasms in, induction by nitrosamines
 - 71:292
 - experiments, as evidence
 - 64:26
 - respiratory tract of, neoplastic changes following cigarette smoke inhalation
 - 71:238-239
 - skin of, carcinogenicity of tobacco tars
 - 71:238, 267
 - tests of, with smoke carcinogens
 - 71:12
 - ventilatory function change from smoking
 - 71:10
- Annandale study
 - 64:286
- Anoxia
 - 64:70, 344
 - cerebral
 - 64:70
 - effect on myocardial tissue function
 - 68:38-40, 43
 - relation to smoking
 - 67:183
- Anthanthrene
 - 64:147
- Anthracene
 - in cigar, pipe, and cigarette smoke
 - 73:178
 - oil, carcinogenic activity of
 - 64:147
- Anthranilic acid, 3-hydroxy-
 - urinary excretion of, smoking effects on
 - 71:296
- Anticarcinogens
 - 64:143, 144
- Antidiuretic hormone
 - 64:69, 320
- Antigen-antibody reactions
 - allergy and
 - 72:103-107
 - smokers vs. nonsmokers
 - 72:7, 105, 111
 - tobacco and
 - 72:7, 104-107
- Antigenic properties
 - of tobacco
 - 64:319
- Antigens
 - effect on alveolar macrophages, in smokers vs. nonsmokers
 - 75:76, 77
- Antioch College study
 - 64:370
- Antismoking campaigns
 - 64:354
- Aortic aneurysm
 - mortality, for men by amount smoked
 - 69:16
 - mortality rates
 - 64:103, 325; 67:69
 - mortality ratios
 - 67:69
 - nonsyphilitic, mortality rates, smokers vs. nonsmokers
 - 72:2
 - smoking and
 - 67:27; 71:9, 67, 71, 75
- Aortic arch reflexes
 - 64:70
- Aortic bodies,
 - nicotine induced stimulation of
 - 64:317
- Appetite reduction
 - 64:71, 355
- Areca nut
 - see Betel nut
- Arecoline
 - 64:351
- Argon
 - in gas phase, in smoke
 - 64:60
- Aromatic alcohols
 - 64:51
- Aromatic compounds
 - carcinogenic properties in cigarette smoke from
 - 71:264, 265
 - detection in urine using chemiluminescence technique
 - 71:297
 - polycyclic, carcinogenicity of
 - 64:142, 146, 165, 166, 189, 229, 230
 - polycyclic, pyrolytic formation of
 - 64:59
 - polycyclic, structure of
 - 64:54, 56
 - stimulation of placental BP-hydroxylase activity in pregnant rats by
 - 71:414
- Aromatic hydrocarbons
 - 64:55
 - carcinogenicity
 - 67:129; 69:61
 - role in lung neoplasm development
 - 74:49-52
 - in tobacco smoke
 - 64:55; 67:127
- Aromatic hydrocarbons, polycyclic
 - binding to DNA and RNA
 - 73:86, 87
 - effect during pregnancy in laboratory animals
 - 73:117, 118
 - effect on tobacco carcinogenicity
 - 72:66
 - maternal-fetal exchange and
 - 73:119
 - tumor initiators in tobacco
 - 75:48

Arousal effects
 nicotine induction of
 64:70, 350

Arrhythmias
 formation in nicotine stimulated damaged myocardium
 71:58
 nicotine toxicity in
 64:73
 smoke induction of
 64:319
 smoking and
 69:4

Arsenic
 64:55, 61, 62
 carcinogenicity of
 64:167
 determination of
 64:61, 62
 lung neoplasm mortality in smelter workers exposed to
 71:257
 lung neoplasm risk from
 64:193, 194
 respiratory tract carcinoma in workers exposed to
 71:256, 257

Arterial diseases
 carboxyhemoglobin levels and
 72:26
 smokers vs. nonsmokers
 72:26
 smoking and
 72:25, 26
 see also Arteriosclerosis; Atherosclerosis

Arteries
 64:274
 aneurysm in aortic, cigarette smoking effects on
 71:9, 67, 71, 75
 atherosclerotic, increased by cigarette smoking
 71:8, 63
 flow of carotid, cigarette smoking effects on
 71:67
 hypoxemia, development from cigarette smoking
 71:9
 occlusions of, cigarette smoking effects on
 71:73
 thickening of, in smokers vs. nonsmokers
 75:74-76
 walls of, mechanism of lipoprotein infiltration
 71:63
 walls of, nicotine-induced necrosis
 71:63

Arterioles
 effect of smoking
 73:22, 23
 thickening of, in smokers vs. nonsmokers
 75:74-76

Arteriosclerosis
 64:32, 320-325

 in aorta and coronary arteries, cigarette smoking effects on
 71:45, 52-56

 aortic
 69:26

 autopsy studies and
 72:19, 20

 cigarette smoking effects on
 71:8

 cigar smoking and
 72:19

 coronary
 69:26

 coronary, mortality rate in
 64:317, 320, 321

 development by increased carboxyhemoglobin formation
 71:9

 development of, carbon monoxide effects on
 71:63

 development of, effects of nicotine on
 71:38

 and effect of smoking on blood circulation
 67:62

 experimentally induced in dogs
 72:19, 20

 experimental studies
 69:26-27

 hypoxia and, hypercholesterolemia in
 69:26

 lesion development in, smoking enhancement
 71:36

 mortality rates
 64:25; 67:26

 obliterans
 64:326

 obliterans, smoking as a cause
 73:19, 20

 pathogenesis of, relating to smoking
 67:65-66

 peripheral, cigarette smoking effects on
 71:72-73; 73:21

 pipe smoking and
 72:19

 severity of, and smoking
 69:26

 smokers vs. nonsmokers
 72:19, 22, 23, 27

 smoking and
 67:28; 69:4-5

 smoking classification and
 72:19

see also Atherosclerosis

Arthritis, rheumatoid
 pulmonary function abnormalities, smoking, and
 74:92, 93

Aryl hydrocarbon hydroxylase
 effect of benzo(a)pyrene in pregnant rats
 73:119

 role in lung neoplasm development
 74:49-52; 75:50-53

- role in metabolism of chemical carcinogens
 - 73:82, 83
- Asbestos
 - chrysotile, effects on lungs
 - 75:49
 - effect on pulmonary function in smokers vs. nonsmokers
 - 73:41
 - effect on radiological findings in smokers vs. nonsmokers
 - 73:41
 - effect on respiratory symptoms in smokers vs. nonsmokers
 - 73:41
 - pulmonary fibrosis and
 - 72:44
 - smoking and, effect on mortality rates from lung neoplasms
 - 73:73
 - synergistic effect with smoking in lung neoplasm development
 - 74:41-43
- Asbestosis
 - 64:167
 - in smokers vs. nonsmokers, asbestos workers in Singapore
 - 74:95
- Asbestos workers
 - 64:193, 232; 74:95
- Asia
 - Central and Southeast, relationship of tobacco use and neoplasms of oral cavity
 - 71:366
- Asthma
 - bronchial, cigarette smoking effects on
 - 71:10, 175
 - cigarette smoking in
 - 64:38, 302
 - definition of
 - 64:27
 - smoking and
 - 67:29; 72:37
 - tobacco allergy in
 - 64:276
 - "Tokyo-Yokohama"
 - 64:276
- Atelectasis
 - 64:272
- Atherosclerosis
 - 64:318, 319, 320
 - aortic, long term smoking effects
 - 71:52-56
 - coronary blood flow in, in rabbits
 - 64:318
 - experimental induction of, in rats
 - 64:319
 - see also Arteriosclerosis
- Athletic performance
 - running, effect of smoking
 - 73:243, 244
 - smokers vs. nonsmokers
 - 73:243, 244
 - swimming, effect of smoking
 - 73:244
- Atropine
 - 64:354
- effects on bronchoconstriction in dogs
 - 71:163
 - mucus secretion blockage by
 - 64:269
- Atypical cells
 - 64:231
 - hyperchromatic nuclei in
 - 64:34
 - smoke-induced, in epithelium
 - 64:168, 169, 170, 172, 173
- Australia
 - COPD morbidity in smokers in
 - 71:203
 - coronary death rate in
 - 64:320
 - laryngeal neoplasms in, relationship to tobacco use
 - 71:357
 - lung neoplasms death rate in
 - 64:176
 - lung neoplasms in, retrospective studies of
 - 71:327
 - peptic ulcer in, methods for retrospective and cross-section studies of smoking and
 - 71:426, 428
- Automobile driving
 - 64:322
- Autonomic nervous system
 - effect of nicotine on
 - 67:60
- Autopsy studies
 - 64:150
 - arteriosclerosis and
 - 72:19, 20
 - bronchiolitis development and smoking
 - 75:74, 76
 - COPD and smoking
 - 73:45-48
 - coronary heart disease and
 - 72:19, 20
 - emphysema development and smoking
 - 74:97; 75:74-76
 - fibrosis development and smoking
 - 75:74-76
 - lung neoplasms in U.S. veterans
 - 73:73, 74
 - mucous gland abnormalities and smoking
 - 74:97
 - small airway abnormalities and smoking
 - 74:97, 98
 - thickening of arteries, arterioles and smoking
 - 75:74-76
- Aviators
 - prevalence of CHD
 - 68:19
 - smoking effect on blood pressure
 - 68:22
- Bacteria
 - effect of cigarette smoke on action of macrophages
 - 71:165

pneumonia, mice resistance following cigarette inhalation 71:173

Bacterial flora in smokers vs. nonsmokers with COPD 73:54

Ballistocardiography 64:319
findings in cardiac disease after cigarette smoking 68:37

Bank employees chronic cough in 64:281

Barbiturates 64:352

Bartenders esophageal neoplasms in 64:134
oral neoplasms in 64:134

Bauhinia 64:211

Bed days by age, sex and smoking history 67:19-21
definition of 67:19

Behavior and coronary disease 67:56; 69:20, 24
of heavy smokers 64:372
patterns, in smokers vs. nonsmokers 68:26-28

Behavioral research smoking habit 67:38, 188-192

Belfast lung neoplasm mortality in 64:195

Benzo(e)acephenanthrylene carcinogenic properties in cigarette smoke from 71:264, 265
see also Aromatic hydrocarbons

Benzoanthracene (9-10 dimethyl-1, 2-) 64:203

Benzo(a)anthracene alcoholic solution of, penetrability of mice esophageal epithelium 71:292
carcinogenicity 67:127
carcinogenicity, as component of cigarette smoke 72:66
in tobacco smoke 67:127

Benzo(a)anthracene, 7, 12-dimethyl carcinoma induction in hamsters following instillation of 71:346
skin painting with, papilloma and carcinoma induction in mice by 71:341
see also Aromatic hydrocarbons

Benzene 64:55, 59
as suspected contributor to health hazards of smoking 72:145

Benzocaine lozenges 64:354

Benzo(b)fluoranthene carcinogenicity 67:127
in tobacco smoke 67:127
see also Aromatic hydrocarbons

Benzo(j)fluoranthene 64:57
carcinogenicity 67:127
carcinogenic properties in cigarette smoke from 71:265
see also Aromatic hydrocarbons

Benzo(k)fluoranthene carcinogenicity 67:127
in tobacco smoke 67:127
see also Aromatic hydrocarbons

Benzo(rst)pentaphene carcinogenic properties in cigarette smoke from 71:265
see also Aromatic hydrocarbons

Benzo(g,h,i)perylene 64:147
carcinogenicity 67:127
in tobacco smoke 67:127
see also Aromatic hydrocarbons

Benzo(c)phenanthrene 64:56
carcinogenicity 67:127
carcinogenic properties in cigarette smoke from 71:265
in tobacco smoke 67:127
see also Aromatic hydrocarbons

Benzo(a)pyrene 64:147, 148, 233
ability of smoking mothers to hydroxylate 71:407
as air pollutant from cigarette smoke 72:123
and air pollution, in lung neoplasm development 74:45, 46
alcoholic solution of, penetration of mice esophageal epithelium 71:292
carcinogenic effect in laboratory animals 73:78-80
carcinogenicity of 64:33, 144, 145, 146; 67:127

carcinogenicity of, in relation to asbestos
 in hamsters
 71:257

carcinogenic properties in cigarette
 smoke from
 71:264, 265

carcinoma induction by
 64:166

in cigar, pipe, and cigarette smoke
 73:177, 178

cocarcinogenic effect on respiratory
 tract in rabbits
 72:67

determination of
 64:57

detoxification by lung aryl hydroxylase
 71:257

effect on DNA and RNA
 73:86, 87

effects during pregnancy in laboratory
 animals
 72:89; 73:117, 118

effects of instillation or implantation in
 animal tracheobronchial tree
 71:346-347

effects on animal tissue and organ cul-
 tures in
 71:343-345

effects with influenza virus on cigarette
 inhalation by mice
 71:352

in ethanol, effect on esophageal tissue
 67:153-154

hydroxylation by pulmonary benzo-
 pyrene hydroxylase
 69:62

hydroxylation by the placenta
 69:80; 72:89

isolation of
 64:55

levels, effects of room size, amount of
 tobacco burned and ventilation
 75:91-94, 98

in olive oil, effect on esophageal tissue
 67:152-153

oral neoplasm induction by
 64:203, 204

pyrolytic formation of
 64:59

reduction of, by copper nitrate
 64:60

role in respiratory tract carcinogenesis,
 in animals
 74:46, 47

sarcoma induction in rats following in-
 stillation of
 71:346

skin painting with, papilloma induction
 in mice by
 71:337-338

in smoke streams
 72:123

in soot
 64:148

squamous cell carcinoma from
 64:166

structural formula of
 64:56

threshold levels of
 64:143

in tobacco smoke
 67:127

from vegetable fibers
 64:59

see also Aromatic hydrocarbons

Benzo(e)pyrene
 64:147

carcinogenicity
 67:127

in tobacco smoke
 67:127

see also Aromatic hydrocarbons

Benzopyrene hydroxylase
 inhibition of nickel carbonyl in cigarette
 smoke
 69:62

Beryllium
 64:55

carcinoma induction by
 64:166

epidermoid neoplasms from
 64:166

lung neoplasm risk from
 64:193

oxide
 64:166

sulfate aerosol
 64:166

Betanaphthylamine
 content of cigarettes
 69:64

Betel nut
 64:203, 349, 351

Betel nut chewing
 64:211, 351

in Bombay, India
 72:69

in head and neck neoplasm etiology
 72:69

laryngeal neoplasms from
 64:211

oral neoplasms from
 64:197; 71:366, 369-370

smoking and
 72:69

smoking and oral leukoplakia
 69:58

and tobacco chewing
 64:203

Biased measurements
 64:36, 98

Bicarbonate
 in pancreatic secretions, effect of smok-
 ing
 73:159, 160

Bicycle ergometer performance
 cardiovascular parameters in smokers vs.
 nonsmokers
 73:242-244

Bioassay methods
 in carcinogenesis
 64:59, 143, 147

Biometry Branch, National Cancer Institute
 64:137, 138, 139

Biri
 64:211

Birth weight
 effect of maternal smoking
 64:39, 343; 67:39, 185-186; 69:5,
 77-80; 71:389, 397-399; 72:5, 83-87;
 73:103-114, 119-122; 75:27
 effect of maternal smoking before and
 during current pregnancy by cigarette
 consumption
 73:107-109
 effect of maternal smoking during pre-
 vious pregnancies
 73:112-114
 effect of paternal smoking
 73:110, 111
 effect of tobacco smoke, nicotine, or
 carbon monoxide in laboratory ani-
 mals
 73:114-118
 gestation duration in smokers vs. non-
 smokers
 73:103-106
 mortality risk of low birth weight infants
 of smoking vs. nonsmoking mothers
 73:126-132
 timing of influence of smoking
 73:120, 121

Bitters
 64:354

Blacks
 maternal smoking and infant weight
 71:397
 maternal smoking and prematurity
 69:78; 71:400-401

Bladder neoplasms
 64:37, 218-235
 aniline dyes in
 64:222
 blood groups in
 64:224
 carcinogenesis, tobacco smoke consti-
 tuents and tars
 67:156
 cotinine and
 69:64
 dose effect in
 64:223
 experimental aspects of
 69:64
 experimental induction by hydro-
 quinone
 67:156
 experimental induction by 3-hydroxy-
 anthranilic acid
 67:156
 experimental induction by 3-hydroxy-
 kynurenine
 67:156
 experimental induction by ortho-amino-
 phenols
 67:156
 experimental induction by tars
 64:219, 223
 experimental induction in mice
 64:223
 frequency in smokers vs. nonsmokers
 71:238, 293-295; 73-77, 78
 in heavy smokers
 64:219, 224

in men, relation to smoking
 67:153
 morbidity, effect of smoking on
 67:155
 mortality rates
 64:133, 148, 149; 71:293, 294
 mortality rates, female
 64:132, 137, 219, 220, 221, 224,
 225; 67:154
 mortality rates, foreign-born
 64:134
 mortality rates, male
 64:130, 132, 137; 67:154
 mortality ratios
 64:148, 149, 222; 67:33
 mortality ratios, male smokers by age
 67:154
 mortality trends, by sex
 64:137
 occupational risk
 64:134, 222, 224
 relationship of cigarette smoking to
 71:13, 299
 relative risk in females by amount smok-
 ed
 72:73
 relative risk in males by amount smoked
 72:72, 73
 relative risk ratios from, in smokers
 64:223
 retrospective studies of, and smoking
 64:218-222; 71:293, 381-384

sarcoma
 64:223

smokers vs. nonsmokers
 72:293-295, 381-384

smoking and
 64:32; 67:33; 69:60, 64; 72:68,
 72-74
 smoking in etiology of
 72:5; 73:77, 78
 and tobacco alkaloids
 69:64
 and tryptophan metabolites in urine
 67:36, 156; 71:296-297
 urban-rural prevalence of
 64:225
 U.S. incidence of
 64:127
 in women
 64:132, 219, 220, 221, 224, 225
see also Urogenital neoplasms

Bladder stones
 64:224

Blood
 gas exchange in
 64:292
 groups, in bladder neoplasms
 64:224
 plasma, and thrombus formation
 69:27-28

Blood chemical analysis
 comparison for smoking and nonsmok-
 ing mothers and their infants
 69:80

Blood cholesterol levels
 and coronary disease
 64:321; 67:58; 71:21-22, 23-24, 43

- and coronary disease mortality
 - 69:17
- effect of carbon monoxide in rabbits
 - 73:18; 75:28
- effect of diet
 - 64:322
- effect of smoking
 - 67:66; 71:8, 41, 43; 74:17, 18
- effect of smoking and body weight
 - 73:11
- effect of smoking and clinical parameters in British business executives
 - 73:11
- effect of smoking in peripheral vascular disease
 - 71:72
- and hypertension, in smokers vs. nonsmokers
 - 75:15
- increase in smokers
 - 64:326
- and lung neoplasms in male smokers
 - 69:57
- myocardial infarction morbidity ratios in males from Framingham study
 - 68:24
- in pipe and cigar smokers
 - 73:215, 216
- in smokers vs. nonsmokers
 - 68:22, 23, 29, 43; 71:41, 98-102
- see also* Cholesterol
- Blood circulation**
 - effect of cigarette smoke inhalation
 - 67:26, 63; 71:58
 - effect of cigarette smoke inhalation, in dogs
 - 67:62
 - effect of nicotine on
 - 67:60-64
 - effect of smoking on
 - 67:60-64; 69:11, 27-28; 73:19, 22, 23
 - effect of variations in hemoglobin and hematocrit
 - 71:66
 - peripheral
 - 64:318
- Blood coagulation**
 - clotting time
 - 64:319
 - effect of smoking
 - 67:64; 71:9, 36; 74:18, 19
- Blood lipids**
 - effect of nicotine in rabbits
 - 68:31
 - effect of smoking
 - 71:65-66, 123-128; 73-11, 12; 74-17
 - effect of smoking and nicotine
 - 68:30, 31
 - effect of smoking and relative weight, in male Parisian civil servants
 - 73:11
 - effect of smoking in middle-aged patients with angina pectoris
 - 73:12
 - effect of smoking in young Norwegian military recruits
 - 73:11
- elevated, as risk factor in CHD
 - 73:11
- elevated, as risk factor in CHD
 - 73:11
- free fatty acids, effect of smoking
 - 64:319; 67:64-65
- smokers vs. nonsmokers
 - 71:41, 98-102
- and thrombogenesis
 - 68:32, 33
- Blood platelets**
 - adhesiveness, effect of cigarette smoking on
 - 71:9, 36
 - counts
 - 64:319
 - effect of smoking
 - 67:64; 69:27-28; 71:66, 75
 - survival
 - 64:319
- Blood pressure**
 - coronary disease
 - 67:54-55, 58; 68:22
 - coronary disease and smoking
 - 69:14; 71:43, 47
 - coronary disease mortality and
 - 69:14, 17
 - diastolic, cigarette smoking effects
 - 71:8, 23
 - diastolic, in smokers with CHD
 - 71:21-22, 24, 42
 - effect of catecholamines on
 - 67:60
 - effect of cigarette smoke inhalation on
 - 67:54
 - effect of CO exposure
 - 74:11, 12
 - effect of exercise and smoking
 - 73:242, 244-246
 - effect of nicotine
 - 64:318; 67:60; 71:36; 74:13
 - effect of pipe and cigar smoking
 - 73:216
 - effect of smoking
 - 67:54-55, 60; 74:17
 - effect of smoking in middle-aged patients with angina pectoris
 - 73:12
 - high risk in mortality from CVD
 - 71:67
 - hypertensive vs. nonhypertensive, mortality rates of CHD in
 - 71:42
 - myocardial infarction morbidity ratios in males
 - 68:24
 - risk factors in arteriosclerosis obliterans
 - 71:72
 - in smokers, nonsmokers, and ex-smokers
 - 75:15-17
 - smokers vs. nonsmokers
 - 68:22, 29; 71:41, 42, 103-104
 - smoking and, effects on pregnancy outcome
 - 69:77-78
 - systolic, mortality from elevated, with CHD
 - 71:42

Blood sugar
 elevation, by tobacco
 64:355

Blood vessels
 effect of nicotine on
 67:62
 effect of smoking on pulmonary arterial
 capillaries
 67:111

Blood viscosity
 and arteriosclerosis
 69:27

Body constitution
 64:321
 and bronchitis
 67:30, 102-103, 108
 and cough development
 67:102-103, 111
 and emphysema
 67:30, 111
 and respiratory tract diseases
 67:30
 smokers vs. nonsmokers
 67:54, 99

Body height
 effect of maternal smoking
 71:407; 72:88
 interaction with smoking as factor in
 cerebrovascular disease
 73:19
 in respiratory function tests
 64:290

Body size
 in male smokers vs. nonsmokers
 68:28

Body weight
 64:384, 385
 and coronary disease
 67:58
 and hypertension, in smokers, nonsmokers,
 and ex-smokers
 75:15-17
 increase in, on cessation of smoking
 64:326
 interaction with smoking as factor in
 cerebrovascular disease
 73:19
 relationship to coronary disease mortal-
 ity rates and smoking
 69:14
 risk factor in CHD
 68:29, 43
 in smokers vs. nonsmokers
 68:21
 and smoking, as factors in CHD inci-
 dence
 73:4-6
 and smoking, effect on blood lipids
 73:11

Boilermakers
 neoplasm risk in
 64:134

Boston Collaborative Drug Surveillance Pro-
 gram
 role of coffee drinking and smoking in
 myocardial infarction
 74:8

Bowel habits
 tobacco effects on
 64:355

Bradycardia
 development in dogs given nicotine
 71:57

Breast feeding
 duration of
 64:368

Breathlessness
 64:27, 38, 301
 prevalence of
 64:285, 286, 287

Britain
 chronic bronchitis studies in
 64:271, 280
 coronary death rates in
 64:320
 curtailment of advertising in
 64:8
 lung neoplasm death rate in
 64:176
 mortality rates, in laryngeal neoplasms
 64:205
 risk ratios in
 64:127
 urban-rural mortality ratios in
 64:186

British agricultural workers
 forced expiratory flow rates in
 64:290

British air pollution
 disease factors in
 64:194, 195, 298

British doctors study
 64:97, 102, 114, 162, 180, 230, 322
 expected deaths in
 64:109
 mortality ratios in
 64:109, 149
 nonresponse rates in
 64:113
 observed death rates in
 64:109

British General Post Office
 64:281, 286

British Medical Research Organization
 64:6

British miners
 forced expiratory flow rate in
 64:290

British Perinatal Mortality Survey
 results of
 71:390

British smokers
 age distribution of
 64:177
 cough prevalence in
 64:281
 inhalation practices among
 64:177

Bronchi
 abnormalities in smokers vs. nonsmokers
 72:45
 histopathologic change in
 64:170
 hyperplasia in
 64:271

- morphology
 - 64:271
- mucus secretion in, nicotine-induced
 - 64:268
- physiology, in animals and humans
 - 68:71-74
- Bronchial epithelium
 - changes after nitrogen dioxide exposure, in animals
 - 74:102, 103
 - changes in, in smokers
 - 64:171, 172
 - disintegrating nuclei in
 - 64:170
 - effect of cigarette smoke on
 - 67:107, 140, 144; 69:40
 - effect of filtered gas-phase cigarette smoke, in rabbits
 - 74:104, 105
 - effect of nitrogen dioxide on, in rats
 - 69:41
 - effect of smoking on
 - 67:104, 106
 - effect of tobacco smoke on
 - 67:129
 - histological changes at autopsy and smoking habit
 - 73:74
 - histological changes in cigar, pipe, cigarette smokers vs. nonsmokers
 - 73:203, 204, 209
 - pre-malignant changes in smokers
 - 73:67; 75:44
- Bronchial glands
 - 64:168
- Bronchial mucosa
 - effect of cigarette smoke on
 - 67:30, 104-107, 144
 - effect of tobacco smoke constituents on
 - 67:30
- Bronchial neoplasms
 - experimentally induced by cigarette smoke
 - 67:144
 - risk ratio of smokers
 - 69:56
- Bronchiectasis
 - 64:277-294
 - induction of, in mice
 - 64:272
- Bronchiolar dilations
 - 64:272
- Bronchiolar neoplasms
 - 64:159
- Bronchiolitis
 - autopsy studies, in male smokers vs. nonsmokers
 - 75:74, 76, 77
 - ozone induction
 - 64:295
 - purulent, in mice
 - 64:272
- Bronchiolo-alveolar neoplasms
 - smoking and
 - 73:71
- Bronchitis
 - 64:277-294
- definition of
 - 64:289; 67:89
- development in infants of maternal smokers
 - 75:103
- diagnosis
 - 67:90
- and disability, in smokers vs. nonsmokers
 - 73:43
- dust exposure as a factor
 - 73:44
- and emphysema
 - 64:113, 280
- etiology of
 - 64:8
- fibrotic, induction by sulfur dioxide
 - 64:295
- incidence in British males by cigarette consumption
 - 72:62
- incidence in children of parental smokers
 - 75:105, 106
- incidence of among smokers
 - 69:37
- morbidity, and cigar smoking
 - 67:29-30, 94
- morbidity, and pipe smoking
 - 67:29-30, 94
- morbidity, and smoking
 - 67:3, 22, 96
- morbidity, in smoking-discordant twin pairs
 - 67:103
- mortality, and smoking
 - 67:3, 30, 90-96
- mortality, in United States
 - 67:9, 90
- mortality rates
 - 67:8, 29
- mortality rates, by sex and smoking classification
 - 67:95
- mortality rates, effect of cessation of smoking on
 - 67:2, 29, 94, 96
- mortality ratios, by amount smoked
 - 67:90-92
- mortality ratios, cigar smokers
 - 67:94
- mortality ratios in male pipe and cigar smokers
 - 73:217, 219
- mortality ratios, male smokers by amount smoked
 - 67:93
- mortality ratios, pipe smokers
 - 67:94
- occupational diseases and
 - 72:42
- in passive smokers, summary of recent findings
 - 75:108
- post-operative, incidence in smokers vs. nonsmokers
 - 74:92

prevalence in cement and rubber industry workers, smokers vs. nonsmokers 74:95, 96

prevalence in Duisburg, Germany, by age and cigarette consumption 73:39

prevalence in ex-coal miners and non-miners by smoking habit 73:42

prevalence in heavy smokers 64:298

prevalence in male smokers by smoking patterns 74:79

prevalence in miners and farmers in Hungary, by smoking habit 73:42

prevalence in moderate smokers 64:298

prevalence in pipe and cigar smokers 73:220, 221

prevalence in rubber industry workers, smokers vs. nonsmokers 74:96

prevalence in smokers in Glenwood Springs, Colorado 72:39

prevalence in smokers vs. nonsmokers in Bordeaux, France 73:36

prevalence in smokers vs. nonsmokers in mountainous and low-lying areas 73:36, 37

prevalence in smokers vs. nonsmokers in Osaka, Japan 73:44

prevalence in smokers vs. nonsmokers in Yugoslavia 72:40

prevalence in smoking vs. nonsmoking yarn mill workers 73:40

prevalence in the elderly, smokers vs. nonsmokers 74:78, 79

prevalence in urban vs. rural population in Mongolia 74:80

prevalence in U.S., statistics 74:75

prevalence in wool and cotton textile workers in North Carolina 74:93

prevalence of 64:25, 288

prevalence of, by sex 64:289

prevalence rates by sex and smoking history 67:96, 99

and respiratory symptoms 68:74

and respiratory symptoms by smoking classification 67:97-98

role of constitutional factors in pathogenesis of 67:30, 102-103, 108-109

role of hereditary factors in pathogenesis of 67:30, 101-104, 108

and small airway abnormalities, in smokers vs. nonsmokers 74:97, 98

in smokers vs. nonsmokers 68:69, 70

in smokers vs. nonsmokers, autopsy studies 73:45, 46

smoking and 69:4

smoking and, effect on pulmonary function 74:80

smoking in etiology of 67:29, 31, 96, 103, 104-106; 69:4; 72:37

smoking vs. coal mining in etiology of 73:42

smoking vs. dust inhalation in etiology of 73:42

summary of previous findings on relationship to smoking 74:75-78

see also Bronchitis, chronic

Bronchitis, chronic 64:31, 38, 271, 272, 277-302

air pollution in 64:297, 298

British incidence of 64:280, 297, 298

cigarette smoking cause and effect relationship 71:3, 9

cigarette smoking in 64:31, 277-302

definition of 64:278; 71:139

diagnosis of 64:278, 280

emphysema relation to 64:279, 280, 297, 298

epidemiology of 64:280-294, 301

etiology of 64:38, 280-294, 298, 299, 302

histopathologic change in 64:271, 272, 300

incidence of, in high pollution areas 75:63, 64

lung neoplasms related to 64:195; 75:49

mortality in cigarette smokers 71:175

mortality rates 64:25; 68:66, 67; 71:139

mortality ratios in 64:29, 277, 293, 301

mucus production in 64:272

occupational exposure in 64:298, 299, 300, 302

ozone induction of 64:295

- pathology of
 - 64:271, 272, 274, 275
- prospective studies in
 - 64:293, 294
- risk ratios in
 - 64:31
- smokers vs. nonsmokers
 - 71:195-205
- symptoms of
 - 64:27, 278-294
- Bronchoconstriction
 - from cigarette smoke in animals
 - 68:72
- Bronchogenic carcinoma
 - see* Carcinoma, bronchogenic
- Bronchopneumonia
 - development in dogs following cigarette smoke inhalation
 - 71:271
- Bronchopulmonary diseases, chronic obstructive
 - 64:272, 277-297, 298
 - air pollution relationship in
 - 64:38; 71:152, 216-217
 - alpha-1-antitrypsin deficiency and
 - 72:3, 44
 - autopsy studies
 - 73:45-48
 - as cause listed on death certificates vs. findings at autopsy
 - 73:47
 - characterization of
 - 71:139
 - cigarette smoking effects on development
 - 71:4, 9-11, 175
 - definition
 - 67:89-90
 - disabilities from
 - 64:277
 - effect of smoking cessation on development
 - 71:10
 - epidemiology
 - 64:280-294, 297, 298; 73:36-45
 - epidemiology in Tecumseh, Michigan
 - 72:39, 40
 - genetic factors in pathogenesis of
 - 71:148, 150-152, 205
 - increased prevalence of heterozygotes in
 - 71:151-152
 - morbidity, smokers vs. nonsmokers in Berlin, New Hampshire
 - 72:39
 - mortality
 - 64:277
 - mortality and morbidity studies
 - 73:36-39
 - mortality rates
 - 71:139-145
 - mortality rates for ex-smokers, and smokers vs. nonsmokers
 - 72:3
 - mortality rates for pipe/cigar smokers vs. cigarette smokers
 - 72:3
 - mortality rates in British citizens by migration patterns
 - 73:36
 - mortality rates in pipe, cigar, and cigarette smokers
 - 71:175
 - mortality rates, smokers vs. nonsmokers
 - 72:38, 39
 - mortality ratios in male pipe and cigar smokers
 - 73:216, 217, 219
 - occupational hazards and
 - 72:42-44
 - prevalence of
 - 69:38
 - relation to pulmonary hypertension and cor pulmonale
 - 68:74-76
 - smoking effect on
 - 64:31, 277-302
 - smoking effects on ventilation-perfusion measurements in
 - 71:163
 - smoking in etiology of
 - 72:3, 37
 - summary of previous findings
 - 73:35, 36
 - summary of recent findings
 - 73:55
 - see also* Bronchopulmonary diseases, non-neoplastic
- Bronchopulmonary diseases, non-neoplastic
 - air pollution and smoking in etiology of
 - 74:82, 83; 75:63-68
 - alpha-1-antitrypsin deficiency and smoking in etiology of
 - 74:87-90
 - closing volume abnormalities, in smokers vs. nonsmokers
 - 74:84-87
 - effects of alpha-1-antitrypsin deficiency in smokers vs. nonsmokers
 - 75:72-74
 - effects of partially deficient heterozygote phenotypes
 - 75:73, 74
 - history of respiratory diseases and smoking in etiology of
 - 74:90
 - incidence in autoworkers
 - 74:80
 - incidence in firemen
 - 75:68
 - mortality and morbidity
 - 68:66-71
 - occupational exposure and smoking
 - 74:80
 - prevalence in Boston policemen, smokers vs. nonsmokers
 - 74:82, 83
 - prevalence in the elderly, smokers vs. nonsmokers
 - 74:78
 - prevalence in urban vs. rural population, in Mongolia
 - 74:80
 - reference listings
 - 74:107-118

- small airways disease, pulmonary function, and
74:84, 87
 - small airways disease, smoking, and
74:84-87
 - summary of previous findings
68:65; 75:61, 62
 - summary of recent findings
74:106, 107; 75:78
- Bronchospasm
64:296
- Buechley, Drake, and Breslow study
64:324
- Buerger's disease
 - smoke toxicity in
64:73, 326
- Bullous disease
 - incidence in men by age, race, and smoking habit
74:90-92
- Bureau of State Services, USPHS
64:13
- Burma
 - methods used in study of smoking and human pregnancy
71:393
- Burns
 - neoplasm initiation by
64:142
- 2, 3-Butadione
 - as suspected contributor to health hazards of smoking
72:145
- Butane
64:60
- Butylamine
 - as suspected contributor to health hazards of smoking
72:145
- Butylamine, N-methyl-nitroso
 - suspected carcinogenic properties in cigarette smoke from
71:265
- Butylmethylnitrosamine
 - in cigarette smoke
67:29, 31, 96, 103
- Byssinosis
 - development in smoking vs. nonsmoking cotton mill workers
75:68
 - dust exposure and smoking in etiology of
74:94-96
 - prevalence in men by index of severity and smoking habits
73:40, 41
 - prevalence in smoking vs. nonsmoking cotton mill workers
73:39, 55
 - smoking and
73:39-41
- Cachexia
64:73
- Cadmium
 - in cigarette smoke, relation to pathogenesis of emphysema
71:154
 - in emphysema etiology, in animals
74:104
- Caffeine
64:349, 351, 352
- California
 - cancer registries
64:127
- California Legion Study
 - expected deaths in
64:110
 - mortality ratios in
64:110, 149
 - nonresponse rates in
64:113
- California Occupational Study
64:95, 106, 217, 342
 - bladder neoplasm prevalence in
64:222
 - expected deaths in
64:109
 - mortality ratios in
64:109, 149
 - nonresponse rates in
64:113
 - observed deaths in
64:109, 110
- Canada
 - COPD morbidity of smokers in
71:204
 - coronary death rate in
64:320
 - human experimental data on smoking and pregnancy
71:409
 - infectious respiratory disease in, relationship to smoking
71:228
 - kidney and bladder neoplasms in smokers in
71:294
 - lung neoplasm death rate in
64:176
 - mortality rates from COPD
71:139-141, 145
 - mortality ratios from COPD
71:143
 - mortality ratios in smokers and nonsmokers from pancreatic neoplasms
71:298
 - National Department of Health and Welfare
64:6
 - neoplasm risk in
64:127
 - prospective study, bladder neoplasm prevalence in
64:222
 - thrombosis in, smoking relationship
71:132
- Canadian veterans study
64:91, 94, 342
 - expected deaths in
64:110

- lung neoplasm mortality ratios in, smokers vs. nonsmokers
 - 71:241
 - mortality ratios in
 - 64:110, 149
 - nonresponse rates in
 - 64:113
 - observed deaths in
 - 64:110
- Cancer
 - see Neoplasms and specific neoplasm terms, e.g., Lung neoplasms
- Cancer registries
 - 64:128, 135
 - in California
 - 64:127
 - completeness of
 - 64:128
 - in Connecticut
 - 64:128
 - in Denmark
 - 64:220
 - mortality rates, by site, in
 - 64:132
 - in New York
 - 64:129
- Cannabinols
 - 64:349
- Capillaries
 - effect of smoking
 - 73:22
- Carbazole, 9-methyl-
 - possible importance in tobacco carcinogenesis
 - 71:266
- Carbon-14
 - labeled smoke particulate deposition in hamster respiratory tract
 - 71:281-282
- Carbon black
 - neoplasm risk from
 - 64:147
- Carbon dioxide
 - in gas phase, in smoke
 - 64:60
 - as suspected contributor to health hazards of smoking
 - 72:145
- Carbon monoxide
 - 64:70, 296, 297
 - as air pollutant from cigarette smoke
 - 72:7, 121-123, 125
 - and carboxyhemoglobin levels
 - 69:28-29; 72:21-23, 127
 - and carboxyhemoglobin levels in smokers vs. nonsmokers
 - 67:63
 - cardiovascular effects, experimental studies
 - 73:17-19
 - cholesterol levels in rabbits, after exposure to
 - 75:28
 - in cigarette smoke
 - 67:63, 183
 - in cigarette smoke, formation of carboxyhemoglobin
 - 71:8-9
- coronary heart disease and
 - 74:10-12
 - and decrease in exercise time before claudication
 - 75:28
 - effect during pregnancy in laboratory animals
 - 73:116, 117, 132, 133
 - effect on aortas in animals
 - 75:28
 - effect on birth weight and neonatal mortality in animals
 - 73:133
 - effect on blood circulation in human beings
 - 67:63
 - effect on cardiovascular system
 - 72:22; 74:10-12
 - effect on cholesterol biosynthesis, in vitro
 - 73:18
 - effect on cholesterol-fed rabbits
 - 71:65-66
 - effect on cholesterol level in aorta in rabbits
 - 73:18
 - effect on coronary hemodynamics and ventricular function in dogs
 - 73:18
 - effect on exercise performance in smokers vs. nonsmokers
 - 73:18
 - effect on healthy smokers vs. nonsmokers
 - 75:26
 - effect on human physiology
 - 71:60-62
 - effect on myocardium
 - 68:38-40, 43-44; 69:28; 75:29
 - effect on nonsmokers
 - 72:126
 - effect on platelet stickiness in rabbits
 - 73:18
 - effect on psychomotor performance
 - 72:126
 - effect on reflex vasoconstrictor responses
 - 73:18, 23
 - effect on vascular resistance
 - 73:22, 23
 - effect on vision
 - 72:126
 - exposure to, and human absorption
 - 75:21-28
 - from freeway traffic, effect on myocardial work capacity and angina
 - 74:11
 - inhalation of, and effect on blood circulation in dogs
 - 67:63
 - as most likely contributor to health hazards of smoking
 - 72:8, 143
 - neonatal mortality effect from
 - 64:343
 - psychological and physiological effects
 - 72:125-128

- summary of previous findings on relationship to passive smoking 75:87, 88, 108
- summary of recent findings 75:33
- from tobacco smoke, effects on psychomotor performance, including attentiveness and cognition function 75:99-101
- see also Carbon monoxide levels
- Carbon monoxide levels
 - in cigarette smoke 71:59
 - effect of room size, amount of tobacco burned and ventilation 75:90-95
 - effect on exercise performance 75:97
 - in fetal blood of smoking mothers 71:407-410
 - from smokers in buses and planes 75:102
- Carboxyhemoglobin
 - effect on fetal tissues 71:407
 - formation from CO in cigarette smoke 71:8-9
 - formation in blood of smokers 71:60, 75
 - see also Carboxyhemoglobin levels
- Carboxyhemoglobin levels
 - 69:26, 28
 - blood cholesterol and 72:23
 - blood circulation and 67:63
 - in cigarette smokers, one hour after last cigarette 75:25, 26
 - and CO burden in smokers vs. nonsmokers 75:25, 26
 - coronary heart disease and 74:10-12, 19
 - during and following exposure to carbon monoxide 72:124, 125
 - effect on CO absorption, in passive smokers 75:95, 96
 - effect on exercise performance 73:246, 247; 75:97
 - in fetuses 75:26, 27
 - following smoking of non-nicotine cigarettes 73:17, 18
 - in neonates of smoking mothers 73:118, 119
 - in nonsmokers exposed to cigarette smoke 72:125
 - occlusive peripheral vascular disease and 72:26
 - in smokers 69:28-29, 80
- in smokers, and carbon monoxide in tobacco smoke 67:183
- smokers vs. nonsmokers 67:63, 100; 72:21-23
- in smokers vs. nonsmokers, by sex, race, employment status or urban location 75:22-24
- summary of recent findings 75:33
- in workers exposed to exhaust gases 75:21
- Carboxylic acids
 - as cocarcinogens 67:131
- Carcinogenesis
 - aryl hydrocarbon hydroxylase activity, and susceptibility to carcinogens 75:50-53
 - bladder neoplasms, and tobacco smoke constituents 67:156
 - bladder neoplasms, and tobacco tars 67:156
 - bladder neoplasms, by o-aminophenols in laboratory animals 67:156
 - bladder neoplasms, by hydroquinone in laboratory animals 67:156
 - bladder neoplasms, by 3-hydroxyanthranilic acid in laboratory animals 67:156
 - bladder neoplasms, by 3-hydroxykynurenine in laboratory animals 67:156
 - cell and tissue culture studies 73:84-86
 - effect of tobacco curing methods 73:212
 - epidermoid carcinoma, experiments in laboratory animals 67:35
 - experimental 68:90-93; 69:62-64; 72:65-67; 73:78-87; 74:46, 47; 75:48, 49, 50
 - initiating and promoting agents in cigarette smoke 73:68
 - initiating agents 64:142
 - initiating agents in cigarette smoke 72:66
 - lung neoplasms by cigarette smoke in laboratory animals 67:144
 - mechanism of action 73:78, 80-87
 - mechanism of action, in lung neoplasm induction, in animals 74:46, 47
 - and occupational asbestos exposure of smokers 67:35
 - and occupational uranium exposure of smokers 67:35

- possible role of tobacco alkaloids in
 - 69:61
- promoters
 - 64:142
- of respiratory tract in laboratory animals
 - 73:78-80
- role of cigarette smoke condensate
 - 73:80-84
- skin neoplasms by cigarette smoke
 - 67:144
- summary of recent findings
 - 75:43
- by tobacco smoke constituents in laboratory animals
 - 67:35, 144
- Carcinogens
 - 64:172
 - action on oral cavity, effect of saliva
 - 71:288
 - anthracene oil as
 - 64:172
 - aromatic hydrocarbons, unspecified
 - 69:61
 - benz(a)anthracene
 - 67:127
 - benzo(b)fluoranthene
 - 67:127
 - benzo(j)fluoranthene
 - 67:127
 - benzo(g,h,i)perylene
 - 67:127
 - benzo(c)phenanthrene
 - 67:127
 - benzo(a)pyrene, and chrysotile asbestos, in animals
 - 75:49
 - benzo(a)pyrene, and exfoliative cytology of hamster lungs
 - 75:47
 - benzo(a)pyrene as
 - 64:55
 - bladder, in tobacco smoke
 - 69:64
 - in cigarette smoke
 - 67:15, 34; 75:49, 50
 - in cigarette smoke condensate
 - 74:47
 - cigar, pipe, and cigarette smoke condensate, in skin painting experiments in animals
 - 73:210-214
 - creosote oil as
 - 64:147
 - dibenz(a,h)acridine
 - 67:127
 - dibenz(a,j)acridine
 - 67:127
 - dibenz(a,h)anthracene
 - 67:127
 - dibenzanthracene as
 - 64:143
 - dibenzo(a,h)acridine as
 - 64:59
 - dibenzo(a,j)acridine as
 - 64:59
 - dibenzo(a,h)anthracene as
 - 64:55, 229
 - 7H-dibenzo-(c,g)carbazole
 - 67:127
 - dibenzo(a,i)pyrene
 - 67:127
 - effect on cell transformations
 - 73:84-86
 - effect on oral mucosa in laboratory animals
 - 72:70
 - effect on respiratory tract in laboratory animals
 - 73:78-80
 - heterocyclics as
 - 64:54
 - hydrocarbons, extraction of
 - 64:147
 - hydrocarbons, polynuclear, and tumor accelerators
 - 75:48
 - hydrocarbons, reduction of
 - 64:60
 - implantation
 - 69:64
 - indeno(1,2,3-c,d)pyrene
 - 67:127
 - listing of, in cigarette smoke
 - 71:265-266
 - metals as
 - 64:166, 167, 189, 193, 194, 232
 - N-nitrosamines
 - 67:127, 128
 - oral administration of, in mice
 - 64:228
 - polycyclic aromatic compounds as
 - 64:26
 - polycyclic, order of potency
 - 64:56
 - polycyclic, structure of
 - 64:56
 - pyrolytic formation of
 - 64:59
 - role in tumor induction in animals
 - 74:46, 47
 - in smoke, effect on oral cavity
 - 71:12
 - sterol hydroperoxides as
 - 64:52
 - tobacco smoke constituents as
 - 64:26, 33, 34, 51-60, 141-148; 68:90, 91; 73:210-214
 - use in experimental bronchogenic carcinoma
 - 69:63-64
 - see also Carcinogenesis, and specific compound listings
- Carcinoid tumor
 - prevalence in male and female smokers and nonsmokers
 - 71:250
 - risk ratio of smokers
 - 69:56
- Carcinoma
 - 64:165, 166
 - benzo(a)pyrene induction of
 - 64:166
 - beryllium induction of
 - 64:166

chromium induction of
64:167

classification of, in smokers vs. non-smokers
67:140

formation following animal skin painting with smoke condensates
71:337-342

induction in rats exposed to cigarette tars
71:348

induction in rhesus monkeys
64:166

in situ
64:172, 203

tobacco tar induction of
64:143

undifferentiated, and pipe smoking
64:143

undifferentiated, and smoking
64:140-143

undifferentiated, relationship to cigarette smoking
71:248-249

see also Specific histologic types

Carcinoma, alveolar cell
64:159

induction in mice by cigarette smoke inhalation
71:349

risk ratio of smokers
69:56

and smoking
64:143

Carcinoma, anaplastic
64:231

classification of
64:173

prevalence in male and female smokers and nonsmokers
71:250

Carcinoma, bronchogenic
64:229

animal models for
69:63-64

development in dogs following cigarette smoke inhalation
71:269, 272-273

experimental induction of
64:33, 165, 189; 69:63-64

in dogs
64:33

mortality from, relationships to smoking, air pollution and residence
71:253

mortality in smoking vs. nonsmoking asbestos workers
71:257

mortality trends in
64:141

multiple primary
67:142-143

risk ratio of smokers
69:56

Carcinoma, epidermoid
64:165, 231

experimental induction of
69:63-64

mortality from, relationship to smoking, air pollution and residence
71:254

pipe smoking and
67:143

prevalence in male and female smokers and nonsmokers
71:250

relationship of cigarette smoking to
71:246-249

risk ratio of smokers
69:56

smoking and
67:35, 140-143

in women
64:159

Carcinoma, epithelial
induction in mice by cigarette smoke inhalation
71:350

Carcinoma, oat cell
64:159, 231

relationship of cigarette smoking to
71:247

smoking and
67:140-141

Carcinoma, oval cell
64:175

Carcinoma, small cell
risk ratio of smokers
69:56

Carcinoma, squamous cell
64:166, 231

development in mice drinking alcoholic benzo(a)pyrene
71:292

increase in
64:175

induction of
64:189, 228

in oral cavity, relationship to tobacco use
71:366-367

smoking in etiology of
72:69

Carcinoma, tracheobronchial
induction in hamsters by cigarette smoke instillation
71:346-347

Cardiac index
effect of exercise and smoking
73:242-244

Cardiovascular diseases
64:38, 317-327

atherosclerotic, cigarette smoking relationship
71:4

atherosclerotic, effects of CO
75:27, 28

glucose metabolism
68:40,41

mortality rates
64:25, 317; 69:17

mortality ratios in male pipe and cigar smokers
73:215, 216

pathogenesis of
75:28, 29

- psychosocial factors in
 - 64:327
 - response to smoking and nicotine
 - 68:34-42
 - in smokers vs. nonsmokers
 - 68:37
 - smoking and
 - 64:32, 38, 317-327; 67:3, 25-28, 47-69; 69:3-5; 73:3-23; 74:3-19
 - smoking effects in
 - 64:38, 317-327
 - and sudden death
 - 68:36
 - summary of previous findings
 - 73:3; 74:3, 4
 - summary of prospective epidemiological studies for cigar and pipe smokers
 - 73:216
 - summary of recent findings
 - 73:23; 74:19
 - see also* Arteriosclerosis; Atherosclerosis; Coronary diseases
- Cardiovascular system
 - effect of carbon monoxide exposure
 - 74:10-13
 - effect of catecholamines on
 - 67:60
 - effect of cigarette smoke on
 - 71:56-58, 107-118
 - effect of nicotine on
 - 67:60; 71:56-58, 107-118; 74:13
 - effect of smoking on
 - 67:26, 60
- Carotid body
 - 64:69, 318
- Catecholamine levels
 - effect of cigar, pipe, and cigarette smoke in dogs
 - 73:216
 - effect of nicotine, in rats
 - 74:13
- Catecholamines
 - 64:70, 318
 - effect of nicotine on release of
 - 67:60; 71:36, 57, 119
 - effect of smoking on release of
 - 69:60; 71:8
 - effect on blood circulation
 - 67:60
 - effect on blood circulation in coronary arteries
 - 71:58
 - effect on blood pressure
 - 67:60
 - effect on cardiovascular system
 - 67:60
 - effect on heart rate
 - 67:60
 - effect on myocardium
 - 67:60
 - and thrombogenesis
 - 68:32
 - see also* Catecholamine levels
- Catholics
 - smoking prevalence in
 - 64:364
- Cats
 - cardiovascular function in, smoking and nicotine effects on
 - 71:110, 111
 - ciliary function in, effect of cigarette smoke on
 - 71:222-224
 - lungs of, cigarette smoke effect on surfactant activity
 - 71:225
 - mucus secretion in
 - 64:268
 - mucus secretion in, nicotine-induced effects
 - 64:318
- Cattle
 - ciliary function in, effect of cigarette smoke on
 - 71:221
- Causality
 - definition of
 - 64:20, 21
 - epidemiological methods in determining
 - 64:20
 - statistical methods in determining
 - 64:20
 - temporal factors in
 - 64:185
- Cell cultures
 - malignant transformations induced by tobacco tars on carcinogens
 - 73:84-86
 - tobacco carcinogenesis and
 - 73:84-86
- Cells
 - atypical, in ex-smokers, smokers, and nonsmokers at autopsy
 - 73:74
 - pathology of, in smokers
 - 64:26, 27, 167-173
 - respiration of, cyanide effect on
 - 64:266
 - stimulation of, by nicotine
 - 64:349
- Cellulose
 - pyrolysis of
 - 64:60
- Cembrene
 - 64:49
- Central nervous system
 - effect of carbon monoxide in smoke on
 - 71:60
 - nicotine effects on
 - 64:69, 70, 317, 318
- Cerebrovascular diseases
 - 64:103
 - definition of
 - 71:66
 - epidemiological studies
 - 74:16, 17; 75:29, 30
 - incidence in longshoremen
 - 74:17
 - incidence in men, Framingham study
 - 74:17
 - incidence in women, smokers vs. non-smokers
 - 74:16, 17

interaction of smoking and other risk factors
 73:19
 mortality rates
 64:325
 mortality rates by age, sex and smoking classification
 67:66; 75:31
 mortality rates, effects of cigarette smoking
 71:9
 mortality rates, smokers vs. nonsmokers
 71:66-70; 72:2
 mortality ratios by age, sex and smoking classification
 67:66
 mortality ratios in pipe and cigar smokers
 73:215, 216
 oral contraceptives and smoking in etiology of
 74:16, 17
 smoking and
 67:27-28, 66, 68; 72:24, 25
 thrombosis, smoking and
 67:27, 68
see also Arteriosclerosis
Cerium
 neoplasm induction by
 64:166
Cervix
 carcinoma in situ of
 64:172
Cesium
 64:137
 tobacco plant uptake of
 64:146
Cessation of smoking
 64:31, 37, 87, 188, 374, 375, 376
 in adults
 64:375
 body weight increase following
 64:326
 compared benefits in cigarette vs. pipe/cigar smokers
 73:172, 173
 death rate reduction following
 64:29, 92
 decreased clinical symptoms following
 64:271, 301
 effect on absolute aerobic power
 73:243
 effect on bladder neoplasm mortality rate
 67:155
 effect on bronchitis mortality rate
 67:29, 94, 96
 effect on COPD development
 71:140
 effect on COPD development in British physicians
 71:142
 effect on COPD morbidity and mortality
 71:175; 72:41, 42
 effect on COPD morbidity in smokers vs. nonsmokers
 71:146
 effect on coronary disease mortality rate
 67:25, 28, 50; 71:32, 46-48, 106
 effect on emphysema mortality rate
 67:29, 94
 effect on esophageal neoplasms
 67:147
 effect on infant birth weight
 73:107-109, 112-114
 effect on laryngeal neoplasm mortality rate
 67:149
 effect on lung neoplasm mortality rate
 64:163, 187, 188; 67:24, 33, 137-140
 effect on lung neoplasm mortality rate in men
 67:134, 136
 effect on morbidity
 67:24
 effect on mortality rates
 67:4, 7, 15-16, 24, 139
 effect on mortality ratios
 64:29, 163
 effect on mouth neoplasm mortality rate
 67:147
 effect on pharyngeal neoplasm mortality rate
 67:147
 effect on pulmonary surfactant levels
 73:55
 effect on respiratory symptoms
 72:41, 42
 effect on respiratory tract neoplasm mortality rate
 67:147
 effect on risk of lung neoplasms
 69:55, 57
 effect on stomach neoplasm mortality rate
 67:158
 effect on tryptophan metabolism disorders
 67:89-90
 emotional disturbances following
 64:350
 gastric ulcer recovery following
 64:337
 genetic factors in
 64:191
 group psychotherapy in
 64:354
 health improvement following
 64:187, 188, 271, 294
 illness as a reason for
 64:92
 improvements in respiratory system
 71:148, 149
 lung neoplasm development and
 72:62
 methods for
 64:354
 myocardial infarct and
 72:17, 18
 as preventive measure in CHD
 72:17, 18
 as preventive measure in occlusive disease
 73:21, 22

- psychosocial aspects of
 - 64:374, 375, 376
- reduction of risk following
 - 64:37, 163, 187, 188
- reinforcing factors in
 - 64:34
- relation to incidence of CHD
 - 71:32, 46-48, 106
- stomatitis nicotina resolution following
 - 64:271; 69:87
- as therapy for peptic ulcer
 - 67:182
- as therapy in arterial diseases
 - 72:26
- thromboangiitis obliterans treatment by
 - 64:326
- Channel blacks
 - 64:147
- Chemicals
 - exposure to, in smokers vs. nonsmokers, by race and sex
 - 75:69, 70
- Chemoreflex
 - nicotine induction of
 - 64:318
- Chest illnesses
 - prevalence of
 - 64:287, 288, 301
 - prevalence of, in pipe and cigar smokers
 - 73:220, 221
 - prevalence of, in smokers
 - 64:27, 297, 298
 - in women
 - 64:288
- Chewing tobacco
 - see Tobacco chewing
- Chickens
 - ciliary function in, effect of cigarette smoke on
 - 71:223
 - ciliastasis in
 - 64:268
 - effect of cigarette smoke on embryos
 - 71:344
 - effect of nicotine on embryos CNS
 - 71:411
- Children
 - effect of parental smoking
 - 64:369; 72:129
 - epithelial tissues in
 - 64:170, 173
 - passive smoking and
 - 72:129
 - respiratory illness and
 - 72:129
 - of smokers, incidence of pneumonia and bronchitis
 - 75:105, 106
 - of smokers, prevalence of respiratory symptoms
 - 75:102, 103
 - smoking patterns in
 - 64:368, 369
- Chile
 - atherosclerosis autopsy studies in
 - 71:55, 56
- Chimney sweeps
 - scrotal cancer in
 - 64:147
- skin cancer in
 - 64:147
- China
 - ginseng root consumption in
 - 64:355
- Chlordane
 - 64:62, 145
- Chlorinated hydrocarbons
 - pesticide use of
 - 64:62, 145
- Chlorogenic acid
 - 64:54
- Chlorpromazine
 - 64:70
- Cholesterol
 - 64:326, 385
 - biosynthesis, effect of carbon monoxide, in vitro
 - 73:18
 - rabbits fed, carbon monoxide effects on
 - 71:65-66
 - synergistic relationship of carbon monoxide in coronary atheromatosis
 - 71:63
 - in tobacco
 - 72:24
 - in tobacco smoke
 - 72:24
 - see also Blood cholesterol levels
- Chromaffin tissue
 - 64:69, 318
- Chromium
 - carcinogenesis by
 - 64:167
 - lung neoplasm induction by
 - 64:189, 193, 194
 - lung neoplasm mortality from
 - 71:257-258
 - in mainstream smoke
 - 64:55
 - neoplasm prevalence in workers exposed to
 - 64:193, 194, 232
 - respiratory tract carcinoma in workers exposed to
 - 71:256
- Chronic diseases
 - smokers vs. nonsmokers
 - 67:22
- Chrysene
 - carcinogenicity
 - 67:127
 - carcinogenicity, as component of cigarette smoke
 - 71:265; 72:66
 - in tobacco smoke
 - 67:127
- Cigar and pipe smokers
 - see Smokers, cigar and pipe
- Cigarette ash
 - nickel in
 - 64:167
- Cigarette butts
 - lengths
 - 64:177
- Cigarette filters
 - see Filters

- Cigarette paper
 - increase of cigarette burning rate
 - 68:91
- Cigarettes
 - definition and processing
 - 73:175
 - and development of esophageal neoplasms
 - 71:12, 293
 - flavor, terpenoids as source of
 - 64:52
 - low nicotine, and respiratory symptoms
 - 64:289
 - low nicotine, ciliastatic effect of
 - 64:268
 - modified, effect on respiratory symptoms and ventilatory capacity
 - 73:37, 38
 - portion smoked, dosage score as function of
 - 67:15
 - similarities with little cigars
 - 73:224, 225
 - tar and nicotine content
 - 72:142, 143
 - tar levels of, relationship to lung neoplasm development
 - 71:275, 276
 - taxation
 - 69:4, 57
 - see also* Cigarettes, filter; Cigarettes, low-nicotine; Cigarettes, non-nicotine; Cigarettes, non-tobacco
- Cigarettes, daily consumption
 - aortic aneurysm mortality by
 - 69:16
 - and atypical nuclei in larynx
 - 69:59
 - average, dosage score as function of
 - 67:15
 - bladder neoplasms mortality rates by
 - 67:155
 - bronchitis mortality ratios by
 - 67:90
 - coronary disease incidence rates
 - 67:58; 69:15; 21-24
 - coronary disease mortality rates by
 - 67:51; 69:13
 - coronary disease mortality ratios by
 - 67:49
 - coronary disease mortality ratios for male smokers by
 - 67:48
 - digestive tract neoplasm mortality rates by
 - 67:147
 - effect on lung neoplasm mortality in Poland
 - 72:61, 62
 - esophageal neoplasm mortality ratios by
 - 67:150
 - increase in, by women
 - 64:363
 - laryngeal neoplasm mortality rates by
 - 67:147
 - liver cirrhosis mortality rates by
 - 67:184
 - liver cirrhosis mortality ratios by
 - 67:184
 - lung neoplasm morbidity rates by
 - 67:33-34
 - lung neoplasm mortality rates
 - 67:135-137
 - lung neoplasm mortality ratios
 - 67:34, 135-140
 - mouth neoplasm mortality rates by
 - 67:146
 - mouth neoplasm mortality ratios by
 - 67:146
 - pancreatic neoplasm mortality rates in men by
 - 67:159
 - pancreatic neoplasm mortality ratios in men by
 - 67:159
 - peptic ulcer mortality rates in male smokers by
 - 67:182
 - per capita
 - 64:26, 45, 46, 185
 - pharyngeal neoplasm mortality rates by
 - 67:146
 - pharyngeal neoplasm mortality ratios by
 - 67:146
 - prevalence of
 - 64:361-374
 - respiratory tract neoplasm mortality rates by
 - 67:147
 - stomach neoplasm mortality rates by
 - 67:157
 - stomach neoplasm mortality ratios by
 - 67:157
 - tracheal neoplasm mortality rates by
 - 67:147
 - in tuberculars
 - 64:277
 - urogenital neoplasm mortality ratios for male smokers by
 - 67:154
- Cigarettes, filter
 - decrease in tar yields
 - 68:91
 - effect on respiratory symptoms
 - 73:55
 - increase in
 - 64:46
 - and polonium-210 content in tobacco smoke
 - 68:92
 - production of, in U.S., by year
 - 64:46
 - and risk of lung neoplasms
 - 69:57; 75:44
 - summary of previous findings
 - 75:4
 - vs. nonfilter, and risk of lung neoplasms
 - 74:40, 41
 - vs. nonfilter, comparison of safety
 - 69:57
 - vs. nonfilter, effect on sputum production
 - 73:37, 38
- Cigarettes, low-nicotine
 - respiratory symptoms from
 - 64:268

- Cigarette smoke
 - see Smoke, cigarette
- Cigarette smokers
 - see Smokers, cigarette
- Cigarette smoking
 - see Smoking
- Cigarettes, non-nicotine
 - effect on apexcardiogram
 - 72:21
 - effect on carboxyhemoglobin levels
 - 73:17, 18
- Cigarettes, non-tobacco
 - 64:59
- Cigars
 - definition and processing
 - 73:175, 176
 - per capita consumption
 - 64:26, 45
- Cigars, little
 - chemical composition of
 - 73:224, 225, 228
 - evaluation of potential public health impact
 - 73:222-228
 - shipment for domestic consumption (1970-1972)
 - 73:222-224, 227
 - similarity to cigarettes
 - 73:224, 225
 - sugar and pH differences with large cigar and cigarettes
 - 73:222-224
 - tar and nicotine content
 - 73:224-226, 228
- Cigar smoke
 - see Smoke, cigar
- Cigar smokers
 - see Smokers, cigar; Smokers, cigar and pipe
- Ciliary activity
 - 64:61
 - clearance mechanism by
 - 64:267, 268
 - effect of cigarette smoke in animals
 - 68:71, 72
 - effect of nitrogen dioxide, in rats
 - 74:103
 - effect of pipe/cigar smoke vs. cigarette smoke in cats
 - 73:217, 218
 - effect of smoke on
 - 64:27, 34, 35, 61, 168, 169, 170, 172, 173, 267; 67:107-108; 69:42
 - effect of smoking on
 - 74:101, 102
 - loss of, in smokers
 - 64:168, 169, 170, 172, 173
 - morphological changes in cilia
 - 64:267, 268, 271
 - transport
 - 64:61, 267, 268
- Ciliary depressants
 - 64:27, 33, 34, 61, 267, 268
 - acrolein as
 - 64:267, 268
 - ammonia as
 - 64:268
- cigarette smoke as
 - 64:33, 35, 370
- formaldehyde gas as
 - 64:268
- gas phase as
 - 64:34
- hydrogen cyanide as
 - 64:268
- nicotine as
 - 64:268
- nitrogen dioxide as
 - 64:268
- ozone as
 - 64:268
- sulfur dioxide as
 - 64:268, 295
- Ciliotoxic agents
 - acetic acid
 - 67:108
 - acrolein
 - 67:107
 - in cigarette smoke
 - 67:107
 - crotonaldehyde
 - 67:108
 - cyanides
 - 67:107
 - effect on adenosine triphosphatase
 - 67:108
 - effect on oxidative enzymes
 - 67:108
 - formaldehyde
 - 67:107
 - formic acid
 - 67:108
 - phenols
 - 67:108
 - propionic acid
 - 67:108
- Circulatory diseases
 - 64:113
- Circumcision
 - 64:224
- Clofibrate
 - and reduction in risk of sudden death in cigarette smokers
 - 75:32
- Closing volume abnormalities
 - as indicator of small airways disease, in smokers vs. nonsmokers
 - 74:84-87; 75:71, 72
- Coal dust
 - effect on pulmonary function in smokers vs. nonsmoker
 - 73:41-43
 - effect on respiratory symptoms in smokers vs. nonsmokers
 - 73:41-43
- Coal gas workers
 - 64:232
 - lung neoplasms in
 - 64:193
- Coal miners
 - pneumoconiosis and
 - 72:42-44
 - respiratory function tests in
 - 64:289, 293, 294

- respiratory symptoms in
64:298, 299
- Coal tar
 - benzo(a)pyrene content of
64:148
 - neoplasm induction by
64:33, 147, 167, 229
- Cocaine
64:349
- Coca leaves
64:349
- Cocarcinogens
 - 64:33, 58, 142, 144, 145
 - benz(a)anthracene as
64:58
 - carboxylic acids as
67:131
 - croton oil as
64:58
 - fatty acids as
64:58, 59
 - nickel carbonyl as
69:62
 - phenols as
64:54, 58, 59; 67:31
 - in tobacco smoke
64:33; 69:61
 - in tobacco tars
67:131
- Cocoa
64:349
- Coffee drinking
64:349
 - angina pectoris, smoking, and
74:8
 - myocardial infarction, smoking and, in
smokers vs. nonsmokers
74:8; 75:19, 20
- Cognition
and smoking habit
67:189-191
- Cologne,
autopsy records in
64:150
- Colonic polyposis
64:191
- Combustion temperature
effect on tumorigenic activity of pipe
and cigarette tobacco
73:210, 211
- Common colds
64:276
- Compensatory behavior,
smoking as
64:372
- Congenital malformations
maternal smoking and
72:87; 73:136, 137
- Congestive heart failure
64:320
- Connecticut Cancer Registry
64:127, 128
 - data from
64:135
 - figures on age-adjusted larynx neoplasm
incidence
71:277
 - figures on incidence of oral neoplasms
71:284
- Constitutional hypothesis
64:190, 191, 192, 193
 - refutation of
64:192
 - relationship to CHD and smoking
71:48-49, 105-106
- Contraceptives, oral
incidence of stroke and, in women smok-
ers vs. nonsmokers
74:16, 17
 - smoking and
72:26
 - thrombophlebitis and
72:26
- Control populations
bias in selection of
64:181, 217, 231
- Copenhagen
neoplasm study in
64:220, 222, 224
 - Tuberculosis Station
64:141
- Copper
64:193
 - nitrate
64:60
 - sulfate
64:354
- Coppersmiths
64:134
- Cornfield method
64:155, 159, 160
- Cornsilk
smoking, lack of arterial epinephrine
level increase
71:57
- Coronary circulation
64:318; 68:41-43
- Coronary diseases
64:8, 29, 36, 38, 103, 106, 108, 317,
320-327, 384, 385
 - age-adjusted rates in smokers
71:23
 - by amount smoked
69:12-13, 18
 - arteriosclerotic, mortality rates in U.S.
71:21
 - associated risk factors and smoking
74:17
 - atherosclerosis
64:320
 - atherosclerosis, effects of smoking on
71:4, 63
 - autopsy studies
72:19, 20; 74:4
 - and behavior
67:57
 - blood pressure of smokers vs. nonsmok-
ers
71:43, 47
 - carbon dioxide effects on oxygen uptake
in
71:62
 - carbon monoxide and
74:4

carboxyhemoglobin levels and
 72:27
 cross-sectional study in Bergen, Norway
 72:16
 death ratios of paired combinations of
 high risk
 71:25
 effect of coffee drinking and cigarette
 smoking
 75:20
 effect of norepinephrine levels
 68:38
 effect of smoking on blood circulation in
 67:26, 61-62
 effect on blood circulation
 67:62-63
 effect on blood pressure
 67:54
 epidemiological studies
 64:320, 321, 322; 69:25; 72:14-16;
 73:4-11; 75:14, 15
 etiology of
 64:320, 321, 322
 excess deaths in
 64:113
 experimental studies
 73:13-19
 heredity as a factor
 72:18
 high blood pressure in
 64:38
 high serum cholesterol in
 64:38
 incidence and education level
 68:24
 incidence and mortality rates in former
 smokers
 71:46, 47-48
 incidence in European vs. American men
 73:9
 incidence in farmers vs. nonfarmers by
 smoking habit
 73:7
 incidence in Hawaiian men of Japanese
 ancestry
 73:10
 incidence in Japanese male smokers vs.
 nonsmokers
 68:17
 incidence in lawyers
 68:25
 incidence in male bank employees in
 Brussels, Belgium
 73:10
 incidence in males by smoking habits or
 physical activity
 68:20, 25
 incidence in male smokers vs. nonsmok-
 ers
 68:17, 18, 20, 23, 25, 27, 28, 37
 incidence in men in Yugoslavia
 73:9
 incidence in men under 60, in New
 South Wales
 74:6
 incidence in men with and without
 ventricular premature beats
 74:4-6

 incidence in middle-aged men from var-
 ious countries
 74:6
 incidence in miners in Sardinia
 73:10
 incidence in Minnesota men by age and
 smoking habit
 72:14-16
 incidence in pipe and cigar smokers
 73:215, 216
 incidence in smokers vs. nonsmokers,
 Peoples Gas Co. Study
 74:6, 7
 incidence in smokers vs. nonsmokers,
 Stockholm Prospective Study
 74:6
 incidence in tribal population area, New
 Guinea
 74:9
 incidence in twins
 68:29
 incidence in white males by body weight
 and smoking habit
 73:5
 incidence in whites vs. blacks in Evans
 County, Georgia
 73:4, 5
 incidence in women, smokers vs. non-
 smokers
 74:9, 10
 incidence of, relation to angina pectoris
 67:53
 incidence of, relation to blood cholester-
 ol levels
 67:58
 incidence of, relation to blood pressure
 67:58
 incidence of, relation to body weight
 67:58
 incidence of, relation to electrocardio-
 graphic abnormalities
 67:58
 incidence of, relation to hemoglobin
 levels
 67:58
 incidence of, relation to myocardial in-
 fart
 67:53
 incidence of, relation to socioenviron-
 mental stress
 67:56
 incidence rates, by age
 67:54, 57-58; 68:21; 69:21-22, 24
 incidence rates, by amount smoked
 67:54, 57-58
 incidence rates, by behavior type
 69:20, 24
 incidence rates, by smoking and other
 risk factors
 69:23
 incidence rates, by smoking history
 69:21-24
 incidence rates in men
 67:65; 69:21-22
 incidence rates in twins, smokers vs.
 nonsmokers
 67:59

incidence rates, smokers vs. nonsmokers
 69:18, 20-22
 in India
 73:11
 infarction in NYC pipe and cigar smokers
 71:32, 38-39
 infarction, relationship to physical activity, smokers vs. nonsmokers
 71:44
 interaction of smoking and other risk factors
 72:16-18; 73:4-11
 in Irish smokers vs. nonsmokers
 68:18
 morbidity ratios
 67:59; 69:19
 morbidity ratios, and blood pressure
 67:55
 morbidity ratios, and lung function
 67:56
 morbidity ratios, by age
 67:54
 morbidity ratios, by blood cholesterol levels
 67:55
 morbidity ratios, by personality characteristics
 67:57
 morbidity ratios, by sociocultural mobility status
 67:57
 morbidity ratios, in New Delhi, India
 72:16
 morbidity, relationship of smoking to
 71:32-35, 37, 39, 93-97
 mortality and morbidity retrospective studies
 71:40, 93-97
 mortality rates
 64:25, 29, 32, 38, 39, 184, 320, 321, 324; 67:8, 25-26
 mortality rates among former college students
 69:16, 18
 mortality rates and per capita cigarette consumption in several countries
 72:16
 mortality rates, by age
 67:25, 28, 47, 49-51; 69:13-14
 mortality rates by blood pressure
 69:14
 mortality rates by relative weight
 69:14
 mortality rates, by sex
 67:25, 27, 28, 47, 49-50; 69:13-14
 mortality rates, by smoking
 67:25, 28, 49-51; 69:13-14
 mortality rates, effect of associated diseases on
 67:51-52
 mortality rates, effect of cessation of smoking on
 67:25, 27-28, 50
 mortality rates, ex-smokers by smoking history
 67:51
 mortality rates in heavy smokers
 64:322
 mortality rates in hypertensives vs. non-hypertensives
 71:42
 mortality rates in industrial workers
 64:323
 mortality rates in Japanese men and women by cigarette consumption and age started smoking
 73:7, 8
 mortality rates in longshoremen
 72:14
 mortality rates in obese vs. nonobese
 71:45
 mortality rates in smokers vs. nonsmokers
 71:21-22, 24, 26-29
 mortality rates in smoking men in Finland
 73:9
 mortality rates in United States
 67:47; 68:16
 mortality rates in, with increased carbon monoxide
 71:62
 mortality rates of cigarette smokers from, AHA pooling project
 71:28, 30, 39
 mortality rates of paired combinations of high risk
 71:25
 mortality rates of U.S. veterans
 71:26, 38
 mortality rates, relationship to electrocardiographic findings
 71:42
 mortality ratios, by age
 67:25, 26, 28, 49-50, 52; 69:13
 mortality ratios, by age and blood pressure
 67:53
 mortality ratios, by age and smoking history
 67:51-52
 mortality ratios, by amount smoked
 67:48-49; 69:13
 mortality ratios, by sex
 67:25, 28; 69:13-14
 mortality ratios, by smoking history
 67:25, 28
 mortality ratios, effect of associated diseases
 67:51-52
 mortality ratios in pipe and cigar smokers
 73:215, 216
 and multiple risk factors
 68:28-30
 in Nepal
 73:11
 in New Zealand
 73:11
 nicotine and
 74:13
 nicotine effect on coronary blood flow in
 71:58

- obesity in
 - 64:38
- occlusion in
 - 64:320
- occupational risks in
 - 64:321, 322
- pathophysiology of, effect of carbon monoxide exposure
 - 74:10
- and personality characteristics
 - 64:321, 326; 67:57
- predisposing characteristics
 - 67:58
- prevalence of
 - 64:320, 321
- relationship of blood pressure and smoking
 - 71:45, 47
- relationship of heart rate and smoking
 - 71:45, 47
- relationship of physical activity and smoking
 - 71:41, 43, 44
- relationship of triglycerides to
 - 71:65
- relationship to constitutional makeup and smoking
 - 71:48-49, 105-106
- relationship to ECG abnormalities and smoking
 - 71:45, 47
- relationship to obesity and smoking
 - 71:43-45
- retrospective studies in Goteborg, Sweden
 - 72:16
- retrospective studies in Prague, Czechoslovakia
 - 72:16
- risk factors
 - 71:23-24, 40-41
- risk factors and personal characteristics
 - 68:26
- role of glucose metabolism
 - 68:40, 41
- in Seventh Day Adventists
 - 64:322
- smokers' age effects on development
 - 71:27, 39
- in smokers vs. nonsmokers
 - 68:26, 42, 43
- in smokers with predisposing factors
 - 71:24
- smoking and
 - 67:26, 54, 64-65; 69:3-5, 11, 20; 71:5
- smoking and, in individuals under 40 years
 - 73:10
- smoking and, in myocardial ischemic patients in Italy
 - 73:10
- smoking as cause of death
 - 67:25-27
- smoking as etiologic agent in
 - 67:26, 54, 62, 65, 66; 69:11; 72:1, 2, 13, 14
- smoking in thrombus formation
 - 67:26, 64-65
- smoking risk factor
 - 71:8
- sudden death, and smoking
 - 67:53; 71:52
- summary of previous findings
 - 68:16; 75:4, 7
- summary of relationship to smoking
 - 74:3, 4, 19
- symptoms of
 - 64:320
- twin studies
 - 72:18
- in women
 - 64:321
- see also* Angina pectoris; Arteriosclerosis; Atherosclerosis; Cardiovascular diseases
- Coronary Drug Project Research Group
 - epidemiologic study of smoking and CHD
 - 74:4-6
- Coronary heart disease
 - see* Coronary diseases
- Coronary vessels
 - effect of cigarette smoking on
 - 67:65
- Coronene
 - 64:147
- Cor pulmonale
 - and chronic obstructive pulmonary disease
 - 74:76
- Cotinine
 - 64:71
 - desmethyl-
 - 64:72
 - effect on rats and mice
 - 69:61-62
 - in experimental induction of bladder adenomas
 - 69:64
 - methonium ion, structure of
 - 64:72
- Cough
 - 64:280, 281, 282, 283
 - chronic
 - 64:27, 280, 281, 282, 283, 299, 302
 - chronic, and cigarette smoking in males
 - 68:69
 - chronic, in women
 - 64:282, 285
 - effect of air pollution and smoking
 - 64:297; 74:90, 91
 - effect of asbestos exposure in smokers vs. nonsmokers
 - 73:41
 - effect of coal dust exposure in smokers vs. nonsmokers
 - 73:41, 42
 - effect of filtered cigarettes
 - 73:55
 - effect of modified cigarettes
 - 73:38
 - epidemiology of
 - 67:97
 - ex-smokers vs. nonsmokers
 - 67:98

- of parental smokers, and respiratory symptoms in children
75:103, 105
- prevalence in cement and rubber industry workers, smokers vs. nonsmokers
74:95, 96
- prevalence in pipe and cigar smokers
73:220, 221
- prevalence in smoking vs. nonsmoking women in Bordeaux, France
73:36
- prevalence of
64:38, 280, 283, 284, 289, 291, 301, 302
- prevalence of among smokers
67:103
- prevalence of, in smoking-discordant twin pairs
67:103
- respiratory function in presence of
64:291, 292
- in school-age smokers vs. nonsmokers
75:62
- smokers vs. nonsmokers
67:29; 72:40
- and smoking
64:297; 67:97
- and smoking, by sex
67:98
- and sputum
64:283-286
- traumatic injury from
64:279
- Coumarin
64:145
- Creosote oil
carcinogenic activity of
64:147
- Cresols
in cigar, pipe, and cigarette smoke
73:177
- as probable contributors to health hazards of smoking
72:144
- suspected carcinogenic agent of cigarette smoke
71:266
- Crotonaldehyde
ciliotoxic agent
67:108
- in tobacco smoke
67:108
- Croton oil
64:58
- Crotononitrile
as suspected contributor to health hazards of smoking
72:145
- Cuba
laryngeal neoplasms in
64:205, 207
- laryngeal neoplasms in, relationship to tobacco use
71:356
- oral neoplasms in, by type of smoking
64:200, 201
- oral neoplasms in, relationship of tobacco use
71:364
- Current Population Survey of 1955
64:177, 180, 186
- Curschmann's spirals
in sputum of smokers
69:39-40
- Customs and Excise Act of 1952, Great Britain
64:62
- Cyanides
detoxification, in pregnant smokers vs. nonsmokers
73:119
- in tobacco amblyopia etiology
67:40; 71:14, 435-436; 72:6
- in tobacco smoke
67:40
- in tobacco smoke, and optic atrophy
67:183
- toxicity, potentiation by vitamin B12 in tobacco amblyopia
67:183
- and vitamin B deficiency in tobacco amblyopia
67:40
- Cysteine
inhibition of smoke cytotoxic action on macrophages
69:42
- Cystitis
64:224
- Cytochrome oxidase
64:266
- Cytologic studies
exfoliative, and lung neoplasm diagnosis
75:47
- macrophage function and smoking
74:104, 105
- Czechoslovakia
64:205
- laryngeal neoplasms in, relationship to tobacco use
71:354, 357
- laryngeal neoplasms in, retrospective study of
64:206
- serum lipid difference in smokers vs. nonsmokers
71:101
- Danish Cancer Registry
64:141, 186, 220
- Danish Morbidity Study
64:224
- Data collection methods
in retrospective studies
64:206, 214, 215, 226
- DDT
64:145
- as suspected contributor to health hazards of smoking
72:65, 145
- Death certification
limitations of, in health statistics
64:101, 127
- neoplasm diagnosis in
64:128

- Death Registration Act
 - 64:127
- Deaths, accidental
 - 64:39, 344, 345
- Deaths, sudden
 - from cardiovascular disease
 - 68:36, 42
 - incidence in men with and without ventricular premature beats
 - 74:5
 - incidence in pipe and cigar smokers
 - 73:215
 - incidence in women, smokers vs. non-smokers
 - 74:9, 19
 - rate by smoking, cholesterol, and blood pressure,
 - 69:17
 - reduction of risk of, in cigarette smokers, using clofibrate
 - 75:32
 - smoking as a risk factor
 - 74:4-6, 19
- Defense mechanisms
 - 64:264
- Demographic factors
 - in smoking
 - 64:361-365
- Denmark
 - advertising curtailment in
 - 64:8
 - atherogenic effect of carbon monoxide and hypoxia
 - 71:64
 - bladder neoplasms in
 - 64:219, 220, 221
 - bladder neoplasms in, methods and results in retrospective studies of smoking and
 - 71:381, 383
 - carbon monoxide effects on human blood lipids in
 - 71:129
 - carbon monoxide effects on rabbit blood lipids in
 - 71:129
 - coronary mortality in
 - 64:320
 - cough prevalence in
 - 64:281
 - Danish Cancer Registry
 - 64:141, 186, 220
 - Danish Morbidity Study
 - 64:224
 - lung neoplasm mortality in
 - 64:176
 - respiratory function tests in
 - 64:291
 - serum lipid differences in smokers vs. nonsmokers in
 - 71:102
 - twins in, angina pectoris in smokers vs. nonsmokers
 - 71:51
- Deoxyribonucleic acid
 - see DNA
- Dermatitis
 - among tobacco workers
 - 72:111
- Dermatologists
 - coronary disease incidence in
 - 64:322
- Dextroamphetamine
 - 64:352
- Diabetes mellitus
 - 64:326
 - effect on CHD in smokers
 - 71:24
 - relationship with cigarette smoking in peripheral vascular disease
 - 71:72
 - risk in mortality from CVD
 - 71:67
- Diarrhea
 - smoking and
 - 64:71
- Dibenz(a,h)acridine
 - 64:56
 - carcinogenicity
 - 67:127
 - carcinogenic properties in cigarette smoke from
 - 71:265
 - pyrolytic formation of
 - 64:59
 - structural formula of
 - 64:59
- Dibenz(a,i)acridine
 - carcinogenicity
 - 67:127
 - carcinogenic properties in cigarette smoke from
 - 71:265
 - pyrolytic formation of
 - 64:59
 - structural formula of
 - 64:56
 - in tobacco smoke
 - 67:127
- Dibenzanthracene
 - tumor induction by
 - 64:143, 167
- Dibenz(a,c)anthracene
 - carcinogenicity, as component of cigarette smoke
 - 72:66
- Dibenz(a,h)anthracene
 - carcinogenicity
 - 67:127
 - carcinoma induction by
 - 64:229
 - structural formula of
 - 64:56
- 7H-Dibenzo(c,g)carbazole
 - carcinogenic effect in laboratory animals
 - 73:79
 - carcinogenic effect on respiratory tract in hamsters
 - 72:66, 67
 - carcinogenicity, as component of cigarette smoke
 - 67:127; 71:265; 72:66, 67
 - structural formula of
 - 64:56
- Dibenzo(a,i)pyrene
 - 64:33, 57
 - carcinogenicity
 - 67:127

- structural formula of
 - 64:26
- Dicarbonyl compounds
 - 64:53
- Dieldrin
 - 64:62
- Diet
 - influence of, in coronary disease
 - 64:322
 - intervention and cholesterol levels in postinfarction patients
 - 68:23
 - and peptic ulcer
 - 67:182
 - and smoking
 - 67:66
 - and smoking, effect on blood lipids
 - 73:12
 - as test constant
 - 64:224
 - tobacco amblyopia
 - 72:6
- Diethylnitrosamine
 - suspected carcinogenic properties in cigarette smoke from
 - 71:265
- Digestive tract neoplasms
 - mortality, and smoking
 - 67:10, 147
- Digital blood flow
 - effect of smoking
 - 64:318
- Digital temperatures
 - effect of smoking
 - 64:318
- Dihydric alcohols
 - 64:52
- Dimethylamine
 - as suspected contributor to health hazards of smoking
 - 72:145
- 9-10-Dimethyl-1, 2-benzanthracene
 - 64:203
- 7, 12-Dimethylbenz(a)anthracene
 - effect on oral mucosa in hamsters
 - 72:70
- Dimethylnitrosamine
 - suspected carcinogenic properties in cigarette smoke from
 - 71:265
- Dipalmityl ketone
 - 64:53
- Dipentene
 - 64:52
- 2,3-Diphosphoglycerate
 - effects of carbon monoxide on
 - 71:60-61
- Disability
 - of emphysema patients
 - 68:66
 - higher rates of smokers
 - 68:7
- DNA
 - alteration, and oral neoplasm carcinogenesis
 - 68:101
 - binding of polycyclic hydrocarbons to
 - 73:86, 87
 - effect of aromatic hydrocarbons on
 - 69:61
 - effect of cigarette smoke on synthesis
 - 69:62-63
 - increases in smokers' oral epithelial cells
 - 71:288
 - levels in mice lung exposed to cigarette smoke
 - 71:161
- Dogs
 - atherogenic effects of nicotine in
 - 71:120
 - bladder neoplasms in, fed 2-naphthylamine
 - 71:296
 - bradycardia and tachycardia in, following nicotine injection
 - 71:57-58
 - bronchogenic carcinoma induction in, from cigarette smoke inhalation
 - 71:269, 270
 - cigarette smoke instillation or implantation effects on tracheobronchial tree of
 - 71:268, 347
 - death in, causes from cigarette smoke inhalation
 - 71:271
 - effect of cigarette smoke on pulmonary clearance in
 - 71:164, 170
 - epinephrine release in
 - 64:318, 319
 - experimental neoplasm induction in
 - 64:146, 165, 189
 - fetal bronchial tubes of, effect of cigarette smoke on
 - 71:345
 - lung neoplasms following cigarette smoke inhalation
 - 71:239, 277
 - lung neoplasms in, types and lobes where found
 - 71:269, 272-273
 - lungs of, cigarette smoke effects on surfactant activity
 - 71:172, 225
 - myocardium, nicotine effects on
 - 71:58
 - neoplasm development in smoking, percentages of
 - 71:274
 - nicotine effect on
 - 64:71, 318, 319
 - ozone effect on
 - 64:295, 296
 - pulmonary histological changes in cigarette smoke inhaling
 - 71:158, 159-160
 - respiratory tract of, cigarette smoke inhalation effects on
 - 71:268, 352, 353
 - smoke deposition in
 - 64:265
 - smoke-induced bronchoconstriction in, atropine effects
 - 71:163

- smoking and nicotine effects on blood lipids in
 - 71:127-128
- smoking and nicotine effects on cardiovascular function in
 - 71:107-112
- smoking and nicotine effects on catecholamine levels in
 - 71:119
- Doll & Hill study
 - 64:324
- Donkeys
 - effect of cigarette smoke on pulmonary clearance in
 - 71:164, 171
- Dorn study
 - 64:324
- Dosage
 - measure of, in light and heavy smokers
 - 67:14-15
 - measure of, in men and women
 - 67:14-15
 - and mortality among women smokers
 - 67:25
 - nicotine and tar content of cigarette smoke as measurement of
 - 67:15
 - score, for smoking
 - 67:14-15
 - smoking exposure
 - 67:25
- Driving habits and coronary disease
 - 64:322
- Drug addiction
 - 64:350, 351, 352
 - definition of
 - 64:351
 - distinction from drug habituation
 - 64:351
 - psychology of
 - 64:353
- Dry mouth
 - 64:354
- Dublin
 - lung neoplasm mortality in
 - 64:195
- Ducks
 - cigarette smoke instillation or implantation effects on tracheobronchial tree of
 - 71:346
 - clearance products in
 - 64:269
- Duodenal ulcers
 - 64:8, 337, 340
 - mortality rates in
 - 64:37
 - mortality ratios in
 - 64:103, 337
 - mortality ratios in male cigar and pipe smokers
 - 73:222
 - nicotine induced, in cats
 - 73:158, 159
 - post-operative complications in smokers vs. nonsmokers
 - 73:157
- potentiating action of nicotine, in animals
 - 73:161-163
- prevalence in smokers, mechanism of action
 - 73:160
- smoking and
 - 72:6, 97, 98
- Dust exposure
 - 64:298, 299
 - bronchitis and
 - 73:44
 - COPD development from
 - 71:153, 218
 - as occupational hazard
 - 73:43, 44
 - in smokers vs. nonsmokers, by race and sex
 - 75:69, 70
 - smoking and
 - 73:44
 - smoking and, as risk factors in bronchitis development
 - 74:93, 94
 - smoking and, as risk factors in byssinosis development
 - 74:94-96; 75:68
- Dysphoria
 - 64:350
- Dyspnea
 - 64:286
 - prevalence in cigar and pipe smokers
 - 73:220, 221
- Ear neoplasm
 - 64:147
- Edentulism
 - smoking and
 - 69:87; 72:6
- Educational level
 - 64:100, 101
 - and incidence of CHD, in males
 - 68:24
 - smoking prevalence by
 - 64:363
- Egypt
 - relationship of human pulmonary histology and smoking in
 - 71:163
- Electrocardiograms
 - abnormalities, and CHD
 - 67:58; 68:29; 71:42, 45, 47
 - effect of smoking
 - 64:319; 71:45, 47; 73:13
 - effect of smoking, in middle-aged Dutch men
 - 73:12
 - effect of smoking, in young military recruits in Poland
 - 73:12
- Electroencephalograms
 - nicotine effect on
 - 64:70
 - placebo effect on
 - 64:70

smoking effect on
 64:70

Electrophoresis
 use in determining serum level of alpha-1-antitrypsin
 71:151

Emotional stress
 64:373, 374

Emphysema
 64:35, 38, 277-294, 302
 air pollution in
 64:297
 alpha-1-antitrypsin deficiency and
 71:150, 151; 72:44; 74:87-90
 alveolar destruction in
 64:294
 asthmatic form of
 64:294
 autopsy studies, in smokers vs. nonsmokers
 75:74-76
 bronchitic form of
 64:294
 and bronchitis mortality rates, for men by amount smoked
 67:93
 and bronchitis mortality ratios, by age, amount smoked, and sex
 67:94
 and bronchitis mortality ratios, for men by amount smoked
 67:93
 bronchitis relation to
 64:278, 279, 280
 cadmium exposure in etiology of, in animals
 74:104
 cigarette smoking effects on
 71:9
 definition of
 64:278; 67:89; 71:139
 development in dogs following cigarette smoke inhalation
 71:271
 development of, relation of cadmium in smoke to
 71:154
 diagnosis of
 64:278, 279, 280; 67:90
 disability payments in U.S.
 68:66
 dyspneic form of
 64:297
 epidemiology of
 64:280-294
 excess mortality from
 64:25, 277
 experimentally induced in smoking dogs
 72:46
 grade II or III, smokers vs. nonsmokers
 71:162
 in horses
 69:40
 hypersensitivity in development of
 67:111
 incidence in cigar/pipe smoking coal miners vs. cigarette smokers and nonsmokers
 73:217

 morbidity, and cigar smoking
 67:99
 morbidity, and pipe smoking
 67:99
 morbidity, and smoking
 67:3, 22, 29-30, 96-98
 morbidity, body constitution as a factor in
 67:30
 morbidity, heredity as a factor in
 67:30
 mortality, and cigar smoking
 67:30
 mortality, and pipe smoking
 67:30
 mortality, effect of cessation of smoking on
 67:29
 mortality, effect of cigarette smoking on
 71:175
 mortality rates
 64:25, 29, 301; 67:29, 90-93; 68:66; 71:139
 mortality ratios
 64:103, 293; 67:8, 90
 mortality ratios, and smoking
 67:3, 91
 mortality ratios, by amount smoked
 67:90-93
 mortality ratios, by sex in United States
 67:91
 mortality ratios, in cigar smokers
 67:94
 mortality ratios, in male pipe and cigar smokers
 73:217, 219
 mortality ratios, in pipe smokers
 67:94
 nonsmoker prevalence of
 64:297
 occupational exposure in
 64:298, 299, 300, 302
 pathogenesis of
 69:38-40
 phases of
 64:294
 pigment deposition in
 64:272, 273
 premature development and smoking, autopsy studies
 74:97
 prevalence in males by smoking category, at autopsy
 73:48
 prevalence in pipe/cigar and cigarette smokers vs. nonsmokers, autopsy studies
 73:45, 46
 prevalence in smokers vs. nonsmokers
 73:55
 prevalence rates in U.S.
 74:75
 prospective studies on
 64:293
 pulmonary function studies and
 74:80
 respiratory symptoms, body constitution as a factor in
 67:30, 102-103, 108-109

- respiratory symptoms, by smoking classification
 - 67:99
- respiratory symptoms, heredity as a factor in
 - 67:30, 102-103, 108, 111
- respiratory symptoms, in pipe smokers
 - 67:99
- respiratory symptoms, in smokers
 - 64:27; 67:99; 68:74
- in smokers vs. nonsmokers, autopsy studies
 - 73:45-47
- smoking and etiology of
 - 64:38, 294, 303; 67:30-31, 96, 104-107, 110-111; 69:37-38; 72:37; 74:87-90
- summary of previous findings on relationship to smoking
 - 74:75-78; 75:5, 7, 61, 62
- Emphysema Registry
 - 64:294
- Endrin
 - 64:145
 - as suspected contributor to health hazards of smoking
 - 72:145
- Enzymes
 - activity, effect of smoking
 - 71:165
 - adenosine triphosphatase, effect of ciliotoxic agents on
 - 67:108
 - aryl hydrocarbon hydroxylase activity in placentas at childbirth
 - 71:410
 - aryl hydroxylase, effect of nickel in cigarette smoke on induction
 - 71:257
 - benzo(a)pyrene hydroxylase, activity in placentas of smoking mothers
 - 71:410
 - carbonic anhydrase, carbon monoxide inhibition in fetal cord blood of smoking mothers
 - 71:407
 - carbonic anhydrase, decrease in activity in fetal cord blood in smoking mothers
 - 71:409
 - effect of cigarette smoke, in rabbit lungs
 - 74:104, 105
 - and macrophage function, in rabbit lungs,
 - 74:104, 105
 - oxidative enzymes, effect of ciliotoxic agents on
 - 67:108
- Epidemiological studies
 - bladder neoplasms and smoking
 - 72:72-74
 - bronchopulmonary diseases and smoking
 - 72:38-41; 73:36-45
 - cerebrovascular disease and smoking
 - 75:29, 30
 - COPD and smoking
 - 74:78-80
 - coronary diseases and smoking
 - 69:12-25; 72:14-16; 73:4-13, 23; 75:14, 15
 - esophageal neoplasms and smoking
 - 72:70, 71
 - laryngeal neoplasms and smoking
 - 69:58-60; 72:68
 - lung neoplasms and smoking
 - 69:55-56; 72:60-65; 73:68-72; 74:37; 75:44
 - lung neoplasms, by age and sex
 - 68:94-99
 - lung neoplasms, in Iceland
 - 68:94, 95
 - lung neoplasms, in Japan
 - 68:95, 96
 - lung neoplasms, in Switzerland
 - 68:95
 - maternal smoking and outcome of pregnancy
 - 69:77-80; 72:83-87
 - oral neoplasms and smoking
 - 69:58; 72:68-70; 74:53
 - pancreatic neoplasms and smoking
 - 69:60-61; 72:74; 74:57
 - peptic ulcer and smoking
 - 73:155-157
 - urinary tract neoplasms and smoking
 - 69:60
- Epiglottitis
 - laryngeal neoplasms
 - 64:212
- Epinephrine
 - 64:318
 - effect in thrombus formation
 - 67:64-65
 - effect of nicotine
 - 75:29
 - levels in arteries, cigarette smoking effects on
 - 71:57
- Epithelial lesions
 - in smokers
 - 64:168, 170, 172, 173, 213
- Epithelial tissues
 - age effects on
 - 64:34
 - changes in female smokers
 - 64:34
 - changes in male smokers
 - 64:34
 - cigarette smoking and
 - 64:34, 165, 167-173, 189, 213, 263-275
 - ciliary loss in
 - 64:34
 - in ex-smokers
 - 64:34
 - histopathologic changes in
 - 64:167-173, 231, 263-275
 - hyperplasia in
 - 64:34, 203
 - hypertrophy caused by nitrogen dioxide
 - 69:41
 - in nonsmokers
 - 64:189
 - pipe and cigar effects on
 - 64:34

- pre-malignant lesions in
 - 64:34; 75:44
 - see also Bronchial epithelium; Esophageal epithelium
- Epithelial tumors
 - classification of
 - 64:174
 - in man
 - 64:146
- Epitheliomas
 - of lip, relationship of tobacco use with
 - 71:361
- Epoxides
 - suspected carcinogenic agents in cigarette smoke
 - 71:265
- Ergonovine
 - effect on blood circulation in laboratory animals with coronary disease
 - 67:62
- Esophageal balloon technique
 - 64:292
- Esophageal epithelium
 - atypical nuclei in basal cells, male smokers
 - 71:292, 379-380
 - effect of smoking on
 - 67:36, 150-153
 - pathological changes by age and smoking history
 - 67:150-162
 - pathological changes by amount smoked
 - 67:152
 - pathological changes by smoking classification
 - 67:150-151
 - pathological changes for male smokers vs. nonsmokers
 - 67:150-153
- Esophageal neoplasms
 - 64:37, 212-218, 234
 - alcohol consumption and smoking in
 - 67:152-153; 72:4, 5, 71; 73:76, 200
 - frequency in smokers vs. nonsmokers
 - 71:12, 238
 - geographical factors in
 - 64:133
 - incidence of, by tobacco use
 - 64:216
 - incidence of, in Jewish women
 - 64:135
 - incidence of, in U.S.
 - 64:127
 - income class gradients in
 - 64:134
 - induction in animals by nitrosamine
 - 71:292
 - inhalation patterns and
 - 64:218; 73:197
 - methods and results of retrospective studies of tobacco use in
 - 71:289, 375-378
 - mortality rates
 - 64:37, 133; 71:289
 - mortality rates, by amount smoked
 - 67:147, 150
 - mortality rates, by smoking classification
 - 67:147, 150
 - mortality rates in females
 - 64:131, 132
 - mortality rates in Japanese males by smoking and drinking characteristics
 - 72:71
 - mortality rates in males
 - 64:130, 132
 - mortality rates in migrants
 - 64:134
 - mortality rates in pipe/cigar and cigarette smokers
 - 68:102
 - mortality ratios, by age
 - 67:150
 - mortality ratios, by amount smoked
 - 67:150
 - mortality ratios, by smoking classification
 - 67:150
 - mortality ratios for cigar, pipe, and cigarette smokers vs. nonsmokers
 - 73:197, 200
 - mortality ratios in
 - 64:148, 149, 217; 71:289-291
 - mortality ratios in cigarette smokers
 - 64:149
 - mortality ratios in Japanese male smokers vs. nonsmokers
 - 73:76
 - mortality ratios in nonwhites
 - 64:218
 - prospective studies of
 - 64:217
 - relative risk in cigar, pipe, and cigarette smokers vs. nonsmokers
 - 73:197, 200-202
 - retrospective studies of
 - 64:212-217
 - risk gradients in, by amount smoked
 - 64:217, 218
 - risk ratios in
 - 64:213
 - smoking in etiology of
 - 64:37, 188; 67:33, 150, 151; 71:293; 72:4, 70, 71
 - summary of previous findings on relationship to smoking
 - 68:89, 90; 74:55
 - summary of retrospective studies
 - 73:201, 202
 - tobacco tars in
 - 64:218
 - tobacco use and
 - 64:32, 217, 218
 - trend in mortality
 - 64:137
 - urban-rural differences in
 - 64:133
- Esophagus
 - effect of benzo(a)pyrene in laboratory animals
 - 67:152-153
 - histological changes in cigar, pipe, cigarette smokers vs. nonsmokers
 - 73:200
- Esters
 - in cigarette smoke
 - 64:52

- Ethane
 - 64:60
- Ethnic groups
 - neoplasm risks in
 - 64:134, 135
 - neoplasm sites by
 - 64:134, 135
- Ethyl alcohol
 - carcinogenic promoter activity of
 - 64:217
- Ethylene
 - 64:60
 - glycol
 - 64:52
- Euphoria
 - 64:350
- Executive Office of the President
 - 64:15
- Exercise
 - on bicycle ergometer, effect of smoking
 - 73:242, 243
 - cardiac index, effect of smoking
 - 73:242, 243
 - effect of carbon monoxide exposure
 - 74:11, 12
 - effect of smoking and smoking abstinence
 - 73:241, 242, 246, 247
 - effects of CO exposure and increased carboxyhemoglobin levels
 - 75:95, 97
 - influencing factors
 - 73:241, 246, 247
 - and pulmonary function, smokers vs. nonsmokers
 - 74:99
 - relationship to mortality rates
 - 64:101
 - summary of findings and mechanism of action
 - 73:246, 247
 - on treadmill, effect of smoking
 - 73:243, 245
- Ex-smokers
 - atypical nuclei in esophageal epithelium, in male
 - 71:379-380
 - chronic cough
 - 67:98
 - decrease of lung neoplasm risk
 - 69:57; 75:43
 - effects of cessation on body weight, blood pressure and hypertension development
 - 75:16-19
 - effects of cessation on closing volume abnormalities
 - 75:71
 - effects of cessation on pathologic changes
 - 75:74
 - histological changes in bronchial epithelium at autopsy
 - 73:74
 - low birth weight infants of
 - 73:112-114
 - lung neoplasms in, lowered rates
 - 71:11
 - lung neoplasms in, prevalence
 - 64:192, 193
 - mortality rates in
 - 64:36; 64:105
 - mortality rates in, by smoking history
 - 67:8-11
 - mortality rates in, COPD
 - 71:175
 - mortality rates in, coronary disease
 - 64:322, 323, 325; 71:46-48
 - mortality rates in, coronary disease, by smoking history
 - 67:51
 - mortality rates in, coronary disease, cigarette vs. pipe/cigar smokers
 - 73:172, 173
 - mortality rates in, coronary disease, for men by amount smoked
 - 69:15
 - mortality rates in, coronary disease, for men, by years stopped smoking
 - 69:15
 - mortality rates in, coronary disease, for men, compared to nonsmokers
 - 69:15
 - mortality rates in, gastric ulcer
 - 64:104
 - mortality rates in, laryngeal neoplasms
 - 64:104
 - mortality rates in, lung neoplasms
 - 64:104; 71:276; 72:5; 73:71-72
 - mortality rates in, oral neoplasms
 - 64:104
 - mortality rates in, stroke, for men, compared to nonsmokers
 - 69:15
 - mortality ratios in
 - 64:36, 92, 93, 103, 104, 105
 - mortality ratios in, circulatory disease
 - 64:104
 - mortality ratios in, ex-cigar smokers
 - 64:94
 - mortality ratios in, lung neoplasms
 - 71:241-242
 - mortality ratios in, respiratory disease
 - 64:104
 - pneumoconiosis incidence in, in miners
 - 64:298
 - prevalence of respiratory symptoms
 - 73:39
 - psychosomatic disorders in
 - 64:367
 - pulmonary fibrosis in
 - 64:274
 - pulmonary function in
 - 73:39
 - relative risk in lung neoplasms development
 - 73:71-72
 - risk ratios in, from neoplasms
 - 64:155, 158, 188
 - summary of previous findings on health consequences of cessation
 - 75:6
 - summary of previous findings on relationship to COPD
 - 75:61

- survival after treatment for pharyngeal, laryngeal, or oral neoplasms 73:75
- thickness of vocal cords in 69:60
- Extroversion 64:365, 366
- Eye irritation
 - effects of exposure to cigarette smoke, in passive smokers 75:99, 100
- Face
 - skin neoplasms of 64:147
- Factory workers, mean expiratory flow rates in 64:290
- False vocal cords
 - epithelial hyperplasia in 64:271
 - hyperkeratosis in 64:271
- Farmers
 - coronary disease incidence in 64:321
 - decreased smoking by 64:323
 - myocardial infarction in 64:323
 - smoking incidence in 64:187
- Fats, saturated 64:322
- Fatty acid levels
 - effect of cigar, pipe, and cigarette smoke in dogs 73:216
 - effect of smoking 73:12
 - rise in, after smoking 71:36, 65
 - in smokers vs. nonsmokers 71:102
 - see also Fatty acids; Free fatty acids
- Fatty acids 64:53
 - suspected carcinogenic agents of cigarette smoke 71:266
 - see also Fatty acid levels; Free fatty acids
- Federal insecticide regulations 64:61
- Federal Trade Commission 64:8, 15
- Fertility
 - and smoking 69:79-80
- Fetal death
 - effect of maternal smoking 64:39, 343; 67:185; 69:77-78; 73:123-135
 - epidemiological studies, in smokers vs. nonsmokers 73:126-132
- Fetus
 - effect of maternal smoking 64:39, 343; 72:5, 83-89
 - heart beats in, increase in smoking mothers 71:408
 - morbidity, effect of maternal smoking on 67:186
 - tissues of, effects of elevated carboxy-hemoglobin on 71:407
- Fibrosis
 - see Pulmonary fibrosis
- Filters
 - advantages in reduction of particulates 71:269, 275
 - cellulose acetate 64:59
 - charcoal, and effect of cigarette smoke on cell cultures 69:62
 - as a factor in reducing lung neoplasm risk 74:40-41
 - reduction of lung neoplasms from, 71:13
- Finland
 - blood pressure differences in smokers vs. nonsmokers 71:103
 - COPD morbidity in smokers in 71:200
 - coronary death rate in 64:320
 - lung neoplasm mortality in, relationship to tobacco use 64:176; 71:245-246
 - lung neoplasms in, retrospective study of, methods 71:325, 327
 - peptic ulcer in, methods and results for retrospective and cross section studies of smoking 71:426, 428
 - risk ratio in 64:127
 - serum lipid differences in smokers vs. nonsmokers in 71:98, 99
 - smoking and nicotine effects on human blood lipids 71:124
- Fires
 - smoking as cause of 64:344, 345; 67:187-188
- Fitness tests
 - smokers vs. nonsmokers 73:245
- Flavors
 - antismoking measures using 64:354
- Flax mill workers
 - chronic respiratory diseases in 64:289, 299
- Fluoranthene
 - alcoholic solution of, penetrability of esophageal epithelium 71:292

- in caffeine solution, effect on esophageal tissue in laboratory animals
67:152-153
- in carbon black
64:147
- in ethanol, effect on esophageal tissue in laboratory animals
67:152-153
- Forced expiratory flow rates
64:288-293
- Forced expiratory volume
64:288, 289, 290, 291, 293, 294, 298
- decline in smokers, by race
75:72
- Formaldehyde
64:60, 61, 268
- ciliastatic action of
64:61, 268
- ciliatoxic agent
67:107
- as suspected contributor to health hazards of smoking
72:145
- in tobacco smoke
67:107
- toxic action of
64:295
- tracheobronchial irritation from
64:266
- Formic acid
ciliatoxic agent
67:108
- in tobacco smoke
67:108
- Formosa
acute effect of cigarette smoke on human pulmonary function in
71:169
- Framingham Study
64:291, 323
- angina pectoris in
64:325
- duration of smoking habit and incidence of CHD
68:17
- effect of coffee drinking on mortality in smokers vs. nonsmokers
75:20
- epidemiologic study of CHD, CDV, intermittent claudication, and smoking
74:14-16
- interaction of smoking and other risk factors in CHD
73:8
- morbidity ratios for CHD, by smoking habit
68:18; 71:24
- mortality rates in
64:324
- France
bladder neoplasms in, methods and results in retrospective studies of smoking
71:381-383
- bladder neoplasms in, retrospective studies
64:219, 220, 221
- CHD mortality and morbidity in
71:94, 97
- cigarette smoke effects on animal tissue in
71:343, 344, 349
- COPD mortality of smokers in
71:201
- esophageal neoplasms in, retrospective studies of tobacco use
64:214; 71:378
- laryngeal neoplasms in, relationship to tobacco use
64:205, 207; 71:355, 357
- lung neoplasms in, methods of retrospective study of smoking in
71:326
- oral neoplasms in, by type of smoking
64:199, 201
- oral neoplasms in, relationship of tobacco use and
71:363
- Free fatty acids
64:52
- plasma, effect of nicotine, in rats
74:13
- plasma, effect of smoking on
69:27
- see also* Fatty acid levels; Fatty acids
- Fried foods
64:100
- Fume exposure
in smokers vs. nonsmokers, by race and sex
75:69, 70
- Fungi
carcinogenic contamination of tobacco
68:92, 93
- Fungicides
concentration in cigarette smoke
71:265, 266
- Furfural
as suspected contributor to health hazards of smoking
72:145
- Ganglia, parasympathetic
64:69, 71, 317, 318
- Ganglion cells
nicotine effect on
64:69, 70
- paralysis of
64:69, 70
- Gas adsorbents
carbon granules as
64:61
- Gas phase, cigarette smoke
69:63
- effect on mucus flow rates in cats
72:47
- harmful constituents in
72:143
- Gas phase, tobacco smoke
64:60
- acetaldehyde in
64:60

acetone in
 64:60
 acetylene in
 64:60
 acrolein in
 64:60
 ammonia in
 64:60
 argon in
 64:60
 butane in
 64:60
 carbon dioxide in
 64:60
 carbon monoxide in
 64:60
 ethane in
 64:60
 ethylene in
 64:60
 formaldehyde in
 64:60
 hydrogen cyanide in
 64:60
 hydrogen in
 64:60
 hydrogen sulfide in
 64:60
 methane in
 64:60
 methanol in
 64:60
 methyl chloride in
 64:60
 methyl ethyl ketone in
 64:60
 methyl nitrate in
 64:60
 nitric oxide in
 64:266
 nitrogen dioxide in
 64:60
 nitrogen in
 64:60
 oxygen in
 64:60
 phenol in
 64:267
 propane in
 64:60
 propylene in
 64:60
 Gastric acidity
 effect of smoking on
 67:182
 Gastric motility
 64:340
 Gastric neoplasms
 64:37, 38, 225-229, 235
 decline in mortality from
 64:133
 geographic factors in
 64:133
 income class gradients in
 64:134
 migrant mortality in
 64:134
 mortality rates in
 64:130, 133
 mortality rates in, in smokers
 64:149
 mortality rates in, Japanese smokers vs.
 nonsmokers
 74:56, 57
 mortality ratios in
 64:148, 149, 228
 prospective studies of
 64:227
 retrospective studies of
 64:225, 226, 227, 228
 retrospective studies of, by smoking pat-
 tern
 64:226, 227
 summary of previous findings on rela-
 tionship to smoking
 68:90; 74:55
 tea drinking and smoking in etiology of
 74:56, 57
 tobacco tars in
 64:228
 trends in prevalence of
 64:135
 U.S. incidence of
 64:127
 Gastric secretion
 effect of nicotine
 72:97
 effect of nicotine in laboratory animals
 73:158, 159
 effect of smoking
 64:340
 effect of smoking in ulcer patients
 73:157, 158
 Gastric ulcers
 64:8, 37, 337, 340
 healing of, after cessation of smoking
 64:337
 mortality ratios in
 64:37, 113, 337
 Gastrointestinal disorders
 prevalence in cigarette and pipe/cigar
 smokers
 73:222
 smoking and
 72:5, 6, 97, 98
 General practitioners
 coronary disease incidence in
 64:321, 322
 Genetic factors
 64:321, 385
 alpha-1-antitrypsin deficiency
 72:44
 alpha-1-antitrypsin deficiency and smok-
 ing in COPD development
 74:87-90; 75:72-74
 in bronchitis development
 67:102-104, 108-109
 cessation of smoking and
 64:191
 COPD pathogenesis and
 71:148, 150-152, 205
 coronary disease and
 72:18
 in cough development
 67:102, 111

- in emphysema development
67:30, 102-103, 108-109, 111
- and heart disease
67:53-54, 57
- lung neoplasms and
64:167, 232
- in respiratory tract disease development
67:30, 108
- short run changes in, in humans
64:191
- smoking and
64:190, 319; 71:5; 72:18, 44
- smoking and, in lung neoplasm develop-
ment
74:37
- susceptibility in neoplasm epidemiology
64:190, 191, 192, 193
- twin studies, effects of smoking
71:49-52, 99
- Genitourinary diseases
see Urogenital diseases
- Genitourinary neoplasms
see Urogenital neoplasms
- Geographic factors
neoplasm incidence by
64:133
- neoplasm mortality by
64:133
- Germany
CHD morbidity and mortality in
71:95-96, 97
- cigarette smoke inhalation effects on
animal respiratory tract in
71:350
- laryngeal neoplasms in
64:205
- laryngeal neoplasms in, relationship to
tobacco use
71:355
- laryngeal neoplasms in, retrospective
study of
64:206
- lung neoplasms in, methods of retro-
spective study of smoking in
71:323, 325, 326
- polonium-210 levels in lungs of smokers
in
71:336
- smoking and nicotine effects on human
blood lipids
71:125
- Gestational age
effect on perinatal mortality rates in
smoking vs. nonsmoking mothers
73:126-132
- and low-birth-weight infants, effect of
maternal smoking
73:103-106
- Gingival neoplasms
64:197, 202
- cigar smoking in
64:202
- pipe smoking in
64:202
- retrospective study of, by type of smok-
ing
64:201
- tobacco chewing in
64:202
- see also Mouth neoplasms; Oral neo-
plasms
- Gingivitis
incidence among Danish Royal Marines
69:86
- incidence among Dutch Navy recruits
69:86
- incidence among U.S. Naval trainees
69:86
- smoking and
69:85-86; 72:6
- Gingivitis, Vincent's
relationship to smoking
69:86
- Ginseng root
64:355
- Glossary
terms used in smoking and ventilatory
function
71:215
- Glucose intolerance
as a risk factor in CHD
73:8
- Glucose metabolism
cardiovascular effects of
68:40, 41
- and insulin response, alteration effects
on myocardial response
71:66
- Glutamic acid
64:54
- Glutamine
64:54
- Glutathione
inhibition of smoke cytotoxic action on
macrophages
69:42
- Glycerol
64:52, 62
- Glycogen
levels in mice lung exposed to cigarette
smoke
71:161
- Glyoxal
64:53
- Goblet cells
morphological changes in
64:35, 268, 271
- Graphite
respiratory tract carcinoma in workers
exposed to
71:256
- Grief,
drug use in
64:353
- Grip strength
effect of smoking
73:241, 242
- Group psychotherapy
cure of tobacco habit by
64:354
- Growth inhibitors
and carcinogenesis
68:92

- Guanethidine
 blockage of nicotine cardiac stimulation by
 71:57
- Guinea pigs
 64:296
 induced pulmonary damage in
 64:266
 lung neoplasm development following chronic nickel carbonyl or dust inhalation
 71:256
 lungs of, cigarette smoke effects on surfactant activity
 71:255
 respiratory changes in, exposed to cigarette smoke
 71:162
 sulfur dioxide effect on
 64:266
- Habituation
 64:350, 352, 354
 definition of
 64:351
- Hamsters
 benzo(a)pyrene inhalation by, effect of asbestos dust on carcinoma induction
 71:162
 bladder neoplasms in, fed 2-naphthylamine
 71:296
 cigarette smoke instillation or implantation effects on tracheobronchial tree of
 71:268, 346-348
 induced carcinogenesis in
 64:166
 induced oral neoplasms in
 64:202, 203, 204, 232
 laryngeal neoplasms following smoke inhalation
 71:12
 larynx of, effect of cigarette smoke inhalation on
 71:281, 284
 lung and embryos, effects of cigarette smoke tars on
 71:343-344
 pulmonary changes from chronic nitrogen dioxide inhalation
 71:220
 respiratory tract of, C-14 labeled particulates deposition in
 71:281-282
 respiratory tract of, cigarette smoke inhalation effects on
 71:268, 351
- Harvard College
 alumni study
 64:385, 386
 student study
 64:383
- Health Insurance Plan
 68:19, 20
- myocardial infarction in pipe and cigar smokers under
 71:32, 38-39
- Heart
 effect of CO exposure
 74:10-12
 effect of nicotine
 64:318; 67:60; 71:36; 74:13
 effect of smoking
 64:318; 67:60-62
see also Myocardium
- Heart disease
 64:320
 description of
 64:320
 U.S. mortality rate from
 64:25, 317, 320
see also Coronary diseases
- Heart rate
 64:318, 326
 effect of catecholamines on,
 67:60
 effect of CO exposure
 74:11, 12
 effect of exercise and smoking
 73:242-246
 effect of nicotine on
 67:60; 74:13
 effect of smoking and coronary disease
 67:61; 71:45, 47
 effect of smoking on
 67:60
 fetal, effect of maternal smoking
 71:408
- Hematite
 64:193
 dust, respiratory tract neoplasms in hamsters exposed to
 71:348
- Hematocrit
 64:319
 infant, smoking mother effects on
 71:407, 409
 variations in, effect on coronary blood flow
 71:66
- Hemoglobin
 64:319
 affinity for oxygen, CO effects on 2,3-diphosphoglycerate control of
 71:60-61
 effect of smoking on oxygen affinity
 69:29
 levels, relation to incidence of coronary disease
 67:58
 risk factor in CHD
 68:29
 variations in, effect on coronary blood flow
 71:66
- Hepatomas
 64:145, 321
- Heptachlor
 64:62, 145
- Heredity
see Genetic factors

- Heterocyclic compounds**
64:54
carcinogenic properties in cigarette smoke
71:264, 265
- Heterocyclic nitrogen compounds**
carcinogenicity
67:127
in tobacco smoke
67:127
- Hexamethonium**
blockage of nicotine cardiac stimulation by
71:57
- High school students**
smoking in
64:370
- Hippocampus**
nicotine effect on
64:71
- Histiocytes**
64:269
- Histological studies**
in laboratory animals
73:49, 50
lung neoplasms and smoking
74:38; 75:44-46
lung neoplasms in U.S. veterans
73:73
macrophage function and
74:104, 105
in smokers vs. nonsmokers
74:8, 49
- Holland**
lung neoplasm mortality rate in
64:176
smoking habits in
64:177
- Honolulu Heart Study**
interaction of smoking and other risk factors in CHD
73:8, 9
- Hookahs**
smokers of, laryngeal neoplasm induction in
71:355
- Humectants**
64:52
- Humidity**
and pathologic effects of exposure to cigarette smoke
75:99
- Hungary**
methods used for retrospective studies of lung neoplasms in
71:328
- Hunger**
64:355
- Hydrocyanic acid**
as probable contributor to health hazards of smoking
72:144
- Hydrogen**
in gas phase, cigarette smoke
64:60
- Hydrogen cyanide**
64:60
- in cigarette smoke, effects on body oxidative metabolism
71:62
ciliastatic action of
64:61, 268
as respiratory enzyme poison
64:60
toxicity of
64:265, 266
- Hydrogen sulfide**
64:60
as suspected contributor to health hazards of smoking
72:145
- Hydrolases**
reduction of in smokers' alveolar macrophages
69:42-43
- Hydroperoxides**
64:52, 72
- Hydroquinone**
64:54
bladder neoplasm induction in laboratory animals
67:156
as suspected contributor to health hazards of smoking
72:145
- 3-Hydroxyanthranilic acid**
bladder neoplasm induction in laboratory animals
67:156
urinary excretion, smokers vs. nonsmokers
67:156
- Hydroxy-cotinine**
structure of
64:72
- Hydroxy-coumarin**
64:145
- 3-Hydroxykynurenine**
bladder neoplasm induction in laboratory animals
67:156
excretion of, smokers vs. nonsmokers
67:156
excretion of, smoking effects on
71:296
- Hydroxyproline**
level in mice lung exposed to cigarette smoke
71:161
- Hypercapnia**
and chronic obstructive bronchopulmonary disease
68:75, 76
- Hypercholesterolemia**
and hypoxia, in arteriosclerosis
69:26
incidence in Belgian military men
74:17, 18
incidence in male British business executives, by smoking habit and clinical parameters
73:11
as a risk factor for coronary heart disease
72:16, 17; 73:8, 9, 11

Hyperchromatic nuclei
in epithelial cells of smokers
64:168, 173

Hyperinsulinemia
during oral glucose tolerance tests after smoking
68:41

Hyperplasia
64:168, 169, 170, 172, 203, 231
basal cell
64:168, 169, 170, 172, 173, 231
basal cell, and smoking
67:36
betel nut chewing and
64:203
bronchial mucosa, by smoking history in men
67:105
nonspecificity of
64:172
precancerous aspects of
64:166
reversibility of
64:172

Hyperpnea
from nicotine
64:70

Hypersensitivity
effect in emphysema development
67:111

Hypertension
incidence in male Israeli civil servants
74:18
interaction with smoking as risk factor in cerebrovascular disease
73:9
pulmonary, and chronic obstructive pulmonary disease
68:74-76
as a risk factor for coronary heart disease
64:32, 321; 72:16, 17; 73:8, 9
risk of, in smokers vs. nonsmokers
68:22, 44
smoker mortality rates in
64:325
smoking effects in
64:325; 75:15-19
summary of recent findings
75:33
in women smokers with CHD
68:22

Hypnotism
cure of tobacco habit by
64:354

Hypothalamus
nicotine stimulation
64:71

Hypoxemia
carbon dioxide effects on
71:61, 75
and chronic obstructive bronchopulmonary disease
68:75, 76
smoking and
72:22

Hypoxia
aortic atheromatosis development in rabbits exposed to
71:64

and arteriosclerosis
69:26
carbon monoxide-induced
73:18, 23
effect of nicotine
72:21
experimentally induced in rats
72:21
postoperative, in smokers
71:174, 230
postural, mechanism in asymptomatic smokers vs. nonsmokers
71:147
tissue, carbon monoxide effects on
71:61

Iceland
lung neoplasm mortality rate in
64:176
lung neoplasms in, relationship to tobacco smoking
71:244

Immune system
response to benzo(a)pyrene-induced lung neoplasms
74:48, 49
suppression of immunoglobulin response, by nicotine or water soluble fraction of cigarettes
75:77

Income class
lung neoplasm mortality by
64:133, 134
smoking prevalence by
64:362

Indeno(1,2,3-cd)pyrene
carcinogenicity
67:127
carcinogenic properties in smoke
67:127; 71:265

India
64:205
esophageal neoplasms in, retrospective studies of tobacco use with
64:214, 215; 71:378
laryngeal neoplasms in, relationship to tobacco use
71:355, 356
laryngeal neoplasms in, retrospective studies of
64:205
oral neoplasms in, relationship of tobacco use
71:362, 366
oral neoplasms in, retrospective studies of, by type of smoking
64:199, 201
relationship of smoking to thrombosis in
71:131
relationship of smoking to tuberculosis in
71:227
smoking and nicotine effects on human cardiovascular system
71:117

- Indole, 1-methyl-
 - possible initiator in tobacco carcinogenesis
 - 71:265
- Industrial carcinogens
 - 64:166
- Industrial hazards
 - effect of dust on COPD development
 - 71:175
 - effect on COPD development in smokers
 - 71:153, 154, 218, 219
- Industrial pollution
 - in etiology of bronchitis
 - 67:108, 110
 - in etiology of emphysema
 - 67:108, 110
- Infant mortality
 - black vs. white smoking mothers
 - 73:129, 132
 - comparison of stillbirth and abortions in smoking and nonsmoking mothers
 - 71:395, 405, 406
 - differences of birth weight and, in smoking and nonsmoking mothers
 - 71:404
 - effect of genetic differences and smoking
 - 73:132
 - effect of maternal smoking
 - 67:185; 69:77, 78; 71:415; 72:83, 87; 73:123, 135
 - effect of previous obstetrical experience and smoking
 - 73:132
 - effect of socioeconomic background and smoking
 - 73:131, 132
 - epidemiological studies in smokers vs. nonsmokers
 - 73:126, 132
 - factors other than smoking
 - 73:131, 132
 - low birth weight and
 - 72:86
 - risk of low-birth-weight infants of smoking vs. nonsmoking mothers
 - 73:126, 132
 - sudden death, relation of smoking and nonsmoking mothers
 - 71:407
- Infants
 - development of bronchitis and pneumonia, and maternal smoking
 - 75:103
 - growth rate, effect of maternal smoking on
 - 69:78
- Infectious diseases
 - 64:38, 276, 277, 302
- Influenza
 - 64:195, 277, 302
 - incidence from antibody deficit in smoking
 - 72:109
 - mortality ratios in
 - 64:276
 - prevalence in pipe and cigar smokers
 - 73:220, 221
- Influenza viruses
 - effect of cigarette smoke on, in mice
 - 68:70, 71
 - effect on dogs inhaling cigarette smoke
 - 71:351
 - enhancing effect in vitro on oxidized nicotine
 - 69:42
 - lung neoplasm induction by
 - 64:172
 - neoplasm induction by
 - 64:166
 - resistance of mice following cigarette smoke inhalation
 - 71:173
- Inhalation
 - 64:91, 187, 188
 - amount smoked and
 - 64:163
 - bladder neoplasm prevalence and
 - 64:219, 223, 225
 - carbon monoxide, effect on blood circulation in coronary disease patients
 - 67:63
 - as carcinogen application method
 - 64:166
 - cigarette smoke, and chronic cough
 - 67:97
 - cigarette smoke, and coronary disease
 - 67:54
 - cigarette smoke, and mortality
 - 67:7, 9
 - cigarette smoke, effect on blood pressure
 - 67:54
 - coronary mortality and
 - 64:324
 - effect of previous smoking habits on patterns of
 - 73:186, 189
 - effect on blood circulation in dogs
 - 67:63
 - esophageal neoplasms and
 - 64:213, 218
 - frequency-per-puff in cigar and cigarette smokers
 - 73:186, 189
 - laryngeal neoplasms and
 - 64:209, 212
 - and lung neoplasms in animals
 - 68:93
 - lung neoplasms prevalence by
 - 64:159, 230
 - by male smokers, and mortality rate
 - 67:11
 - as measures of exposure to cigarette smoke
 - 67:15
 - mortality rate from
 - 64:36, 91, 92, 99, 111
 - mortality rate, inhalers vs. noninhalers
 - 67:7; 68:5
 - mortality ratios
 - 64:91, 111
 - particulate retention in
 - 64:264, 350; 69:62
 - personality factors in
 - 64:367

- pipe, cigar, and cigarette smokers
 - 73:184, 189
- possible determining factors in patterns of
 - 73:183, 184
- of radon
 - 64:145
- risk in, in lung neoplasms
 - 64:188
- stimulatory effect from
 - 64:350
- of thoron
 - 64:145
- tobacco smoke, and bronchogenic carcinoma
 - 67:129
- tobacco smoke, and epidermoid carcinoma
 - 67:129
- tobacco smoke, and papilloma formation
 - 67:129
- summary of previous findings on
 - 75:4
- Inorganic compounds
 - 64:141
- Insecticides
 - 64:61, 145
 - aldrin as
 - 64:62
 - arsenic as
 - 64:61
 - chlordane as
 - 64:62, 145
 - DDT as
 - 64:62, 145
 - Diazinon as
 - 64:62
 - dieldrin as
 - 64:62
 - Dylox as
 - 64:62
 - Endosulfan as
 - 64:62
 - endrin as
 - 64:62
 - Guthion as
 - 64:62
 - heptachlor as
 - 64:62, 145
 - lead arsenate as
 - 64:61
 - malathion as
 - 64:62, 145
 - parathion as
 - 64:62, 145
 - paris green as
 - 64:61
 - Sevin as
 - 64:62
 - TDE as
 - 64:62, 145
- Insoluble particles
 - clearance mechanisms
 - 64:267
- Insufflation
 - application of carcinogens by
 - 64:166
- Insurance policyholders
 - breathlessness in
 - 64:287
- Intelligence quotient
 - 64:370
- Intermittent claudication
 - decrease in exercise time after exposure to CO
 - 75:28
 - effects of coffee drinking and cigarette smoking
 - 75:20
 - smokers vs. nonsmokers
 - 72:22, 26
 - smoking and
 - 73:21
 - smoking as a major risk factor
 - 74:14-16
- International Cooperative Study
 - interaction of smoking and other risk factors in CHD
 - 73:9
- International Statistical Classification of Diseases, Injuries, and Causes of Death
 - 64:101
- Intestinal neoplasms
 - 64:103
- Intestinal tone,
 - tobacco effect on
 - 64:355
- Intratracheal injections
 - application of carcinogens by
 - 64:166
- Involuntary smoking
 - see Passive smoking
- Ionized radiation
 - neoplasm induction by
 - 64:142, 143
 - threshold levels in
 - 64:143
- Ireland
 - acute effect of cigarette smoke on human pulmonary function in
 - 71:168
 - CHD mortality and morbidity in
 - 71:96
 - CHD mortality and morbidity in, smokers and nonsmokers in
 - 71:94
 - lung neoplasms in, methods of retrospective study of smoking in
 - 71:328
 - maternal smoking and infant weight in
 - 71:399
 - methods used in study of smoking and human pregnancy
 - 71:394, 396
 - Northern, mortality rates from COPD
 - 71:144
 - occupational exposure and smoking relationships to COPD in
 - 71:218
 - relationship of lung neoplasms to smoking, air pollution and residence in
 - 71:218
 - serum lipid differences in smokers vs. nonsmokers in
 - 71:99

- smoking and nicotine effects on human peripheral vascular system
 - 71:133
 - smoking relationship to thrombosis in
 - 71:130
 - Iron oxide
 - 64:166
 - Irritants
 - tissue tolerance to
 - 64:353
 - Ischemia
 - 64:319
 - Ischemic heart disease
 - see Coronary disease
 - Isomethylnicotinium ion
 - structure of
 - 64:72
 - Isoparaffins
 - 64:51
 - Isoprene
 - 64:52
 - Isoprenoids
 - 64:49, 51
 - structural formula of
 - 64:49
 - Isopropyl oil
 - lung neoplasm risk from
 - 64:193
 - Israel
 - cigarette smoke effects on animal embryos in
 - 71:343
 - mortality rates from COPD in
 - 71:140
 - Isuprel
 - aerosol
 - 64:292, 293
 - Italy
 - human experimental data on smoking and pregnancy
 - 71:409
 - prohibition of advertising in
 - 64:8
 - serum lipid differences
 - in smokers vs. nonsmokers in
 - 71:100
 - tracheobronchial tree changes in smokers and nonsmokers in
 - 71:263
 - Japan
 - bladder neoplasms in, methods and results in retrospective studies of smoking
 - 71:382, 384
 - CHD mortality
 - 64:320
 - CHD mortality and morbidity in
 - 71:96
 - cigarette smoke effects on human fetal lung tissue in
 - 71:343
 - esophageal neoplasms in retrospective studies of tobacco use in
 - 71:378
 - kidney and bladder neoplasms of smokers in
 - 71:295
 - lung neoplasms, mortality of smokers and nonsmokers in
 - 71:243
 - lung neoplasms, retrospective smoking study, methods of
 - 71:326, 328
 - mortality ratios, esophageal neoplasms in
 - 71:291
 - mortality ratios, kidney neoplasms, smokers vs. nonsmokers
 - 73:77
 - mortality ratios, pancreatic neoplasms in cigarette smokers
 - 71:298
 - neoplasm risk in
 - 64:127
 - relationship of lung neoplasms to smoking, air pollution, and residence in
 - 71:255
 - "Tokyo-Yokohama asthma"
 - 64:276
- Jena
 - autopsy records in
 - 64:150
- Jews
 - esophageal neoplasms in, in women
 - 64:135
 - gastric neoplasms in
 - 64:135
 - increased smoking among, in women
 - 64:363
- Job changing
 - smoker prevalence of
 - 64:363
- Johns Hopkins student study
 - 64:384
- Joint Tuberculosis Society of Great Britain
 - 64:6
- Keratin
 - oversecretion of, in stomatitis nicotina
 - 64:271
- Keratosis, senile
 - 64:203
- Keto-acids
 - 64:53
- Ketoamide
 - structure of
 - 64:72
- Ketones
 - 64:52
- Khat
 - 64:349
- Kidney neoplasms
 - epidermoid, associated with cigarette smoking
 - 69:60
 - mortality rates in U.S.
 - 71:296
 - mortality ratios in
 - 64:148, 149

mortality ratios, Japanese men and women, smokers vs. nonsmokers
 73:77
 mortality trends in
 64:137, 149
 relationship of tobacco use and
 71:13, 299
 in smokers and nonsmokers
 71:238, 294-295
 smoking and
 69:60, 64; 73:77, 78
see also Urogenital neoplasms

Korea
 relation of human pulmonary histology and smoking in
 71:255
 tracheobronchial tree changes in smokers and nonsmokers of
 71:259

Kreyberg classification
 comparison with World Health Organization classification
 64:174
 in lung neoplasms
 64:35, 159, 173

Kreyberg study
 lung neoplasms and smoking
 69:55-56

Labeling
 of tobacco products
 64:8

Laboratory techniques
 for induction of experimental neoplasms
 69:63-64

Laborers
 coronary incidence in
 64:321

Lactate metabolism
 effect of smoking, in patients with angina pectoris
 73:13

Lactation
 effect of maternal smoking
 73:138-141
 effect of maternal smoking, summary of findings
 73:141
 epidemiological studies
 73:138
 experimental studies
 73:138, 139

Lactones
 carcinogenicity of
 64:145
 suspected carcinogenic agents in cigarette smoke
 71:265

Laparotomy
 postoperative pulmonary complications following, in smokers vs. nonsmokers
 71:174

Laryngeal neoplasms
 64:37, 205-212, 233, 234; 71:12, 237-239, 281

alcohol consumption in
 64:210
 development in hamsters following cigarette smoke inhalation
 71:239
 development in smokers
 71:12, 281
 dose effect in
 64:210, 234
 effect of cessation of smoking on
 67:149
 epidemiological studies
 72:68
 extrinsic origin of
 64:211, 212
 incidence in males and females, by age
 68:101, 102
 incidence of secondary primary, in smokers vs. nonsmokers
 75:50
 income class gradients in
 64:134
 inhalation effects in
 64:209
 inhalation patterns and,
 73:193
 intrinsic origin of
 64:211, 212
 mortality rates
 64:37, 133, 135, 210; 71:277
 mortality rates, by age
 67:149
 mortality rates, by age for men
 67:148
 mortality rates, by amount smoked
 67:149
 mortality rates, by smoking classification
 67:147, 149
 mortality rates, for women
 64:134; 67:153
 mortality rates, in smokers vs. nonsmokers
 71:237-238
 mortality rates, in United States by age
 67:148
 mortality rates, in United States by sex
 67:148
 mortality ratios
 64:113, 148, 149; 71:277-279
 mortality ratios, and smoking
 67:33-35, 148-149
 mortality ratios, by age
 67:149
 mortality ratios, by age for men
 67:148
 mortality ratios, by amount smoked
 67:149
 mortality ratios, by smoking classification
 67:149
 mortality ratios, cigar smokers vs. nonsmokers
 67:35
 mortality ratios for pipe, cigar, and cigarette smokers vs. nonsmokers
 73:193, 196, 197
 mortality ratios in, in females
 64:132

- mortality ratios in, in males
64:130, 132
- mortality ratios in, in smokers
64:149
- mortality ratios in, Japanese male smokers vs. nonsmokers
73:76, 77
- mortality ratios, pipe smokers vs. nonsmokers
67:35
- mortality trends in
64:137
- in nonwhites
64:209
- recurrent, incidence in smokers vs. ex-smokers
73:71, 74-77
- relationship of tobacco use and development of
71:354-357
- relative risk for cigar, pipe, and cigarette smokers
72:67; 73:76, 77, 197-199
- relative risk ratios from tobacco use
71:277, 358
- retrospective studies of
64:205-209
- risk ratios in
64:209
- in Seventh Day Adventists
64:209
- smokers vs. nonsmokers
69:58-59
- smoking in etiology of
64:32, 188, 189; 72:4, 67, 68
- summary of previous findings on relationship to smoking
68:89, 90; 74:57
- summary of retrospective studies
73:198, 199
- susceptibility to
64:189
- in Sweden, retrospective study of
64:205, 207
- vitamin deficiency in
64:212
- in women
64:234
- Laryngitis
reversibility of
64:275
- Larynx
atypical nuclei in cells of smokers
69:58-59
- effect of cessation of smoking on
69:59
- epithelial changes in, classification of
71:281, 283
- epithelial changes in, smoke induced
64:275
- hamster, C-14 labeled particulate deposition in
71:281-282
- histological changes in cigar, pipe, cigarette smokers vs. nonsmokers
73:197
- premalignant changes in, and smoking
69:5, 55
- see also* Vocal cords
- Laws
PL 89-92, requirements for smoking hazards literature review
71:7
- PL 91-222, requirements for smoking hazards literature review
71:7
- Lead arsenate
64:61
- Leaf constituents
hydroxy-coumarin as
64:145
- Leather workers
bladder neoplasm prevalence in
64:222, 224
- Leukemia
and cigarette smoke
67:148
- and tobacco tars
67:148
- Leukocytes
effects of cigarette smoke on, in guinea pigs
75:77, 78
- Leukoplakia
64:233
- experimentally induced, in rabbits
64:203
- oral neoplasm development in smokers and
72:68, 69
- as precancerous lesion,
64:142
- prevalence in tobacco chewing coal miners
73:75
- reverse smoking and,
73:76
- smoking and betel nut chewing
69:58
- smoking in etiology of
72:68, 69
- see also* Stomatitis nicotina
- Licorice
64:62
- Life expectancy
U.S.males, by cigarette consumption
68:9, 10
- Lip neoplasms
chewing tobacco in
64:202
- cigarette smoking in etiology of
73:190, 191
- cigar smoking in etiology of
73:190, 191
- mortality rates in United States
67:145
- pipe smoking in etiology of
64:32, 37, 188, 197, 204; 67:35, 145; 71:289; 72:4; 73:190, 191
- relative risk in pipe, cigar, and cigarette smokers vs. nonsmokers
73:190, 191
- retrospective studies of, by type of smoking
64:201
- snuff in
64:202

- summary of retrospective studies
 - 73:192
 - tobacco use relation to
 - 64:233; 71:361, 362, 365, 367
 - see also* Mouth neoplasms; Oral neoplasms
- Lipoproteins
 - infiltration in arterial walls, carbon monoxide effects on
 - 71:63
 - in smokers vs. nonsmokers
 - 71:99-102
- Liquid paraffins
 - 64:51
- Liver
 - nicotine effects on
 - 64:342
- Liver cirrhosis
 - 64:103, 342
 - and alcohol consumption
 - 67:40
 - mortality rates, and smoking
 - 67:39, 184-185
 - mortality rates, by age
 - 67:184
 - mortality rates, by amount smoked
 - 67:184
 - mortality rates, by sex
 - 67:184
 - mortality ratios, by age
 - 67:184
 - mortality ratios, by daily amount smoked
 - 67:184
 - mortality ratios, by sex
 - 67:184
 - mortality ratios, by smoking classification for men
 - 67:184
 - rates among cigarette smokers
 - 71:5
 - and smoking
 - 67:39, 184-185
- Lobeline
 - as antitobacco agent
 - 64:70, 354
- Local anesthetics
 - 64:354
- London
 - mortality from smog
 - 64:295
- London Transport Executive
 - cough and smoking among male employees of
 - 64:281, 286
- Longevity
 - 64:99
 - constitutional differences in
 - 64:112
- Longshoremen
 - coronary death rates in
 - 64:323
 - pulmonary function in
 - 64:292
 - respiratory conditions in
 - 64:289
- Los Angeles County General Hospital Study
 - 64:173
- Luminescence
 - techniques of, use in determining aromatic hydrocarbons in urine
 - 71:297
- Lung diseases
 - infections, and smoking, role in lung neoplasm development
 - 74:47, 48
 - in rabbits, similar to emphysema
 - 69:41
 - in women
 - 64:289
 - see also* Bronchitis; Bronchitis, chronic; Emphysema; Respiratory symptoms; Respiratory tract diseases
- Lung function
 - see* Pulmonary function; Respiratory function tests
- Lung neoplasms
 - 64:143, 144, 167
 - air pollution in etiology of
 - 67:140; 68:98, 99; 71:11; 73:72
 - amount smoked in
 - 64:105, 155, 175
 - anaplastic
 - 64:159, 160
 - in animals
 - 68:93
 - asbestos exposure and smoking as risk factors
 - 74:41-43; 75:49
 - in asbestos workers, by smoking habit
 - 67:143
 - benzo(a)pyrene induction of
 - 64:147
 - and blood cholesterol levels in male smokers
 - 69:57
 - causality
 - 64:30, 31, 37
 - cigarette smoking in
 - 64:31, 149, 175-196, 231; 71:11
 - and cigar smoking
 - 67:34, 138-140
 - classification of, in smokers vs. non-smokers
 - 67:140-141
 - classification systems compared
 - 64:174
 - decrease in risk of for ex-smokers
 - 69:57; 75:43
 - detection of by sputum analysis of smokers
 - 69:58
 - development in dogs following cigarette smoke inhalation
 - 71:239
 - and development of chronic bronchitis
 - 75:49
 - early smoking factor in
 - 64:158
 - effect of air pollution and smoking
 - 75:44, 47
 - effect of cessation of smoking on
 - 67:15-17, 34, 139-140
 - effect of sex on development
 - 71:11
 - environmental and atmospheric factors
 - 71:252-255

epidemiological methods
 64:175-189
 epidemiological studies
 69:55-58; 72:60-65; 73:68-72;
 74:37, 38; 75:44
 epidermoid, in male smokers
 69:57
 epithelial change in
 64:168, 170, 172
 etiology of
 64:8; 72:59, 60
 excessive smoking in
 64:7
 experimental
 67:35, 144-145; 74:43-52
 experimental induction by cigarette
 smoke
 67:144
 experimental induction by radioactive
 substances
 67:128
 experimental induction by tobacco
 smoke constituents
 67:145
 ex-smoker risk in
 64:158
 filtering of tobacco
 68:97
 foreign-born mortality rate in
 64:134
 genetic factors and
 64:167, 190, 191, 192, 193
 genetic factors and smoking as risk fac-
 tors
 74:37
 group characteristics of tobacco use in
 smokers and nonsmokers
 71:240, 244, 329-333
 groupings
 71:246-334
 in heavy smokers
 64:151, 196, 230, 232
 histology of
 64:159, 160, 167-173; 67:140-144
 histology of, and smoking
 71:246-249; 74:38, 39, 44-46
 in human beings and laboratory animals
 67:145
 immunologic response to benzo(a)pyr-
 ene-induced tumor, in animals
 74:48, 49
 incidence by smoking classification
 67:34
 incidence in British males by amount
 smoked
 72:62
 incidence in cigar and/or pipe smokers
 vs. nonsmokers
 74:39, 40
 incidence in cigar smokers
 68:95, 96
 incidence in Czechoslovakian males by
 amount smoked
 72:61
 incidence in Jewish vs. non-Jewish wom-
 en
 72:63, 64
 incidence in male smokers
 69:4
 incidence in Norway
 69:55-56
 incidence in pipe smokers
 68:95
 incidence in smokers vs. nonsmokers in
 India
 74:37, 38
 incidence in smokers vs. nonsmokers in
 Jersey, Channel Isles
 73:70
 incidence in smokers vs. nonsmokers in
 LaPlata, Argentina
 73:70
 incidence in smokers vs. nonsmokers in
 Philadelphia
 73:70
 incidence in uranium miners
 72:64, 65
 incidence in women
 68:97; 69:4, 57
 incidence in women smokers vs. non-
 smokers
 74:39, 40
 income class gradients in
 64:134
 increased mortality from
 64:25, 26, 128, 135, 136, 139, 140,
 141, 185, 220, 231, 232
 increase in mortality of female smokers
 75:47
 inhalation patterns and
 73:203
 Kreyberg classification of
 64:35, 159, 173, 174
 Kreyberg study
 69:55-56
 in men, smoking as cause
 67:33, 131
 microscopic determination of
 64:140
 mortality from chromium compounds
 71:257-258
 mortality rates
 64:36, 105, 133, 134, 135, 138, 139,
 140, 141, 176; 67:8, 34, 140; 68:68;
 69:57
 mortality rates, age-specific
 64:36
 mortality rates, by age
 67:132-137; 68:94-99
 mortality rates, by amount smoked
 64:105, 175; 67:134-140
 mortality rates by cigarette consump-
 tion, by country
 64:176
 mortality rates, by degree of inhalation
 67:134-136
 mortality rates, by sex
 67:134, 140; 68:94-99
 mortality rates, by smoking charac-
 teristics
 67:131-140
 mortality rates, by smoking classification
 67:34, 138-140
 mortality rates, by smoking history
 67:134-137
 mortality rates, effect of cessation of
 smoking on
 67:4, 15, 34, 139

mortality rates expected in U.S. in 1970
 71:237, 239
 mortality rates, for men
 64:132, 175, 176; 67:132, 134-135,
 137, 139-140; 74:43
 mortality rates, for women
 64:132, 135, 175; 67:34-35,
 133-134, 136, 153
 mortality rates in asbestos workers,
 smokers vs. nonsmokers
 73:73
 mortality rates in Britain
 64:195
 mortality rates in British physicians vs.
 general population
 67:16-17; 73:70
 mortality rates in, errors in measurement
 of
 64:140
 mortality rates in, occupational differ-
 ences in
 64:95
 mortality rates in, sex differences in
 64:177, 178, 179
 mortality rates in smelter workers ex-
 posed to arsenic
 71:257
 mortality rates in smokers
 64:29, 162
 mortality rates in smokers and nonsmok-
 ers
 71:240-243
 mortality rates in smokers in Norway
 and Finland
 71:245-246
 mortality rates in Sweden
 64:176
 mortality rates in United States
 67:34; 71:239
 mortality rates, smoking and
 67:3, 10, 34
 mortality rates, smoking duration and
 64:36, 175; 71:240, 244
 mortality ratios
 64:103, 113, 148, 149, 162, 175
 mortality ratios, by amount smoked
 67:134-140
 mortality ratios, by degree of inhalation
 67:134-136
 mortality ratios, by sex
 67:134, 140
 mortality ratios, by smoking charac-
 teristics
 64:164; 67:134-136
 mortality ratios, by smoking classifica-
 tion
 67:138-140
 mortality ratios, by smoking history
 67:134-137
 mortality ratios for cigar, pipe, and
 cigarette smokers vs. nonsmokers
 73:203-205
 mortality ratios for women
 67:34-35, 136, 153
 mortality ratios in Japanese by amount
 smoked and age started smoking
 73:69
 mortality ratios in Japanese males by
 amount smoked
 72:61
 mortality ratios in Japanese women
 72:63
 mortality ratios in, variables affecting
 64:163
 mortality studies of, limitations of
 64:163
 multiple primary, autopsy findings
 67:141-142
 multiple primary, in smokers
 67:35
 mustard gas in
 64:195, 196
 nonrespondent rates, in surveys of
 64:151
 oat-cell, in male smokers
 69:57
 observed mortality in
 64:118
 occupational exposures
 64:193, 194; 71:12
 occupational exposures and smoking
 73:67
 particle deposition in bronchi and site of
 74:44, 45
 Philadelphia Pulmonary Neoplasm Re-
 search Project histopathologic study
 74:38
 pipe and cigar smoking in
 64:31, 37, 192, 196, 233
 pipe smoking
 67:34, 138-140
 and polonium
 67:128
 prevalence in females
 64:37
 prevalence in males
 64:35, 37
 prevalence in males and females by
 tumor type
 71:246, 250
 prevalence in smokers vs. nonsmokers in
 Czechoslovakia
 73:70
 prevalence of, age factors in
 64:177, 178, 179
 prevalence of, in smokers
 64:151
 prevalence ratios in
 64:182, 184, 185
 previous respiratory history in
 64:195, 196
 prospective study in Czechoslovakian
 males
 72:61
 prospective study in Japanese adults
 72:4, 60, 61; 73:68, 69
 race as a factor, smokers vs. nonsmokers
 73:70
 radioactive induction of
 64:172
 reduction in number using filter-type
 cigarettes
 71:275
 relationship of asbestos and smoking to
 71:257

- relationship of chronic bronchitis and smoking to
72:62
- relative risk in cigar, pipe, and cigarette smokers vs. nonsmokers
73:203, 206-208
- relative risk in ex-smokers by length of cessation and previous duration of habit
72:62-64
- relative risk in ex-smokers vs. continuing smokers
73:72
- relative risk in pipe/cigar smokers
73:67, 68
- retrospective studies of
64:150-165, 230, 231
- retrospective study methods for smoking relationships
71:240, 323-328
- risk ratios in
64:160, 183, 184, 185, 187, 188
- risk reduction with filter vs. nonfilter cigarettes
74:40, 41
- role of aryl hydrocarbon hydroxylase activity and polyaromatic hydrocarbons in
74:49-52
- role of pulmonary infections and smoking in etiology of
74:47, 48
- and selenium in cigarettes
67:128
- in Seventh Day Adventists
64:322
- sex ratios in
64:133
- sex ratio statistic
74:40
- smoke inhalation in, urban-rural differences in
64:133, 186, 194, 195
- and smokers
69:4-5
- of smokers, in Rhodesia
69:57
- smoking in etiology of
67:32-34, 141-144; 71:3, 237, 276;
72:4, 5, 59, 60; 73:67
- and smoking in men
67:34
- and smoking in women
67:10, 34; 71:246, 251
- summary of previous findings
75:3, 5-8
- summary of previous findings on relationship to smoking
68:89, 90; 74:35-37
- summary of recent findings
75:43
- summary of retrospective studies
73:206-208
- types implicated in smoking
71:237
- typing of
64:35, 159, 173, 174, 175
- and ulcers, relation to smoking
69:57
- in uranium miners by smoking habit
67:143
- World Health Organization classification of
64:173, 174
- Xenon-133 washout technique for detection of
74:43, 44
- see also* Respiratory tract neoplasms; and specific histological types
- Lungs
 - alveolar tissue, effect of smoking on
64:274, 275; 67:30
 - arterioles, effect of pipe/cigar smoking vs. cigarette smoking on
73:217
 - bactericidal activity, effect of nitrogen dioxide on, in mice
74:103
 - compliance
64:292
 - effect of cigarette smoke in laboratory animals
67:106
 - effect of cigarette smoke on tissue
64:274; 71:343-345
 - effect of nitrogen dioxide
64:266; 69:41
 - hamster, C-14 labeled particulates deposition in
71:281-282
 - histology of pipe/cigar smokers vs. cigarette smokers
73:217
 - histopathological differences in smokers vs. nonsmokers
73:48, 49
 - hygiene
64:267, 268
 - injury
64:270
 - lesions
64:73, 295
 - parenchyma
64:27, 35, 167, 263, 264, 272, 301
 - parenchyma, effect of smoking on
67:144
 - pathological changes in emphysema patients by smoking history and sex
67:105
 - pathological effects of smoking on
64:165-172; 69:5
 - physiology, new animal model for testing of
74:102
 - polonium-210 levels, smokers vs. nonsmokers
67:128
 - scars and susceptibility to carcinogens
69:64
 - see also* Respiratory system
- Lymphosarcoma
 - and cigarette smoke
67:148
 - and tobacco tars
67:148

- Lysozyme**
secretion by rabbit pulmonary alveolar macrophages
69:42
- Macrophages, alveolar**
decrease in pinocytosis, in smokers vs. nonsmokers
75:76
effect of cigarette smoke on
67:110; 69:42; 71:165; 73:52, 53; 74:50
effect of nitrogen dioxide
73:54
effect of tobacco smoke
72:47, 48
lysozyme secretion in rabbits
69:42
and pathogenesis of chronic bronchopulmonary disease
64:43
reduction of enzymes in smokers
69:42-43
response to migration inhibition factor or antigens, in smokers vs. nonsmokers
75:76, 77
in sputum specimens of smokers vs. nonsmokers
72:48
- Macrophages, peritoneal**
effect of nicotine on, in mice
74:105
- Macrophages, pulmonary**
effect of cigarette smoke extract, in sheep lungs
74:105
effect of cigarette smoke, in guinea pigs
75:77, 78
effect of cigarette smoke, in rabbits
74:104, 105
effect of smoking
72:3, 4, 47-48; 73:55
morphologic differences in smokers vs. nonsmokers
72:4, 47-48
summary of recent findings
75:78
- Mainstream smoke**
see Smoke streams
- Malathion**
64:62, 145
- Malaya**
betel nut-tobacco chewing in
64:203
- Mammals**
effect of cigarette smoke tars on cells
71:343
nicotine metabolism in
64:71, 72, 73, 74
- Marihuana**
64:349
- Marital status**
bladder neoplasms and
64:224
smoking prevalence by
64:364
- Masculinity**
64:383, 384, 385
smoking behavior association with
64:372, 373
- Massachusetts General Hospital**
64:141, 174
- Mass spectrometry**
64:51
- Maternal-fetal exchange**
effect of nicotine
72:88
polycyclic hydrocarbons and
73:119
see also Smoking, maternal
- Maternal smoking**
see Smoking, maternal
- Maximum breathing capacity**
64:290
- Mayo Clinic**
64:322
- Mean expiratory flow rate**
64:290
- Measurement errors**
in smoking studies
64:97, 111
- Men**
arteriosclerosis obliterans in
64:326
bladder neoplasms in
64:219, 222, 224, 255
breathlessness in
64:286, 287
bronchitis prevalence in
64:289
chest illness in
64:288
chronic cough in
64:281, 282, 285
college students, smoking patterns in
64:369
coronary diseases in
64:321, 322, 327
cough and sputum prevalence in
64:284
epithelial change in
64:170, 173
forced expiratory volume in
64:290, 291
increased lung neoplasm prevalence in
64:192
irreversible obstructive lung disease in
64:288, 289
laryngeal neoplasms
64:212
lung neoplasms in
64:183, 186
lung neoplasms in, by amount smoked
64:155
lung neoplasms in, cigarette smoking in relation to
64:31, 37
lung neoplasms in, early smoking in
64:158
lung neoplasms in, prevalence of
64:231
lung neoplasms in, prevalence of, in Seventh Day Adventists
64:363

- mortality rates in
 - 64:28, 85
- mortality ratios in
 - 64:28
- mortality trends in
 - 64:133, 135, 192
- neoplasm mortality in, by site
 - 64:132
- neoplasm mortality rates in
 - 64:135, 137, 175, 176
- neoplasm mortality ratios in
 - 64:130, 132, 175
- nonsmokers, U.S. incidence of, by age
 - 64:178
- oral neoplasms
 - 64:202, 204
- risk ratios in
 - 64:161
- risk ratios in, in bladder neoplasms
 - 64:222
- single, mortality trends in
 - 64:101
- smokers, U.S. incidence of, by age
 - 64:178
- smoking and respiratory symptoms in
 - 64:286
- smoking habits of
 - 64:231
- smoking patterns in
 - 64:177, 178, 179
- smoking prevalence in
 - 64:363
- sputum production in
 - 64:283
- Menopause
 - and cardiovascular disease, in women smokers vs. nonsmokers
 - 74:10, 19
 - coronary death rates following
 - 64:321
- 1,8-p-Menthadiene
 - 64:51
- Menthol
 - 64:62
- Mesenchymal tumors
 - classification of
 - 64:174
- Mesotheliomas
 - classification of
 - 64:174
- Metal mine workers
 - pulmonary function in
 - 64:299
- Metals
 - as carcinogens
 - 64:166, 167, 189, 193, 194, 230, 232
- Metal-working trades
 - neoplasm risks in
 - 64:134
- Metaplasia
 - 64:170
 - anaplasia, lung neoplasms and
 - 64:172
 - as precancerous change
 - 64:166
 - squamous, experimentally induced in lungs by cigarette smoke
 - 67:144
- squamous, in stomatitis nicotina
 - 64:271
- squamous, nickel carbonyl in
 - 64:166
- Methacrolein
 - as suspected contributor to health hazards of smoking
 - 72:145
- Methane
 - in tobacco smoke
 - 64:60
- Methanol
 - 64:60
- Methoxy-coumarin
 - 64:145
- Methyl alcohol
 - as suspected contributor to health hazards of smoking
 - 72:145
- 6-Methylanthranthrene
 - carcinogenicity, as component of cigarette smoke
 - 72:66
- Methyl chloride
 - 64:60
- 3-Methylcholanthrene
 - 64:166
 - effects during pregnancy in laboratory animals
 - 73:117
- 20-Methylcholanthrene
 - 64:203-228
- Methyl ethyl ketone
 - 64:52, 60
- Methylglycerol
 - 64:62
- N-methylnicotinamide
 - urinary excretion, effect of smoking
 - 67:156, 71:297
- Methyl nitrite
 - 64:60
- Methyl protoanemonin
 - carcinogenicity of
 - 64:145
- Metrazol
 - treatment of depression with
 - 64:352
- Metropolitan Life Insurance Company
 - 64:344
- Mice
 - bladder neoplasms in, induction by tryptophan metabolites
 - 71:296
 - embryo, lethal effects of nicotine on
 - 71:411
 - esophageal epithelium of, alcoholic benzo(a)pyrene penetrability of
 - 71:292
 - esophageal epithelium of, oil-dissolved benzo(a)pyrene penetrability of
 - 71:292
 - genetic variation in
 - 64:167
 - induction of bladder neoplasms in
 - 64:219, 223
 - induction of bronchitis in
 - 64:272
 - induction of epidermoid neoplasms in
 - 64:166

- induction of hepatomas in
 - 64:145
- induction of oral neoplasms in
 - 64:202
- induction of neoplasms in
 - 64:143, 144, 146
- induction of pulmonary adenomas in
 - 64:143, 144
- induction of skin neoplasms in
 - 64:143
- induction of squamous cell carcinoma in
 - 64:228
- inhibition of phagocytic clearance in
 - 64:269
- irritation in, by formaldehyde
 - 64:260
- lung neoplasm incidence in, from chromium oxide dust exposure
 - 71:258
- lungs of, effects of cigarette smoke on
 - 64:165; 71:159, 343, 344
- pulmonary carcinoma induction in, following asbestos dust inhalation
 - 71:257
- pulmonary changes from chronic nitrogen oxide inhalation
 - 71:161, 220
- pulmonary clearance in, cigarette smoke effects on
 - 71:170
- resistance to pneumonia bacteria following cigarette inhalation
 - 71:173
- respiratory tract of, cigarette smoke inhalation effect on
 - 71:268-269, 349-353
- skin painting of, smoke condensates effects on
 - 71:267, 337-342
- spontaneous neoplasms in
 - 64:165
- spontaneous pulmonary adenomas in
 - 64:165
- Migrants
 - lung neoplasm rates in
 - 64:194
- Migration
 - lung neoplasm risks in
 - 64:195
- Migration inhibition factor
 - effects on alveolar macrophages, in smokers vs. nonsmokers
 - 75:76, 77
- Mill workers
 - breathlessness in
 - 64:286
 - chronic cough in
 - 64:280
 - chronic respiratory disease in
 - 64:289, 299
- Mineral oil
 - carcinogenicity of
 - 64:147, 148, 229
- Miners
 - forced expiratory flow rates in
 - 64:290
 - forced expiratory volume in
 - 64:293, 294
 - impairment of pulmonary function in
 - 64:299
 - mucous gland hyperplasia in
 - 64:271
 - respiratory symptoms in
 - 64:298, 299
- Minnesota Multiphasic Personality Inventory
 - 64:366
- Mitochondria
 - effect of tobacco smoke on, in rat liver
 - 74:104
- Molders
 - neoplasm risk in
 - 64:134
- Mollusks
 - ciliary function in, effect of cigarette smoke on
 - 71:223
- Monkeys
 - atherogenic effects of carbon monoxide and hypoxia
 - 71:64
 - ciliary function in, effect of cigarette smoke on
 - 71:222
 - fetal bronchial tubes of, effects of cigarette smoke on
 - 71:345
 - rhesus, development of bladder neoplasms from 2-naphthylamine
 - 71:296
 - squirrel, nitrogen oxide effects on resistance to pneumococcus
 - 71:173
- Monoamine oxidase inhibitors
 - effect on rabbits receiving nicotine
 - 69:27
- Monohydric alcohols
 - 64:52
- Morbidity
 - bladder neoplasms, and smoking
 - 67:155
 - bronchitis, and smoking
 - 67:3, 30, 96-99
 - bronchitis, in smoking discordant twin pairs
 - 67:102-103
 - chronic bronchopulmonary diseases
 - 72:39-41; 73:36-39
 - coronary diseases, smokers vs. nonsmokers
 - 67:53-54
 - emphysema, and cigar smoking
 - 67:97
 - emphysema, and pipe smoking
 - 67:97
 - emphysema, and smoking
 - 67:3, 30, 96-99
 - lung neoplasms, and smoking
 - 67:3
 - peptic ulcers, and smoking
 - 67:40
 - respiratory diseases, smokers vs. nonsmokers among college students
 - 67:98
 - respiratory symptoms
 - 75:62, 63

- and smoking
 - 67:6, 19
- and smoking in college students
 - 67:98
- and smoking in 45-64 age group
 - 67:24
- studies of
 - 64:127, 133, 293, 294
- Morbidity rates
 - bronchitis, by age and smoking history
 - 67:96-98
 - bronchitis, by sex and smoking history
 - 67:96-98
 - coronary disease, smokers vs. nonsmokers by age
 - 67:54
 - emphysema, by age and smoking history
 - 67:96-98
 - emphysema, by sex and smoking history
 - 67:96-98
 - smokers vs. ex-smokers
 - 67:15
 - smokers vs. nonsmokers, by age
 - 67:19-24
 - smokers vs. nonsmokers, by amount smoked
 - 67:19-24
 - smokers vs. nonsmokers, by sex
 - 67:19-24
 - smokers vs. nonsmokers, by smoking history
 - 67:19-24
- Morbidity ratios
 - angina pectoris, by smoking habit in males
 - 68:20
 - angina pectoris, smokers vs. nonsmokers,
 - 67:59
 - coronary diseases
 - 69:19
 - coronary diseases, smokers vs. nonsmokers
 - 67:59; 71:21-22, 24, 30-35
 - coronary diseases, smokers vs. nonsmokers and lung function
 - 67:56
 - coronary diseases, smokers vs. nonsmokers by age
 - 67:54
 - coronary diseases, smokers vs. nonsmokers by blood cholesterol levels
 - 67:55
 - coronary diseases, smokers vs. nonsmokers by blood pressure values
 - 67:55
 - coronary diseases, smokers vs. nonsmokers by personality characteristics
 - 67:57
 - coronary diseases, smokers with predisposing factors
 - 71:24
 - coronary diseases, smoking and
 - 71:32-35, 37, 39
 - coronary diseases, smoking habit in males
 - 68:17, 18
 - coronary diseases, retrospective studies
 - 71:40, 93-97
- in Danish twins, smoking effects on
 - 71:49-51
- development of COPD in smokers vs. nonsmokers
 - 71:145, 195-205
- myocardial infarction, by risk factors in males
 - 68:23
- myocardial infarction, smokers vs. nonsmokers
 - 67:59
- myocardial infarction, smokers vs. nonsmokers by physical activity
 - 67:56
- Mortality rates
 - 64:25, 27, 30, 35, 36, 37, 84, 101, 162, 301
 - by age
 - 67:9-10, 12-13, 23
 - by age, and smoking history
 - 67:10; 68:6
 - by age, for men
 - 67:9, 10
 - by age, for women
 - 67:23
 - age started smoking and
 - 64:29, 111
 - alcoholism, relation to smoking
 - 67:10
 - amount smoked and
 - 64:111; 67:9, 23
 - aortic aneurysm, for men by amount smoked
 - 69:16
 - arteriosclerosis
 - 64:25, 321; 67:28
 - bladder neoplasms, by amount smoked
 - 67:155
 - bladder neoplasms, by sex
 - 67:154
 - bladder neoplasms, by smoking classification
 - 67:155
 - bladder neoplasms, effect of cessation of smoking on
 - 67:155
 - bladder neoplasms, for men by age
 - 67:154
 - bladder neoplasms, in United States
 - 67:154
 - from bladder neoplasms in U.S. for 1967
 - 71:293
 - bronchitis
 - 64:25, 297; 67:8, 90-91; 68:66-68
 - bronchitis, and smoking
 - 67:3, 90-96
 - bronchitis, effect of cessation of smoking on
 - 67:94, 96
 - from bronchopulmonary disease
 - 71:141-145
 - cardiovascular diseases
 - 69:17
 - cerebrovascular diseases, and athletic activity
 - 67:68
 - cerebrovascular diseases, and coronary disease history
 - 67:68

cerebrovascular diseases, and parental death history
 67:68
 cerebrovascular diseases, and smoking
 67:68
 cerebrovascular diseases, by age
 67:66; 75:31
 cerebrovascular diseases, by sex
 67:66; 75:31
 cerebrovascular diseases, smokers vs. nonsmokers
 71:66-67, 68-70
 cerebrovascular diseases, smoking classification
 67:66; 75:31
 in chronic bronchopulmonary disease
 64:301; 72:38, 39; 73:36-39
 in chronic bronchopulmonary disease, cigar/pipe smokers vs. cigarette smokers and nonsmokers
 73:216, 217
 cigar smokers vs. nonsmokers
 67:8
 in cigar smoking
 64:30; 67:7
 compared rates for cigarette vs. pipe/cigar ex-smokers
 73:172, 173
 Connecticut data on
 64:132
 coronary diseases
 64:25, 320, 321; 67:8, 25-28, 47; 71:21; 75:14
 coronary diseases, among physicians
 68:17
 coronary diseases, and age
 67:47, 50-51; 69:13-14; 74:6; 75:14
 coronary diseases, by amount smoked
 67:51; 69:12-13, 17
 coronary diseases, by blood cholesterol
 69:17
 coronary diseases, by blood pressure
 69:14, 17
 coronary diseases, by relative weight
 69:14
 coronary diseases, by sex
 67:47, 50; 69:13-14
 coronary diseases, by smoking habit
 67:51; 69:14
 coronary diseases, effect of cessation of smoking on
 67:25, 28, 47-49, 50
 coronary diseases in Japanese men and women by cigarette consumption and age started smoking
 73:7, 8
 coronary diseases in middle-aged men in seven countries
 74:6
 coronary diseases in survivors of myocardial infarction, smokers vs. nonsmokers
 74:4-6
 coronary diseases, male smokers vs. ex-smokers by age
 67:49
 coronary diseases, paired combinations of high risk characteristics in
 71:25
 coronary diseases, retrospective studies
 71:40, 93-97
 coronary diseases, smokers vs. ex-smokers
 67:9; 69:15
 coronary diseases, smokers vs. ex-smokers by amount smoked
 67:49
 coronary diseases, smokers vs. ex-smokers by smoking history
 67:51
 coronary diseases, smokers vs. nonsmokers
 69:12-13, 15-17; 71:24, 26-29; 74:3-6
 coronary diseases, smoking and
 67:10, 27, 65-66
 in Danish twins, smoking effects on
 71:51
 differences in rates, defined
 68:7
 digestive tract neoplasms, by amount smoked
 67:147
 digestive tract neoplasms, by smoking classification
 67:147
 duration of smoking in
 64:29, 36
 early smoking and, excess in, in smokers
 64:29, 30, 35, 36, 84, 111, 162, 301
 emphysema
 64:25; 67:3-4, 8, 90-91; 68:66-68
 emphysema, effect of cessation of smoking on
 67:7, 24, 29
 esophageal neoplasms
 67:150, 153; 68:102; 71:289
 esophageal neoplasms, by age
 67:150
 esophageal neoplasms, by amount smoked
 67:150
 esophageal neoplasms, by smoking classification
 67:150
 esophageal neoplasms, for men by age
 67:150
 esophageal neoplasms, for women
 67:153
 esophageal neoplasms in Japanese males by smoking and drinking characteristics
 72:71
 in former smokers, relation to CHD
 71:46, 47-48
 in heavy smokers
 64:36, 107, 111, 163
 inhalation patterns and
 64:111; 68:5
 from kidney neoplasms in U.S. for 1967
 71:296
 in laryngeal neoplasms
 64:205; 67:153; 68:101, 102
 laryngeal neoplasms, by age
 67:148-149
 laryngeal neoplasms, by amount smoked
 67:149

laryngeal neoplasms, by sex
 67:148
 laryngeal neoplasms, by smoking classification
 67:149
 laryngeal neoplasms, for women
 67:148
 from laryngeal neoplasms, in Japanese smokers vs. nonsmokers
 68:102
 lip neoplasms, in United States
 67:145
 liver cirrhosis, and smoking
 67:40, 184
 liver cirrhosis, by age
 67:184
 liver cirrhosis, by amount smoked
 67:184
 liver cirrhosis, by sex
 67:184
 liver cirrhosis, for men
 67:184
 lung neoplasms
 64:25, 29; 67:8, 153; 68:68, 94-99; 69:57
 lung neoplasms, and smoking
 67:3
 lung neoplasms, by age
 67:34, 134-137, 140
 lung neoplasms, by amount smoked
 67:137, 140
 lung neoplasms, by birth cohorts
 67:131-133
 lung neoplasms, by sex
 67:134, 137, 140
 lung neoplasms, by smoking characteristics
 67:134-136, 140
 lung neoplasms, by smoking classification
 67:136, 140
 lung neoplasms, by smoking exposure
 67:34
 lung neoplasms, by smoking habit
 67:136, 140
 lung neoplasms, by smoking history
 67:134-137
 lung neoplasms, cigar smokers
 67:34, 140
 lung neoplasms, effect of cessation of smoking on
 67:34, 140
 lung neoplasms, effect of reduction of smoking on
 67:4
 from lung neoplasms expected in 1970
 71:237, 239
 lung neoplasms, ex-smokers
 67:140
 lung neoplasms, for men
 67:34, 131, 133-137, 139-140
 from lung neoplasms for 1939 vs. 1967 in U.S.
 71:239
 lung neoplasms, for women
 67:132-133, 136, 153; 75:47
 lung neoplasms in Japanese women
 72:63
 from lung neoplasms in smelter workers exposed to arsenic
 71:257
 lung neoplasms, pipe smokers
 67:140
 lung neoplasms, reduction in, British physicians
 67:15
 male-female ratios in
 64:133
 mouth neoplasms, by age and amount smoked
 67:146
 mouth neoplasms, by smoking classification
 67:146
 mouth neoplasms, for women
 67:153
 mouth neoplasms, in United States
 67:145-146
 from myocardial infarction
 75:14
 neoplasms
 64:128, 129, 130, 131, 132, 136, 137, 138, 139
 neoplasms, by site, in women
 64:132
 neoplasms, increase in
 64:127, 136
 neoplasms, in Japanese smokers vs. nonsmokers
 68:17
 in nonwhites
 64:218
 occupations
 64:134; 67:11
 from oral neoplasms in 1967
 71:285
 overall rates for cigar smokers vs. pipe smokers
 73:179, 180
 overall rates for pipe/cigar smokers and dose-response relationships
 73:180-189
 overall rates for pipe/cigar smokers vs. nonsmokers
 73:179, 180
 overall rates from cancer in pipe and cigar smokers
 73:189
 pancreatic neoplasms
 68:103; 72:74
 pancreatic neoplasms by age
 67:158-159
 pancreatic neoplasms, by amount smoked
 67:159
 pancreatic neoplasms, by sex
 67:153, 158, 159
 pancreatic neoplasms, by smoking classification
 67:159
 paralysis agitans
 67:8
 peptic ulcer
 67:40, 181-182; 71:423
 peptic ulcer, by age
 67:181
 peptic ulcer, for men
 67:181-182

peptic ulcer, smokers vs. ex-smokers
 67:181
 pharyngeal neoplasms
 67:153
 pharyngeal neoplasms, by smoking classification
 67:35
 pharyngeal neoplasms, for women
 67:153
 in pipe smokers
 64:30; 68:6
 pipe smokers vs. nonsmokers
 67:10
 Poisson distribution of
 64:117, 118
 reduction in, effect of cessation of smoking
 67:16
 from renal neoplasms in males, by age, type and smoking habit
 68:105, 106
 respiratory tract neoplasms, and smoking
 67:5-7, 9-10, 147
 rural vs. urban
 64:133; 67:11
 in selected diseases
 64:26
 by sex
 67:12-13
 of smokers, non- and ex-smokers
 68:5-8, 69
 smokers vs. ex-smokers
 67:9, 15
 smokers vs. ex-smokers, by smoking history
 67:9
 smokers vs. nonsmokers
 67:8-9, 19; 71:3
 and smoking
 67:5-9; 69:3
 by smoking history
 67:9-10, 23
 stomach neoplasms, by age
 67:157-158
 stomach neoplasms, by amount smoked
 67:157-158
 stomach neoplasms, by smoking classification
 67:157-158
 stomach neoplasms, effect of cessation of smoking
 67:157-158
 stroke
 69:17
 stroke, by age
 67:67; 69:12-13
 stroke, by amount smoked
 67:67; 69:12-13
 stroke, by sex
 69:12-13
 stroke, smokers vs. ex-smokers
 69:15
 stroke, smokers vs. nonsmokers
 69:12-13, 15
 in Swedish twins, smokers vs. nonsmokers
 71:51
 studies of
 64:100
 study of Chicago Peoples Gas Light and Coke Co. employees
 69:16-17
 summary of previous findings
 75:3-8, 13
 summary of previous findings on relationship to smoking
 68:5-10
 trends
 64:135, 140
 urinary tract neoplasms, by age
 67:154
 urinary tract neoplasms, by amount smoked
 67:154
 urinary tract neoplasms, by smoking classification
 67:154
 urogenital neoplasms, by age
 67:154
 U.S. male veterans from CHD
 71:26, 38
 in veterans
 64:88, 293
 in women
 64:133
 in women smokers
 67:7, 9; 68:6, 8, 9
 Mortality ratios
 64:36, 84, 99, 101, 118, 119; 69:12-13, 18
 after cessation of smoking
 64:29, 111
 age effects on
 64:36, 87
 alcohol consumption and
 64:112
 by amount smoked
 67:150, 153
 aortic aneurysm, for men by amount smoked
 69:16
 behavioral factors in
 64:101
 bladder neoplasms
 67:36, 154
 bronchitis
 64:28, 29, 293; 67:90, 94
 cerebrovascular diseases, by age
 67:66
 cerebrovascular diseases, by sex
 67:66
 cerebrovascular diseases, by smoking classification
 67:66
 in cigarette smokers
 64:28, 29, 35
 in coronary diseases
 64:29, 184
 coronary diseases, associated with other complicating diseases
 67:52
 coronary diseases, by age
 67:25-26, 49, 51-52; 69:12-13, 18
 coronary diseases, by amount smoked
 67:49
 coronary diseases, by blood pressure status
 67:52

- coronary diseases, by sex
67:49; 69:12-13
- coronary diseases, by smoking habit
67:51-52
- coronary diseases, by smoking history
67:25-26
- coronary diseases, by sociocultural mobility status
67:57
- coronary diseases, for men by age
67:48
- coronary diseases, for men by amount smoked
67:48
- coronary diseases, smokers vs. ex-smokers
69:15
- coronary diseases, smokers vs. nonsmokers
69:12-13, 15
- coronary diseases, with high risk characteristics, estimated
71:25
- daily cigarette consumption and
64:89
- definition of
64:28, 117; 67:11; 68:6
- duration of smoking in
64:111
- educational level factors in
64:112
- in emphysema
64:28, 29
- esophageal neoplasms, by age
67:150
- esophageal neoplasms, prospective and retrospective studies
71:289-291
- in ex-smokers
64:104
- genetic factors in
64:36, 112, 113
- in influenza, in smokers
64:276
- inhalation effects on
64:36, 91, 92
- internal consistency of
64:130
- laryngeal neoplasms
67:35; 71:277-279
- laryngeal neoplasms, by age
67:149
- laryngeal neoplasms, by amount smoked
67:149
- laryngeal neoplasms, by smoking classification
67:149
- laryngeal neoplasms, cigar smokers vs. nonsmokers
67:35
- laryngeal neoplasms, for men by age
67:148-149
- laryngeal neoplasms, for women
67:153
- laryngeal neoplasms, pipe smokers vs. nonsmokers
67:35
- liver cirrhosis
64:342; 67:184
- liver cirrhosis, by age
67:184
- liver cirrhosis, by sex
67:184
- liver cirrhosis, by smoking classification
67:184
- liver cirrhosis, for men
67:184
- liver cirrhosis, for men by amount smoked
67:184
- longevity and
64:99, 100
- lung neoplasms and
64:28, 29, 133, 163, 164, 175-189
- lung neoplasms, by age
67:134-140
- lung neoplasms, by amount smoked
67:135, 137-140
- lung neoplasms, by sex
67:135, 137-140
- lung neoplasms, by smoking characteristics
67:134-136
- lung neoplasms, by smoking classification
67:139-149
- lung neoplasms, cigar smokers
67:140
- lung neoplasms, for men
67:34, 134-135, 137-139
- lung neoplasms, for women
67:34, 153
- lung neoplasms, in Japanese males by amount smoked
72:61
- lung neoplasms, in males by cigarette smoking duration
71:240, 244
- lung neoplasms in smokers in Norway and Finland
71:246
- lung neoplasms, pipe smokers
67:140
- measurement limitations of
64:98
- mouth neoplasms
67:35
- mouth neoplasms, by age and amount smoked
67:146
- mouth neoplasms, by smoking classification
67:146
- mouth neoplasms, cigar smokers vs. nonsmokers
67:35, 146
- mouth neoplasms, for women
67:153
- mouth neoplasms, pipe smokers vs. nonsmokers
67:35, 146
- neoplasms, by site
64:149
- in occasional smokers
64:163
- occupational exposure and
64:112

pancreatic neoplasms, by sex
 67:158
 pancreatic neoplasms, for men by age
 67:159
 pancreatic neoplasms, for men by amount smoked
 67:159
 pancreatic neoplasms, for men by smoking classification
 67:159
 pancreatic neoplasms, for women
 67:153
 from pancreatic neoplasms in smokers and nonsmokers
 71:289-299
 peptic ulcer, for men by age
 67:181
 from peptic ulcer in smokers and nonsmokers
 71:424
 peptic ulcer, smokers vs. ex-smokers by age
 67:181
 pharyngeal neoplasms
 67:35
 pharyngeal neoplasms, by age and amount smoked
 67:146
 pharyngeal neoplasms, by smoking classification
 67:146
 pharyngeal neoplasms, cigar smokers vs. nonsmokers
 67:35
 pharyngeal neoplasms, for women
 67:153
 pharyngeal neoplasms, pipe smokers vs. nonsmokers
 67:35
 pharyngeal neoplasms, smokers vs. nonsmokers
 67:3
 in pipe and cigar smokers by age and inhalation
 73:184, 187
 previous respiratory history and
 64:112
 psychological factors in
 64:101
 sampling in
 64:95, 98, 99
 smokers vs. nonsmokers, from lung neoplasms
 71:240-243
 stability of
 64:117
 stomach neoplasms, by age
 67:157
 stomach neoplasms, by amount smoked
 67:157
 stomach neoplasms, by smoking classification
 67:157
 stroke, by age
 69:12-13
 stroke, by amount smoked
 69:12-13
 stroke, by sex
 69:12-13
 stroke, for men
 67:67
 stroke, for men by amount smoked
 67:67
 stroke, smokers vs. ex-smokers
 69:15
 stroke, , smokers vs. nonsmokers
 69:12-13, 15
 thrombosis, by age
 67:36
 thrombosis, by smoking history
 67:26
 underestimation of
 64:111
 urban-rural differences in
 64:99
 urinary tract neoplasms, by age
 67:154
 urinary tract neoplasms, by smoking classification
 67:154
 urogenital neoplasms, by amount smoked
 67:154
 in white population
 64:132
 Motor vehicle exhaust hydrocarbons as
 64:296
 Mouth
 retention of tar in
 64:264
 Mouth epithelium
 histopathological change in
 64:271
 keratinization of
 64:203
 smoking effect on
 64:275
 Mouth neoplasms
 and cigar smoking by age
 67:146
 and cigar smoking in men
 67:146
 experimental induction by pipe tobacco smoke
 67:147-148
 frequency in smokers and nonsmokers
 71:238
 mortality rates, by age
 67:146
 mortality rates, by amount smoked
 67:146
 mortality rates, by smoking classification
 67:146-147
 mortality rates, for women
 67:153
 mortality rates in United States
 67:145
 mortality ratios
 67:35
 mortality ratios, by smoking classification
 67:35, 146
 mortality ratios, cigar smokers, men, by age
 67:146

- mortality ratios, for men by age
 - 67:146
- mortality ratios, for pipe smokers
 - 67:35, 146
- and smoking
 - 67:35, 145-147
- smoking induced
 - 71:12
- and tobacco use
 - 67:145
- in women, smokers vs. nonsmokers
 - 67:153
- see also* Gingival neoplasms; Lip neoplasms; Oral neoplasms; Palatal neoplasms; Salivary gland neoplasms; Tongue neoplasms
- Mucociliary transport
 - effect of smoking
 - 74:101, 102
- Mucopolysaccharides
 - function as surfactants in lung tissue
 - 71:172
- Mucous cells
 - hyperplasia in
 - 64:272
 - hypertrophy of
 - 64:271
 - increase in number of
 - 64:269
- Mucous glands
 - abnormalities, in smokers vs. nonsmokers
 - 74:97
 - morphological changes in
 - 64:35, 268, 271
- Mucous membranes
 - effect of cigarette smoke on
 - 67:140
 - effect of smoking on
 - 67:144
 - irritation of
 - 64:73
 - smoking and neoplasms of
 - 69:58
- Mucus
 - alterations in
 - 64:268
 - reduction of, by smoke
 - 64:270
 - secretion
 - 64:268, 269, 270
- Muscles, skeletal
 - curariform action of nicotine in
 - 64:69
- Mussels
 - ciliary function in, effects of cigarette smoke on
 - 71:221, 222
- Mustard gas
 - 64:195, 196
- Mutation rate
 - hypothesized variation in
 - 64:192
- Myocardial infarct
 - 64:320, 323
 - acute, and smoking effects on blood circulation in coronary disease patients
 - 67:62
- cholesterol levels and relapse rate
 - 68:23
- coffee drinking, smoking and
 - 74:8; 75:19, 20
- coronary thrombosis and
 - 64:321
- damage to rabbits after exposure to carbon monoxide
 - 75:29
- in Danish twins
 - 71:51
- epidemiological study in Goteborg, Sweden
 - 72:14, 15, 16
- etiology of
 - 69:27-28
- etiology of, smoking as
 - 64:325
- fatal, incidence of, and smoking
 - 67:59
- in German, Japanese, and Norwegian smokers vs. nonsmokers
 - 68:18, 19
- incidence in European vs. American men
 - 73:9
- incidence in male smokers vs. nonsmokers
 - 68:18, 19, 23
- incidence in men in Yugoslavia
 - 73:9
- incidence in men with and without ventricular premature beats
 - 74:10
- incidence in miners in Sardinia
 - 73:10
- incidence in Minnesota men by age and smoking habit
 - 72:14, 15
- incidence in pipe and cigar smokers
 - 73:215
- and incidence of coronary disease
 - 67:53
- incidence rates and smoking
 - 69:21-22; 72:15
- morbidity ratios, for smokers vs. nonsmokers
 - 67:56, 59
- mortality, in smokers vs. nonsmokers
 - 75:14
- nonfatal, morbidity ratios, smokers vs. nonsmokers
 - 67:59
- prevalence in current vs. ex-smokers
 - 74:8
- prevalence in farmers
 - 64:323
- prevalence in smoking vs. nonsmoking men in Czechoslovakia
 - 73:10
- recurrence in smokers vs. nonsmokers, in Buenos Aires
 - 74:9
- and smoking
 - 69:4, 18; 73:19
- and smoking in India
 - 74:8
- summary of previous findings
 - 75:4, 13

- in Swedish women smokers vs. nonsmokers
 - 75:14
 - see also* Coronary diseases
- Myocardium
 - arteriole wall, effects of filtered cigarettes in dogs
 - 72:20
 - arteriole wall thickness in smokers vs. nonsmokers
 - 72:2, 19
 - arteriole wall thickness in smoking and nonsmoking dogs
 - 72:2, 20
 - effect of catecholamines on
 - 67:60
 - effect of cigarette smoking on
 - 67:60; 69:11; 71:5, 8
 - effect of nicotine on
 - 67:60
 - effect of nicotine on catecholamine release from
 - 67:60
 - effect of nicotine on, clinical and experimental studies
 - 67:26
 - effects of hydrogen cyanide in smoke on
 - 71:62
 - oxygen consumption in nicotine stimulated
 - 71:59
 - oxygen demand of, nicotine effects
 - 71:38
 - see also* Heart
- Myosmine
 - structural formula of
 - 64:49
- 2-Naphthylamine
 - development of bladder carcinomas and papillomas in dogs, hamsters, and monkeys
 - 71:296
 - suspected bladder carcinogen in tobacco smoke
 - 71:265
- Naphtols
 - 64:54
- Nas (tobacco and ashes)
 - and oral neoplasms in the USSR
 - 69:58
- Nasopharyngeal neoplasms
 - in smokers vs. nonsmokers, in Taiwan
 - 75:50
- National Cancer Institute
 - 64:7
 - Biometry Branch
 - 64:137, 138, 139
- National Center for Health Statistics
 - 64:13
 - survey of U.S. smoking habits by
 - 71:5-6
 - survey on relationship of smoking and incidence of respiratory disease
 - 71:173
- National Clearinghouse for Smoking and Health
 - responsibilities
 - 71:7
 - survey of smoking, 1970
 - 71:6
- National Cooperative Pooling Project
 - mortality statistics from coronary disease
 - 71:21-22
- National Heart Institute
 - 64:7
- National Institutes of Health
 - 64:13
- National Library of Medicine
 - 64:13, 14
 - assistance in literature review on smoking
 - 71:7
- National Safety Council
 - 64:344
- National Tuberculosis Association
 - 64:8
- National Vital Statistics Division
 - 64:134
- Natural gas
 - respiratory tract carcinoma in workers exposed to
 - 71:256
- Neonates
 - effect of maternal smoking on
 - 67:39, 185-187
 - rats, LD 50, nicotine determination
 - 71:412
 - see also* Birth weight; Infant mortality; Smoking, maternal
- Neoplasms
 - adenomatous, induction in mice by cigarette smoke inhalation
 - 71:350
 - age-adjusted incidence of
 - 64:183
 - benign, in mice
 - 64:165
 - classification of, by World Health Organization
 - 64:173
 - death statistics in, validation of
 - 64:101
 - development in smoking dogs, percentages of
 - 71:274
 - experimental, bronchogenic carcinoma
 - 69:63-64
 - experimental, epidermoid carcinoma
 - 69:64
 - experimental, induction by tobacco smoke
 - 67:35
 - female mortality trends in
 - 64:129, 131, 132, 133, 135, 137
 - induction of
 - 64:33, 143, 146, 147, 148, 166
 - mammalian, cigarette smoke effect on
 - 71:343
 - mortality rates in alcoholics
 - 73:71

- mortality rates in, international statistics of
 - 64:129, 130, 131
- mortality rates in Japan
 - 68:17
- mortality ratios in, by site
 - 64:137, 148, 149
- mortality trends in
 - 64:135, 137
- occupational factors in
 - 64:147
- prevalence of, smokers vs. nonsmokers
 - 69:56
- recurrent primary, incidence in smokers vs. nonsmokers
 - 73:71, 74
- by sex
 - 69:56
- sex ratios in, in mortality
 - 64:132, 133
- by site
 - 64:127, 133, 134, 148, 149, 188, 189, 191, 197, 211
- smoke constituents in, as promoters
 - 64:26, 229
- smoking and
 - 72:4, 5, 59-75
- summary of previous findings on relationship to smoking
 - 68:89, 90; 73:67, 68; 75:3-8
- summary of recent findings on relationship to smoking
 - 73:88; 74:58, 59; 75:43, 54
- by type of tumor and smoking history
 - 69:56
- typing of
 - 64:35
- virus induction of
 - 64:142, 166
- see also Cancer registries; and specific neoplasm terms, e.g., Lung neoplasms
- Nephritis
 - 64:103
- Netherlands
 - cigarette smoke inhalation effects on mice respiratory tract in
 - 71:349
 - lung neoplasms, methods of retrospective study of smoking in
 - 71:323
 - serum lipid difference, in smokers vs. nonsmokers of
 - 71:101
- Neuroticism
 - 64:365, 366, 367
- New Haven Study
 - 64:186
- Newton, Massachusetts study
 - 64:368, 369, 370
- New York City
 - myocardial infarctions in cigar and pipe smokers in
 - 71:32, 38-39
- New York State
 - cancer registry in
 - 64:127, 129
 - neoplasm statistics in
 - 64:135
- New Zealand
 - coronary death rate in
 - 64:320
 - human experimental data on smoking and pregnancy
 - 71:408-409
- Nickel
 - anaplastic changes from
 - 64:166
 - carbonyl, as a cocarcinogen
 - 69:62
 - chloride
 - 64:55
 - cigarette content of, in ash and smoke
 - 64:55, 167
 - compounds, suspected carcinogenic agents in cigarette smoke
 - 71:265; 72:145
 - metaplasia and
 - 64:166
- Nickel workers
 - 64:193, 194, 232
- Nicotine
 - 64:49, 69-75
 - absorption of
 - 64:73, 74, 349
 - acceleration of alpha rhythm by
 - 64:70
 - administration of
 - 64:349
 - antigenic properties
 - 72:104
 - atherogenic effects of
 - 71:120-122
 - carcinogenic effect of
 - 64:144
 - in cigar, pipe, and cigarette smoke
 - 73:177
 - clinical effects on offspring of smoking mothers
 - 73:140, 141
 - coronary heart disease and
 - 74:13, 19
 - degradation of
 - 64:74
 - dosage of
 - 64:74, 352
 - in duodenal ulcer induction in cats
 - 73:158, 159
 - effect as antidiuretic
 - 64:69
 - effect as cerebral anoxia
 - 64:70
 - effect as chronic toxicity
 - 64:32, 73, 74
 - effect as convulsant
 - 64:70
 - effect as curariform action
 - 64:69
 - effect as depressor action
 - 64:74
 - effect as digestive disturbance
 - 64:74
 - effect as discharge pattern
 - 64:70
 - effect as emetic
 - 64:70

effect as nausea
 64:71, 74
 effect as paralysis of ganglia
 64:317
 effect as stimulation
 64:69
 effect as stimulation of ganglia
 64:317
 effect as tranquilization
 64:350
 effect as vasomotor activity
 64:70, 74
 effect during pregnancy
 67:186-187
 effect during pregnancy in laboratory animals
 72:88; 73:115, 116
 effect in "arousal" action
 64:70, 350
 effect on adipose tissue, in rats
 74:13
 effect on apexcardiogram
 72:21
 effect on autonomic nervous system
 67:60
 effect on birth weight in rats
 72:88
 effect on blood circulation
 60:61
 effect on blood circulation in coronary disease patients
 67:61
 effect on blood lipids
 71:123-128
 effect on blood pressure
 64:70; 67:60; 71:36
 effect on blood vessels
 67:62
 effect on bronchoconstrictor response in laboratory animals
 72:46
 effect on cardiac rhythm of heart
 71:36
 effect on cardiovascular system
 67:60; 71:56-58, 107-118
 effect on cardiovascular system in dogs
 73:17
 effect on catecholamine release
 67:60; 71:36, 119; 75:29
 effect on cats
 64:70
 effect on chemoreceptor activity
 64:69
 effect on chemoreflex induction
 64:318
 effect on chlorpromazine inhibition
 64:70
 effect on ciliary activity
 64:268
 effect on colon
 64:71
 effect on dogs
 64:70
 effect on fetus in laboratory animals
 72:88
 effect on gastric secretion
 72:97
 effect on gastric secretion in cats
 73:158, 159
 effect on gastric secretion in rats
 73:159
 effect on gastrointestinal secretion in dogs
 72:6
 effect on habituation
 64:349-354
 effect on heart blood flow in dogs
 73:17
 effect on heart function
 67:60
 effect on heart rate
 67:60; 71:36
 effect on hypercholesterolemic rabbits
 69:27
 effect on immune response in man
 72:109
 effect on lactation in laboratory animals
 73:138, 139
 effect on lactation in smokers vs. non-smokers
 73:139, 140
 effect on lipid biosynthesis in aorta in dogs
 73:17
 effect on lipid metabolism in rabbits
 72:21
 effect on liver
 64:342
 effect on microcirculation in atrium in cats
 73:17
 effect on monkeys
 64:70
 effect on mucus secretion
 64:268, 269
 effect on myocardium
 67:26, 60
 effect on myocardium oxygen demand
 71:38
 effect on myometrial strips in gravidic women
 71:408
 effect on nicotine-sensitive cells
 64:69
 effect on novice smoker
 64:70
 effect on pancreatic secretions in animals
 73:161, 162
 effect on peripheral vascular system
 71:72, 75, 133-134; 72:25, 26
 effect on peritoneal macrophages, in mice
 74:105
 effect on pinocytosis, in mouse peritoneal macrophages
 74:105
 effect on pipe/cigar smoke inhalation
 73:183, 184
 effect on pregnancy
 71:411-414
 effect on pregnant laboratory animals
 67:187-188
 effect on pregnant rats
 69:80

- effect on rabbits
 - 64:70
- effect on rat and mouse fetus, site of action
 - 73:121
- effect on respiration, clinical experimental studies
 - 67:26
- effect on respiratory system
 - 64:70
- effect on respiratory tract in rats
 - 74:104
- effect on supraopticohypophyseal system
 - 64:69
- effect on sympathetic ganglia cells
 - 64:69
- effect on systolic pressure rise
 - 64:74
- effect on vascular resistance in dogs
 - 67:60
- effect, tolerance to
 - 64:353, 354
- effect, toxicity from
 - 64:74
- effect, tremors from
 - 64:70
- effect, unpredictability of
 - 64:69
- excretion, by passive smokers
 - 75:97
- experimental studies
 - 72:21; 73:16, 17
- hypoxia and
 - 72:21
- induction of necrosis in arterial walls
 - 71:63
- as most likely contributor to health hazards of smoking
 - 72:8, 143
- neurogenic effects of
 - 71:57
- N-oxides, presence in tobacco smoke
 - 69:62
- oxidized, in vitro ciliostatic effects
 - 69:42
- as potentiator of duodenal ulcers in animals
 - 73:161-163
- pyrolysis of
 - 64:59
- secretion, effect of cigar, pipe and cigarette smoke in dogs
 - 73:216
- structural formula of
 - 64:49
- substitutes for
 - 64:34, 354
- suppression of immunoglobulin response, in cell cultures
 - 75:77
- systemic toxicity of
 - 64:71, 73
- tissue storage of
 - 64:71
- toleration of
 - 64:352, 353, 354
- toxicity of
 - 64:32, 71, 73, 74, 352, 353, 354
 - see also* Nicotine content; Nicotine metabolism; Nicotine pharmacology
- Nicotine content
 - in blood, new assay methods
 - 73:15, 23
 - and cigarette smoke
 - 72:21
 - and cigarette smoke and tumorigenicity
 - 67:34
 - effects of room size, amount of tobacco burned and ventilation
 - 75:91-94, 97
 - in little cigars compared to cigarettes and cigars
 - 73:223-226, 228
 - in milk of laboratory animals
 - 73:138, 139
 - in milk of smoking mothers
 - 73:139
 - smoker awareness of
 - 64:349
 - and tar content, and tumorigenicity of cigarette smoke
 - 67:15
 - and tar content, of cigarette smoke as measurement of dosage
 - 67:15
- Nicotine metabolism
 - 64:31, 71, 72
 - metabolites
 - 69:61-62
 - metabolites, excretion of
 - 64:71, 72
 - pathways of, in mammals
 - 64:72
 - see also* Cotinine
- Nicotine pharmacology
 - 64:32, 69, 70, 71, 72, 317, 318, 319, 320, 349
 - effect of acetylcholine on
 - 67:60
 - effect of adrenalectomy on
 - 67:60
 - effect of tetraethylammonium chloride on
 - 67:60
- Nine-State Study
 - expected deaths in
 - 64:109
 - mortality ratios in
 - 64:109, 149
 - observed deaths in
 - 64:109
- Nitrates
 - in tobacco smoke
 - 67:128
- Nitric oxide
 - exposure to
 - 64:266
 - as probable contributor to health hazards of smoking
 - 72:144
- Nitrogen
 - gas phase, cigarette smoke
 - 64:60
- Nitrogen bases
 - 64:54

Nitrogen dioxide
 64:60, 266
 ciliastatic effect of
 64:268
 effect on AHH activity
 74:52
 effect on alveolar wall cells in guinea pigs
 73:50
 effect on bacterial retention in hamsters
 73:54
 effect on bactericidal activity in mouse lung
 74:103
 effect on pulmonary physiology, in animals
 74:102-103
 effect on pulmonary physiology, in monkeys
 74:103
 effects on rats' lungs
 69:41; 72:46, 47; 73:49, 50
 in emphysema etiology
 72:46
 obliterative fibrosis from
 64:266
 as probable contributor to health hazards of smoking
 72:144
 pulmonary changes in rodents chronically inhaling
 71:161, 220
 pulmonary edema from
 64:266
 toxic action of
 64:295
 Nitrogen oxides
 64:296, 297
 as air pollutants in cigarette smoke
 74:124, 125
 in cigarette smoke
 64:296, 297
 effects on resistance of squirrel monkeys to pneumococcus
 71:173
 pharmacology of
 64:266
 smoke content of
 64:266
 Nitroglycerine
 effect on blood circulation in coronary disease patients
 67:61-62
 effect on blood circulation in normal individuals
 67:61-62
 4-Nitroquinoline 1-oxide
 alcoholic solution of, development of papillomas in mice drinking
 71:292
 Nitrosamines
 effect on lactating hamsters
 73:139
 role in respiratory tract carcinogenesis, in animals
 74:47
 N-nitrosamines
 69:62
 carcinogenicity
 67:127
 carcinogenicity in cigarette smoke
 71:264-266
 determination in cigarette and tobacco smoke condensate
 73:87, 88
 esophageal neoplasms induced in animals by
 71:292
 in tobacco smoke
 67:127
 N-nitrosoanabasine
 69:62
 N-Nitrosoheptamethyleneimine
 incidence of lung neoplasms, in rats
 75:49
 N-nitrosornicotine
 in tobacco
 69:62; 75:48, 49
 Nonrespondents
 age adjusted death rates in
 64:114
 magnitude of, in surveys
 64:97
 mortality ratios in
 64:116
 proportion of smokers in
 64:114
 Nonresponse bias
 64:96, 104, 115
 Nonsmokers
 age-adjusted mortality in
 64:100
 by age and sex, U.S.
 64:178
 airway resistance in
 64:292, 293
 allergic and irritative reactions to cigarette smoke
 72:128, 129
 allergic skin reactions in
 64:319
 allergic symptoms in, from tobacco smoke exposure
 72:110, 111
 bladder neoplasm risk in
 64:222
 bladder neoplasms in
 64:223
 body weight of
 64:384, 385
 carboxyhemoglobin effects on oxygen uptake
 71:61
 carboxyhemoglobin levels in
 72:125
 chronic cough prevalence in
 64:299, 302
 coronary diseases rate in
 64:322, 323
 emphysema in
 64:297
 epithelial changes in
 64:170, 173, 189
 epithelial changes in, females
 64:170

- extroversion in
 - 64:366
- forced expiratory volume in
 - 64:290, 291
- hemoglobin concentration in
 - 64:319
- I.Q. measurement of
 - 64:370
- liver cirrhosis in
 - 64:342
- lung neoplasms in
 - 64:118, 184, 191, 193, 230, 232
- morphology of
 - 64:385, 386
- mortality rates in
 - 64:100, 102, 117, 118
- mortality ratios in
 - 64:163, 202, 301
- occupational factors in
 - 64:187
- oral neoplasms
 - 64:202
- passive smoking and
 - 72:121-125
- as percent of population
 - 64:114
- pneumoconiosis in
 - 64:298
- psychosomatic disorders in
 - 64:367
- respiratory conditions in
 - 64:289
- risk ratios in
 - 64:222, 223, 230, 232
- urban-rural mortality in
 - 64:186, 194
- U.S., by age
 - 64:178
- see also* Smokers vs. nonsmokers
- Norepinephrine
 - 64:318
 - effects of nicotine
 - 75:29
- Nornicotine
 - 69:62
 - structural formula
 - 64:49
- North Dakota studies
 - 64:323
- Norway
 - coronary death rates in
 - 64:320
 - incidence rates of lung neoplasms
 - 69:55-56
 - lung neoplasms in, for pipe smokers
 - 71:244
 - lung neoplasms mortality in, relationship to tobacco use
 - 64:176; 71:245-246
 - neoplasm risk in
 - 64:127
 - tracheobronchial tree changes in smokers and nonsmokers of
 - 71:259
- Nose
 - effect of smoking
 - 64:275
- Nose neoplasms
 - 64:193
- mortality rates, by amount smoked
 - 67:147
- mortality rates, by smoking classification
 - 67:147
- Noxious gases
 - exposure magnitude of
 - 64:296, 297
 - in respiratory diseases
 - 64:279
- Nutritional deficiency
 - 64:341
- Oat cell carcinoma
 - see* Carcinoma, oat cell
- Obesity
 - 64:38, 321, 355
 - coronary diseases mortality and
 - 64:321; 71:43
 - relationship to smoking and CHD
 - 71:43-45
 - relationship to smoking in peripheral arteriosclerosis
 - 71:72
 - as risk factor for CHD
 - 72:16; 73:9
- Occupational diseases
 - asbestosis
 - 73:41
 - asbestosis, in asbestos workers, in Singapore
 - 74:95
 - bronchitis
 - 72:42
 - bronchitis and respiratory tract irritation, in rubber industry workers
 - 74:96
 - bronchitis, in cement and rubber industry workers
 - 74:95, 96
 - bronchitis, in wool and cotton textile workers
 - 74:93, 94
 - byssinosis
 - 73:39, 41
 - byssinosis, in cotton and wool textile workers
 - 74:93, 94
 - byssinosis in cotton millworkers
 - 75:68
 - chronic obstructive pulmonary disease
 - 72:3, 42-44
 - chronic obstructive pulmonary disease, in autoworkers
 - 74:80
 - chronic obstructive pulmonary disease, in firemen
 - 75:68
 - coal workers' pneumoconiosis
 - 73:42
 - lung neoplasms in uranium miners
 - 75:47
 - pneumoconiosis
 - 72:42-44
 - pulmonary fibrosis
 - 72:44

and risk of neoplasms
 75:43
 smoking and
 72:3, 42-44; 74:93-96; 75:68-70
see also Occupational factors; Occupational hazards; Occupations
 Occupational factors
 64:224
 chronic bronchitis and
 64:298, 299, 300, 302
 coronary disease and
 64:321, 322; 73:5, 7
 lung neoplasms and
 64:95, 187, 193, 194, 232
 mortality and
 64:112, 134
 smoking prevalence and
 64:362, 363
see also Occupational diseases; Occupational hazards; Occupations
 Occupational hazards
 64:100, 101, 232
 air pollution exposure in Boston policemen
 74:82, 83
 asbestos exposure
 67:35; 73:41
 asbestos exposure and smoking as factors in lung neoplasm development
 74:41-43; 75:49
 in bladder neoplasms
 64:222
 bladder neoplasms, and smoking
 73:78
 carboxyhemoglobin levels in workers exposed to exhaust gases
 75:21
 coal dust exposure
 73:41-43
 from coal tar
 64:147
 cotton, flax, and hemp dust exposure
 73:39-41
 dust exposure
 73:43, 44
 exposure to chemicals, fumes, sprays and dusts, in smokers vs. nonsmokers, by race and sex
 75:69, 70
 exposure to 100% pure oxygen
 73:43
 higher reporting of exposure to, by smokers vs. nonsmokers
 75:68
 in lung neoplasms
 64:232
 myocardial infarction as
 64:323
 nitrogen dioxide in
 64:266
 pancreatic neoplasms and
 73:77
 pulmonary disease from
 64:266, 298, 299, 300, 302
 radiation exposure in uranium miners
 73:72
 risk ratios in
 64:31, 134
 rubber industry fumes and smoking
 74:96
 smoking and
 72:3, 4, 42-44; 73:39-44
 smoking as additive risk for COPD
 73:55
 textile dust exposure and smoking
 74:93-96
 uranium exposure
 67:35
see also Occupational diseases; Occupational factors; Occupations
 Occupations
 asbestos workers, lung neoplasm morbidity
 67:143
 asbestos workers, lung neoplasm mortality and smoking
 71:257
 asbestos workers, respiratory tract carcinoma
 71:256
 bank employees, smoking and COPD
 71:198
 coal miners, impaired pulmonary function in smoking
 71:163
 coal miners, respiratory tract carcinoma
 71:256
 coal miners, smoking and COPD
 71:153, 197, 218-219
 coal miners, smoking and ventilatory function
 71:207
 flax mill workers, smoking and COPD
 71:199
 government employees, blood pressure differences in smokers vs. nonsmokers
 71:99
 longshoremens, mortality from smoking-related cerebrovascular disease
 71:70
 longshoremens, mortality rates from CHD in
 71:28
 longshoremens, smoking and COPD
 71:28
 longshoremens, smoking and ventilatory function
 71:208
 medical students, serum lipid differences in smokers vs. nonsmokers
 71:98
 medical students, smoking and nicotine effects on blood lipid levels
 71:124
 medical students, smoking and thrombosis relationships
 71:130
 medical students, smoking and ventilatory function
 71:209-210
 mortality rates, smokers vs. nonsmokers by
 67:11
 nickel workers, lung neoplasms in
 71:256

- physicians, bladder and kidney neoplasms in smoking
71:293, 294
- physicians, cessation of smoking effect on COPD
71:142
- physicians, COPD mortality rates
71:149
- physicians, decline in cigarette smoking rates
71:48
- physicians, mortality from smoking-related cerebrovascular disease
71:68
- physicians, mortality rates from CHD
71:26
- physicians, mortality ratios from esophageal neoplasms
71:290
- physicians, mortality ratios from peptic ulcer in smoking and nonsmoking
71:424
- physicians, pulmonary function following cessation of smoking
71:149
- physicians, smoking and ventilatory function
71:209-210, 213
- plant workers, occupational exposure and smoking relationships to COPD
71:153, 218, 219
- plant workers, smoking and COPD
71:198
- plant workers, smoking and ventilatory function
71:206-208
- post office workers, blood pressure differences in smokers vs. nonsmokers
71:104
- post office workers, smokers and ventilatory function
71:209
- post office workers, smoking and COPD
71:200, 202
- prisoners, serum lipid differences in smokers vs. nonsmokers
71:100
- prisoners, smoking and nicotine effects on peripheral vascular system
71:133
- railroad employees, mortality and morbidity, CHD and smoking
71:28, 34, 97
- and respiratory symptoms by smoking habit
67:97
- smelter workers, lung neoplasm mortality from arsenic exposure
71:257
- smoking habit for
67:143
- soldiers, smoking and COPD
71:197
- steel workers, COPD development from dust exposure
71:153
- students, carbon monoxide effects on blood lipids
71:129
- students, infectious respiratory disease in smokers vs. nonsmokers
71:228-229
- students, mortality from smoking-related cerebrovascular disease
71:68
- students, mortality rates from CHD
71:28
- students, smoking and COPD
71:201
- students, smoking and nicotine effects on blood lipid level
71:125
- students, smoking and thrombosis relationships
71:130
- students, smoking and ventilatory function
71:211
- telephone company employees, smoking and COPD
71:200
- textile workers, occupational exposure and smoking relationship to COPD
71:218-219
- transportation workers, air pollution relationship to COPD
71:198, 202
- transportation workers, smoking and COPD
71:198, 202
- transportation workers, smoking and ventilatory function
71:207, 212
- uranium miners, lung neoplasms in smokers and nonsmokers
71:256
- uranium miners, lung neoplasms morbidity by smoking habit for
67:143
- utility company employees, CHD morbidity in smoking
71:30
- veterans, bladder and kidney neoplasms in smoking
71:294-295
- see also* Occupational diseases; Occupational factors; Occupational hazards
- Office of Science and Technology
64:8
- Oleic acid
suspected carcinogenic agent in cigarette smoke
71:266
- Olive oil
penetrability of benzo(a)pyrene in mice esophageal epithelium
71:292
- Opium
64:349
- Optic nerve
atrophy, and cyanide in tobacco smoke
67:183
- sensitivity, amblyopia from
64:341
- Oral diseases, non-neoplastic smoking and
69:5-6, 85-87; 72:6

- Oral hygiene
 - relationship to smoking and noncancerous oral disease
 - 69:85-86
 - smoking and
 - 72:6
- Oral mucosa
 - 64:203
 - effect of carcinogens in laboratory animals
 - 72:70
 - effect of cigarette smoke
 - 72:6, 69
 - effect of reverse smoking
 - 72:69
 - effect of tobacco/bidi smoking and chewing
 - 72:69
- Oral neoplasms
 - 64:37, 196-204, 233
 - alcohol consumption and smoking in etiology of
 - 73:193; 74-53-55
 - amount smoked in
 - 64:233
 - cigar smoking in
 - 64:189
 - epidemiologic studies
 - 64:196-202; 74:53-55
 - estimated incidence in U.S. for 1970
 - 71:284
 - experimental induction of
 - 64:233
 - incidence of secondary primary, in smokers vs. nonsmokers
 - 75:50
 - income gradients in
 - 64:134
 - inhalation patterns and
 - 73:191
 - mortality rates in
 - 64:37, 133; 71:285
 - mortality rates in, in females
 - 64:131, 132
 - mortality rates in, in foreign born
 - 64:134
 - mortality rates in, in Irish
 - 64:135
 - mortality rates in, in males,
 - 64:130, 132
 - mortality rates in Japanese male smokers vs. nonsmokers
 - 73:74
 - mortality ratios for pipe, cigar, and cigarette smokers vs. nonsmokers
 - 73:191-193
 - mortality ratios in
 - 64:113, 202
 - mortality ratios in, in cigarette smokers
 - 64:149
 - mortality trends in
 - 64:137
 - neoplasm site by tobacco use in
 - 64:197
 - pipe smoking in
 - 64:37, 150, 189; 72:67
 - prevalence of, decline in
 - 64:204
 - recurrent, incidence in smokers vs. ex-smokers
 - 73:71, 74-75
 - relationship of tobacco use
 - 71:285, 289, 361-367
 - relative risk in tobacco smokers and chewers
 - 72:70
 - relative risk of development in pipe, cigar, and cigarette smokers vs. nonsmokers
 - 73:191, 194, 195
 - retrospective studies of
 - 64:198, 199, 200, 201
 - reverse smoking in
 - 64:203, 204; 73:76
 - risk gradients in, by amount smoked
 - 64:233
 - risk ratios in, in females
 - 64:134
 - smoking induced increase in
 - 64:197
 - smoking in etiology of
 - 64:204; 69:58; 71:289; 72:4, 67-70; 73:74-76
 - snuff in
 - 64:233
 - summary of previous findings on relationship to smoking
 - 74:52, 53
 - summary of retrospective studies
 - 73:194, 195
 - and tobacco chewing
 - 69:58
 - urban-rural factors in
 - 64:133
 - in waiters
 - 64:134
 - see also* Gingival neoplasms; Mouth neoplasms; Oropharyngeal neoplasms
- Oral ulceration
 - reverse smoking in
 - 64:203
- Organ cultures
 - cigarette smoke effects on cell growth and reproduction in
 - 71:267, 343-345
- Oropharyngeal neoplasms
 - 64:201
 - frequency in smokers and nonsmokers
 - 71:238
- Oxidoreductases
 - reduction of, in smokers' alveolar macrophages
 - 69:42-43
- Oxygen
 - in cardiac function
 - 64:318
 - debt, effect of smoking
 - 73:246, 247
 - debt, exercise performance and
 - 73:246, 247
 - myocardial consumption of, following nicotine stimulation
 - 71:58, 75
 - in smoke
 - 64:60

- tension, smokers vs. nonsmokers
72:22
- transport in body, carbon monoxide effects
71:60, 75
- uptake in nonsmokers with specific carboxyhemoglobin levels
71:61, 75
- Ozone
 - ciliastasis from
64:268
 - irritation action of
64:295
- Ozonized gasoline
64:166

- Pachyderma oralis
64:203
- Palatal mucosa
64:275
- Palatal neoplasms
64:204
see also Mouth neoplasms; Oral neoplasms
- Palate
 - hamster, C-14 labeled smoke particulates deposition in
71:281-282
 - smoking and stomatitis nicotina
69:87
- Pancreatic neoplasms
 - incidence in cigar/pipe and cigarette smokers vs. nonsmokers
74:55, 56
 - mortality rates, by age
67:158-159
 - mortality rates, by amount smoked
67:159
 - mortality rates, by sex
67:158
 - mortality rates, by smoking classification
67:159
 - mortality rates, for women
67:153
 - mortality rates in United States
72:74
 - mortality ratios, by age
67:158-159
 - mortality ratios, by age and amount smoked
67:159
 - mortality ratios, by sex
67:158
 - mortality ratios, for men by smoking classification
67:159
 - mortality ratios, for women
67:153
 - mortality ratios in Japanese male and female smokers
72:74
 - occupational exposure and
73:77
 - relationship of smoking to mortality from
71:298-299
- relative risk in men by number of cigarettes smoked
74:55
- smoking and,
67:36, 158-159; 69:60-61; 71:13, 238, 298-299; 72:5, 68, 74; 73:77
- summary of previous findings on relationship to smoking
74:55
- Pancreatic secretions
 - bicarbonate content, effect of smoking
73:159, 160
 - effect of nicotine in animals
73:161, 162
- Papain
 - pulmonary effects on rats exposed to cigarette smoke with
71:163
- Paper chromatography
64:51, 57
- Papillomas
 - 64:142, 165
 - development in mice drinking alcoholic benzopyrene
71:292
 - formation following skin painting with smoke tars
71:337-339, 341
 - induction in hamsters exposed to benzo(a)pyrene
71:346-347
 - induction of
64:142, 143, 144, 203, 223
 - transformation of
64:144
- Papillomas, benign
 - 64:142
 - origin of,
64:165
 - tar induced, in mice
64:223
- Paraffin
64:147
- Paralysis
 - of ganglionic nerve cells
64:69
- Paralysis agitans
 - mortality rates, smokers vs. nonsmokers
67:8
- Parasorbic acid lactone
64:145
- Parathion
62:145
- Parents
 - incidence of pneumonia and bronchitis in children of smokers
75:105, 106
 - influence
64:369, 370
 - prevalence of respiratory symptoms in children of smokers
75:102, 103
 - smokers cough and phlegm production, and respiratory symptoms in children
75:103
 - see also* Smoking, parental
- Paris green
64:61

- Particulate matter
 - and lung neoplasm development
 - 74:44, 45
 - pollution levels in four U.S. locations
 - 75:65, 66
- Particulate phase, cigarette smoke
 - 64:51-60, 263, 264, 265
 - carcinogenic accelerators in
 - 72:5, 65
 - effect on pulmonary and cardiac structure and function
 - 72:7 8
 - harmful constituents in
 - 72:143
- Particulate phase, tobacco smoke
 - composition of
 - 64:51
 - deposition sites of
 - 64:264, 265
 - gravitational settling of
 - 64:264
 - measurement of
 - 64:263
 - removal of
 - 64:264
 - respiratory damage from
 - 64:279
 - retention of
 - 64:264, 300
 - water content of
 - 64:51
- Passive smokers
 - pathologic studies
 - 75:99
 - summary of previous findings
 - 75:87, 88
 - summary of recent findings
 - 75:107, 108
- Passive smoking
 - CO, nicotine, benzo(a)pyrene, acrolein and acetaldehyde levels
 - 75:90-95
 - effect on cardiovascular function in dogs
 - 73:14
 - effect on children
 - 72:129,
 - effect on respiratory tract in laboratory animals
 - 72:129, 130
 - effects of carboxyhemoglobin levels, in persons with angina pectoris
 - 75:95, 97
 - effects of carboxyhemoglobin levels on CO absorption
 - 75:95, 96
 - effects of CO in tobacco smoke on psychomotor performance
 - 75:99-101
 - effects of exposure to cigarette smoke, in passive smokers
 - 75:99
 - effects of tobacco smoke constituents
 - 75:88-98
 - effects on bus and plane passengers
 - 75:102
 - excretion of nicotine
 - 75:97
 - exposure to cigarette smoke, and development of eye and throat irritations
 - 75:99, 100
 - incidence of pneumonia and bronchitis in children of parental smokers
 - 75:105, 106
 - maternal smoking, and development of bronchitis and pneumonia in infants
 - 75:103, 104
 - in neoplasm induction in laboratory animals
 - 72:130
 - parental cough and phlegm production, and respiratory symptoms in children
 - 75:103
- Pathophysiological studies
 - alveolar macrophages and smoking
 - 75:76, 77
 - effects of cigarette smoke on leukocytes, in guinea pigs
 - 75:77, 78
 - effects of cigarette smoke on pulmonary macrophages, in guinea pigs
 - 75:77, 78
 - effects of smoking on tracheal mucus velocity, in dogs
 - 75:78
 - suppression of immunoglobulin response by nicotine or water soluble fraction of cigarette
 - 75:77
- Patulin
 - 64:145
- Peak Flow Meter
 - 64:290
- Pearl's hypothesis
 - 64:105
- Peer group status
 - 64:372, 373
- Penicillic acid
 - 64:145
- Penis
 - skin neoplasms of
 - 64:147
- Pentacyclic compounds
 - 64:54
- Pentolinium
 - blockage of nicotine cardiac stimulation by
 - 71:57
- Peoples Gas Company Study
 - epidemiologic study of smoking and CHD
 - 74:6, 7
- Peoples Gas Light and Coke Co.
 - study of CHD, serum cholesterol and smoking relationships
 - 71:43
- Peptic ulcer
 - 64:337-340
 - antacid efficacy and healing of, effects of cigarette smoking on
 - 71:423
 - cessation of smoking as therapy for
 - 67:182
 - cigarette smoking in
 - 64:39

- clinical studies
 - 73:155-157
 - development in smokers
 - 71:13
 - and diet
 - 67:182
 - duodenal, and smoking
 - 67:39
 - epidemiological studies
 - 73:155-157
 - gastric, morbidity, and smoking
 - 67:40, 182
 - gastric, mortality, and smoking
 - 67:40, 181-182
 - gastric secretion in smokers vs. nonsmokers
 - 73:157, 158
 - incidence rates, smokers vs. nonsmokers, by sex
 - 67:182
 - increased mortality in Japanese smokers vs. nonsmokers
 - 73:155, 156
 - increased prevalence in male smokers
 - 72:97
 - and lung neoplasms, relation to smoking
 - 69:57
 - morbidity, and smoking
 - 67:40, 181
 - mortality rates
 - 67:40; 71:423
 - mortality rates, by amount smoked
 - 67:182
 - mortality rates, by smoking classification
 - 67:182
 - mortality rates, smokers vs. ex-smokers
 - 67:181
 - mortality ratios, for men by age
 - 67:181
 - mortality ratios from
 - 64:339, 340
 - mortality ratios from, in smokers and nonsmokers
 - 71:424
 - mortality ratios from, smokers vs. ex-smokers by age
 - 67:181
 - mortality ratios in Japanese adults by age started smoking
 - 73:155, 156
 - mortality ratios in male cigar and pipe smokers
 - 73:222
 - predisposing factors
 - 73:157
 - recurrence in smokers vs. nonsmokers
 - 73:157
 - retrospective and cross section study methods for smoking relationship to smoking and
 - 71:425-427
 - 67:22, 39-40, 181-182; 72:5, 6, 97, 98; 73:155
 - smoking as cause in dogs
 - 72:26
- Perception
 - of health hazards, and smoking behavior
 - 67:191
- 1,8,9-Perinaphthoxanthene
 - 64:54
- Perinatal studies
 - effect of maternal smoking on mc
 - summary of findings
 - 73:134, 135
 - maternal smoking and
 - 72:83-88
- Periodontal diseases
 - smoking and
 - 69:85-86; 72:6
 - smoking and, in Ceylon
 - 69:85-86
 - smoking and, in Norwegian Ar
 - cruits
 - 69:85
- Peristalsis
 - 64:71
- Peroxides
 - suspected carcinogenic agent in c
 - smoke
 - 71:265
- Personality characteristics
 - 64:365-368
 - and coronary disease
 - 64:321; 67:57
 - coronary disease morbidity ratios
 - ers vs. nonsmokers by
 - 67:57
 - drug use and
 - 64:353
 - relationship to CHD and smoking
 - 71:48-49, 105-106
 - in smokers
 - 64:326, 365-368
 - and smoking habit
 - 67:57, 188-192
 - and smoking habit in college stuc
 - 67:189
- Pesticides
 - 64:61, 62, 145
 - content in cigarette smoke
 - 71:265, 266
- pH
 - pipe/cigar smoke inhalation and
 - 73:183
 - of smoke in cigarettes, cigars, a
 - cigars
 - 73:223, 224, 228
- Phagocytosis
 - 64:35, 267, 269, 270, 300
 - effect of cigarette smoke in lat
 - animals
 - 73:53, 54
 - effect of cigarette smoke in rabbi
 - 72:109
 - effect of tobacco smoke
 - 72:47-48
 - pulmonary alveolar, in smokers
 - smokers
 - 71:165
- Pharyngeal fungi
 - smokers vs. nonsmokers in Sout
 - 73:54
- Pharyngeal neoplasms
 - 64:201, 202
 - frequency in smokers vs. nonsmo
 - 71:238

- incidence of secondary primary, smokers vs. nonsmokers 75:50
- mortality rates, by smoking classification 67:35, 146-147
- mortality rates, cigar smokers vs. nonsmokers 67:146
- mortality rates, for men by amount smoked 67:147
- mortality rates, for women 67:153
- mortality rates, pipe smokers vs. nonsmokers 67:146
- mortality ratios 67:35
- mortality ratios, by smoking classification 67:146
- mortality ratios, for cigar smokers 67:35
- mortality ratios, for cigar smokers by age 67:146
- mortality ratios, for men by age 67:146
- mortality ratios, for men by amount smoked 67:146-147
- mortality ratios, for pipe smokers 67:35
- mortality ratios, for pipe smokers by age 67:146
- recurrent, incidence in smokers vs. ex-smokers 73:74, 75
- relationship to tobacco use 71:362-364, 366
- retrospective studies of, by type of smoking 64:200, 201
- smoking in etiology of 67:35, 145, 147
- Phenols
 - 64:49, 54, 58, 59, 61, 62, 145, 267
 - in cigar, pipe, and cigarette smoke 73:177
 - ciliatotoxic agents 67:108
 - cocarcinogens 67:131
 - as probable contributors to health hazards of smoking 72:144
 - suspected carcinogenic agent of cigarette smoke 71:266
 - in tobacco smoke 67:129
 - tumor promoting agents 67:129
- Phenotypes
 - partially deficient heterozygote, in COPD etiology 75:73, 74
- Phenylmethyloxadiazole (PMO)
 - protection against adverse effects of cigarette smoke in animals 73:49, 53
- Philadelphia Pulmonary Neoplasm Research Project
 - lung neoplasm histopathologic studies and 74:38
- Phlebitis 64:103
- Phlegm production
 - by occupation and smoking habit 67:97
 - by parental smokers, and development of respiratory symptoms in children 75:103
 - by parental smokers, and incidence of pneumonia and bronchitis in children 75:105, 106
 - by smoking habit and sex 67:98
- Phospholipids
 - function as surfactants in lung tissue 71:172
 - smokers vs. nonsmokers 71:99-100, 102
- Physical activity 64:322
 - as a factor in coronary heart disease 73:4, 5
 - myocardial infarct morbidity ratios, for smokers vs. nonsmokers by level of 67:56
 - occupational, and smoking habit 67:56
 - relationship to myocardial infarction, smokers vs. nonsmokers 71:44
 - and risk of cerebrovascular accident 67:68
 - smoking and, relationship to CHD 71:41, 43, 44
- Physique smokers 64:383-387
- Phytadiene 64:51
- Phytol
 - structural formula of 64:52
- Picoline 64:59
- Pigmentation
 - induction of 64:146
- Pigments 64:272
 - in lungs of emphysematous patients 64:273
- Pinocytosis
 - decrease in alveolar macrophages, in smokers vs. nonsmokers 75:76
 - effect of nicotine, in mouse peritoneal macrophages 74:105

- Piperidine, nitroso-
suspected carcinogenic properties in cigarette smoke from
71:265
- Pipe smoke
see Smoke, pipe
- Pipe smokers
see Smokers, cigar and pipe; Smokers, pipe
- Pipe smoking
see Smoking, pipe
- Pipe tobacco
see Tobacco, pipe
- Pitch
64:147, 229
skin neoplasms from
64:33
- Placebos
ginseng root as
64:355
nicotine-free cigarettes as
64:70
- Placenta
ability to hydroxylate benzo(a)pyrene in smoking mothers
71:407
morphology
64:343
- Platelets
see Blood platelets
- Plethysmogram
abnormalities, in smokers vs. nonsmokers
73:22
- Pleural neoplasms
mesotheliomas, classification of
64:174
- Plumbers
neoplasm risks in
64:134
- Pneumoconiosis
64:269, 290, 298
in coal miners
72:42-44
in coal miners, smokers vs. nonsmokers
73:42
smokers vs. nonsmokers
72:42-44
- Pneumonia
64:277, 294, 302
epithelial changes in
64:170
incidence in children of smokers
75:105, 106
maternal smoking, and development in infants
75:103
mortality ratios in
64:276
neoplastic-like pathology in
64:195
in passive smokers, summary of recent findings
75:108
phenol induction of
64:267
- Pneumothorax, spontaneous
smoking and
73:37
- Poisson distribution
in mortality rates
64:117, 118, 119
- Poland
bladder neoplasms, in, methods and results in retrospective studies of smoking and
71:382, 383
CHD mortality and morbidity in,
71:96
esophageal neoplasms in Polish-born
64:135
esophageal neoplasms in, retrospective studies of tobacco use with
64:214; 71:378
gastric neoplasms in Polish-born
64:135
laryngeal neoplasms in, retrospective studies of tobacco use with
64:205, 208; 71:357
lung neoplasms, in males
64:135
oral neoplasms in, retrospective studies of tobacco use with
64:200, 201; 71:364
serum lipid differences in smoker nonsmokers in
71:100, 102
smoking and nicotine effects on human blood levels in
71:124
smoking relationship to thrombosis
71:131
- Polonium 210
64:145
carcinogenicity
67:128
in cigarette smoke
67:128
levels in lung tissue, smokers vs. smokers
67:128
and lung neoplasms
67:128
suspected carcinogenic agent in cigarette smoke
71:265-267, 335-336
in tobacco leaf
67:128
as tumor initiator
67:128
- Polyoma virus
64:166
- Polyphenols
64:54
- Population studies
British physicians, mortality and smoking (Doll and Hill Study)
67:5, 17, 52, 93, 139, 155, 18
bronchitis and smoking
69:37
Canadian pensioners smoking and study
67:5, 48, 93, 138, 154, 159
U.S. population, mortality and smoking (Hammond)
67:5, 13, 49-54, 66, 69, 94, 13
146-158, 181-189

- U.S. veterans, mortality and smoking (Dorn)
 - 67:5, 13, 48-49, 67-69, 92, 137-139, 146-159, 181-184
- Portland student study
 - 64:368
- Postal employees
 - breathlessness in
 - 64:286
 - chronic cough in
 - 64:281
- Post-operative complications
 - in duodenal ulcer removal, smokers vs. nonsmokers
 - 73:157
 - incidence in bronchitic and nonbronchitic smokers vs. nonsmokers
 - 74:92
 - pulmonary, smokers vs. nonsmokers
 - 71:174-175; 72:38
 - smoking, obesity, anesthesia and
 - 73:39
- Potassium
 - 64:55
- Potassium-40
 - 64:145
 - present in tobacco leaf
 - 71:266
- Preeclampsia
 - maternal smoking and
 - 69:79; 72:84; 73:142
 - in smoking vs. nonsmoking women
 - 71:404, 407; 73:142
- Pregnancy
 - carboxyhemoglobin levels in fetuses
 - 75:26, 27
 - carboxyhemoglobin levels of smokers in
 - 69:80
 - effect of blood pressure and smoking habits on
 - 69:77-78
 - effect of nicotine on, in rats
 - 69:80
 - effect of smoking during
 - 64:343; 67:185-187; 69:4-5, 77-81; 71:4, 13, 82-87, 389, 397-399, 415; 73:103-142
 - effect of smoking during, and development of bronchitis and pneumonia in infants
 - 75:103, 104
 - effect of smoking during, in Hungary
 - 69:79
 - effect of smoking during, in Ireland
 - 69:79
 - effect of smoking during, in Scotland
 - 69:79
 - effect of smoking during, in Venezuela
 - 69:79
 - effect of tobacco smoke, nicotine, and carbon monoxide in laboratory animals
 - 73:114-118
 - effects of nicotine on uterus during
 - 67:187
 - human, methods used in smoking study of
 - 71:391-396
 - nicotine effects on myometrial strips in
 - 71:408
 - and previous smoking habits, effect on infant birth weight
 - 73:112-114
 - summary of previous findings
 - 75:5, 6
 - timing of influence of smoking on birth weight
 - 73:120, 121
 - unsuccessful, smoking effects on
 - 71:13
 - see also* Maternal fetal exchange; Smoking, maternal
- Premalignant lesions
 - in bronchi
 - 64:27
 - in epithelial tissue
 - 64:231
 - in oral cavity
 - 64:142
- Prematurity
 - and maternal smoking
 - 64:343; 67:185-186; 69:77, 79; 71:390, 400-403; 72:5, 83-87; 73:112
 - and maternal smoking, among Negroes
 - 69:78
- Presbyterian Hospital Study
 - 64:141, 174
- Pressure-volume work loops
 - 64:292
- Prevalence studies
 - 64:301
 - in bronchopulmonary disease
 - 64:280-293
 - pulmonary function tests in
 - 64:280
 - sputum production in
 - 64:383
- Printing ink
 - 64:193
- Professional workers
 - smoking incidence of
 - 64:187
- Promoting agents
 - 64:26, 142, 146, 229
 - ethyl alcohol as
 - 64:217
 - urethan as
 - 64:142
- Propane
 - 64:60
- beta-Propiolactone
 - 64:145
- Propionaldehyde
 - 64:52
- Propionic acid
 - ciliatotoxic agent
 - 67:108
 - in tobacco smoke
 - 67:108
- Propylene
 - 64:60
- Prospective mortality studies
 - age adjustments in
 - 64:84

alcohol in
 64:99, 101
 by American Cancer Society
 64:81, 96, 101
 by Best, Josie, and Walker
 64:81
 British doctors study as
 64:97, 102, 109
 California occupational study as
 64:95, 106
 Canadian study as
 64:91, 92, 94
 cause of death in
 64:109
 certification validity in
 64:109, 110
 city population size in
 64:99
 comparison of
 64:83
 by Dorn
 64:81
 by Dunn, Buell, and Breslow
 64:81
 by Dunn, Linden, and Breslow
 64:81
 educational level in
 64:100, 101
 exercise in
 64:101
 in ex-smokers
 64:93
 fried foods in
 64:100
 genetic longevity in
 64:99
 by Hammond
 64:81
 by Hammond and Horn
 64:81
 infectious diseases in
 64:276
 inhalation practices in
 64:99
 limitations in
 64:94, 95, 96, 111, 163
 male death rates in
 64:28
 maternal smoking in
 64:343
 mortality ratios in
 64:84, 118
 nonresponse bias in
 64:96, 97, 104
 occupational exposure in
 64:100, 101
 previous disease in
 64:100, 101
 religious factors in
 64:99, 101
 smoking data in
 64:82
 socioeconomic factors in
 64:96
 tranquilizers in
 64:100
 twenty five-state study as
 64:103, 104

 type of smokers in
 64:82
 usable responses in
 64:96
 U.S. veterans study as
 64:91, 94, 96, 97, 103
 variables affecting
 64:84
 weaknesses of
 64:96
Prospective studies
 64:27, 28, 30, 81-116, 293, 29
 323
 bias in
 64:36
 by Doll and Hill
 64:81
 esophageal neoplasms
 64:217
 excess deaths in
 64:28
 in gastric neoplasms
 64:227
 methodology of
 64:81
 methodology of, in peptic ulcer
 64:338, 339
 morphology correlations in
 64:385, 386
 neoplasms
 64:231
 neoplasms by site
 64:149
 reliability of
 64:180
Prostatic neoplasms
 64:135, 136
 mortality rates in
 64:131
 mortality ratios in
 64:148, 149
Protestants
 smoking prevalence in
 64:364
Protozoa
 ciliary function in, effect of
 smoke on
 71:165, 224
Pseudoephedrine
 64:349
Psychoanalytic theory
 64:367
Psychomotor performance
 effects of CO in tobacco smoke
 75:99-101
 in passive smokers, summary of
 findings
 75:108
Psychosocial factors
 in cardiovascular disease
 64:327
 smoking habit
 67:39, 188-192
Psychosomatic disorders
 in heavy smokers
 64:367
Psychotherapy
 cure of tobacco habit by
 64:354

- Public Health Service
 - 64:6, 13, 127, 34²
 - 1967 study of, starting point for new studies
 - 71:4
 - review of medical literature on smoking hazards
 - 71:7
- Public transportation
 - effects of passive smoking on bus and plane passengers
 - 75:102
- Puerto Rico
 - esophageal neoplasms in, retrospective studies of tobacco use with
 - 71:378
 - relationship of tobacco use and neoplasms of oral cavity in
 - 71:367
- Puffmeter ratios
 - 64:291, 292
- Pulmonary alveoli
 - changes in rates after exposure to nitrogen dioxide
 - 69:41
 - effect of smoking on
 - 64:274, 275; 67:30, 107
 - epithelium
 - 64:165
 - epithelium, experimentally induced changes in
 - 64:272
 - fluid lining, smoking effects on
 - 64:269, 270
 - rupture, in pipe/cigar smokers vs. cigarette smokers and nonsmokers
 - 73:217
 - septa, rupture of
 - 64:35, 274, 275, 301
 - septa, thickening of
 - 64:275
 - stability, cigarette smoke in
 - 64:35, 300
- Pulmonary clearance
 - effect of heavy smoking
 - 73:52, 53
 - effect of nitrogen dioxide, in rats
 - 74:103
 - effect of smoking
 - 72:3, 47; 73:55; 74:101, 102
 - effect of sulfur dioxide on
 - 64:295
 - mechanical vs. bactericidal clearance in guinea pigs
 - 73:53
 - mechanism, in smokers vs. nonsmokers
 - 73:52, 53
 - in monozygotic vs. dizygotic twins
 - 73:51
 - particle deposition in smokers vs. nonsmokers
 - 73:53
 - in smokers, ex-smokers, and nonsmokers with and without pulmonary disease
 - 74:100, 101
 - see also Pulmonary function
- Pulmonary diseases
 - see Lung diseases
- Pulmonary edema
 - nitrogen dioxide in
 - 64:266
- Pulmonary embolism
 - 64:103
- Pulmonary emphysema
 - see Emphysema
- Pulmonary fibrosis
 - 64:35, 301
 - in asbestos textile workers
 - 72:44
 - autopsy studies, smokers vs. nonsmokers
 - 75:74-76
 - chronic
 - 64:277-294
 - in heavy smokers
 - 64:274
 - in moderate smokers
 - 64:274
 - obliterating
 - 64:266
 - in pipe/cigar smokers vs. cigarette smokers and nonsmokers
 - 73:217
 - smokers vs. nonsmokers
 - 71:161
 - smoking and
 - 67:107; 72:44
- Pulmonary function
 - 64:35
 - abnormalities, and rheumatoid arthritis in smokers vs. nonsmokers
 - 74:92, 93
 - abnormalities, during viral illness, in smokers vs. nonsmokers
 - 75:63
 - in asymptomatic young men in Romania
 - 73:39
 - before and after smoking one non-filter cigarette
 - 74:99
 - of Boston policemen, smokers vs. nonsmokers
 - 74:82, 83
 - closing volume abnormalities as indicator of small airways disease
 - 75:71, 72
 - in coal miners, smokers vs. nonsmokers
 - 73:42, 43
 - in coal miners vs. nonminers
 - 73:42
 - decline in forced expiratory volume, in smokers by race
 - 75:72
 - diffusing capacity, smokers vs. nonsmokers in Berlin, New Hampshire
 - 73:50, 51
 - effect of asbestos exposure and smoking
 - 73:41
 - effect of cigarette smoke, in monkeys
 - 74:102
 - effect of coal dust exposure and smoking
 - 73:41-43
 - effect of dust exposure and smoking
 - 74:95
 - effect of exercise performance and smoking
 - 74:99

- effect of isoproterenol in smokers, non-smokers and bronchitics
74:99, 100
- effect of lung hyperinflation in coal miners
73:42, 43
- effect of nitrogen dioxide, in animals
74:102, 103
- effect of smoking
69:5, 42; 72:37, 38; 74:80
- effect on exercise performance in smokers vs. nonsmokers
73:246, 247
- in ex-smokers
73:39
- of insurance company employees, smokers vs. nonsmokers
74:80, 81
- in jet fighter pilots, smokers vs. nonsmokers
73:43
- of male and female smokers, in New Guinea
74:81, 82
- of male executives, smokers vs. nonsmokers
74:81
- in males from industrial town in England, smokers vs. nonsmokers
68:69
- of pipe and cigarette smokers, ex-smokers, and nonsmokers
74:99
- in pipe/cigar smokers vs. nonsmokers
73:217, 221
- prevalence of deficient heterozygote phenotypes, in smokers vs. nonsmokers
75:74
- pulmonary hypertension and
73:43
- respiratory flow resistance
64:266
- small airways disease, smoking, and
74:84-87; 75:71, 72
- in smokers vs. nonsmokers
67:99-101; 72:40; 73:55; 74:80-82
- in smokers vs. nonsmokers in Berlin, New Hampshire
73:50, 51
- in smokers vs. nonsmokers, under 30 years of age
73:50
- smoking and
73:38, 39
- summary of recent findings
75:78
- tests
64:278, 292
- volume tests
64:292
- in young smokers
67:110-111
- see also* Pulmonary clearance; Respiratory function tests
- Pulmonary heart disease
COPD and
72:24
- smoking as cause
72:24, 27
- Pulmonary surfactant
effect of smoke
67:110; 72:48
- effect of smoking
69:42; 73:55
- Pyelitis
64:224
- Pyrene
64:59, 147
- in cigar, pipe, and cigarette smoke
73:178
- Pyridine
64:54, 59
- as suspected contributor to health hazards of smoking
72:145
- 3-Pyridylacetic acid
64:72
- gamma-(3-Pyridyl)-gamma-methylbutyric acid
64:71, 72
- gamma-(3-Pyridyl)-gamma-oxobutyric acid
64:72
- Pyrolysis
64:50, 53, 59, 62
- Pyrrolidine, nitroso-suspected carcinogenic properties
rette smoke from
71:265
- Pyruvic acid
64:53
- Quassia
64:354
- Quinine
64:354
- Quinoline
64:54
- Rabbits
atherogenic effects of carbon monoxide and hypoxia
71:64
- atherogenic effects of nicotine
71:120-122
- blood lipids in, smoking and effects on
71:127
- cardiovascular function in, smoking and nicotine effects
71:108, 109
- cholesterol fed, carbon monoxide on
71:65-66
- ciliary function in, cigarette smoke effect on
71:221-222
- ciliastasis in
64:268
- coronary blood flow in
64:318

- leukoplakia in
 - 64:233
- neoplasm induction in
 - 64:143, 146, 202, 203
- offspring, nicotine and smoke effects on
 - birth weight
 - 71:407
 - offspring, smoking effects on stillbirth and mortality
 - 71:411
- pregnant, tritium-labeled nicotine effects in
 - 71:413
- pulmonary changes in cigarette smoking
 - 71:159
- pulmonary clearance in, cigarette smoke effect on
 - 71:164, 170, 171
- pulmonary damage in
 - 64:266
- skin painting, smoke condensate effects on
 - 71:267, 338
- smoke deposition in
 - 64:265
- Race
 - 64:224, 363, 364
 - as a factor in coronary heart disease
 - 73:4, 5, 23
 - as a factor in perinatal mortality in smoking vs. nonsmoking mothers
 - 73:129-132
 - as a factor in stillbirth rates
 - 73:124, 125
- Radiation exposure
 - smoking and, as cause of respiratory cancers
 - 73:72
 - smoking and, in uranium miners
 - 72:64, 65
- Radioactive carbon
 - 64:166
- Radioactive cerium
 - 64:166
- Radioactive particles
 - in tobacco leaf, tobacco smoke, and smokers' lungs
 - 73:72
- Radioactive substances
 - epidermoid neoplasms from
 - 64:166, 230
 - as tracers
 - 64:265
- Radioactivity
 - 64:145, 166, 193, 230
- Radionuclides
 - 64:193
- Radium
 - 64:145
- Radon
 - inhalation
 - 64:145
- Rats
 - alveolar lining changes in
 - 64:269, 270
 - atherosclerosis in, nicotine induced
 - 64:319; 71:120, 121
 - blood lipids in, nicotine and smoke effects
 - 71:128
 - carcinoma induction in
 - 64:165
 - ciliary function in, cigarette smoke on
 - 71:221, 222
 - clearance mechanisms in
 - 64:269
 - epidermoid lung neoplasm induction in
 - 64:66
 - hepatoma induction in
 - 64:145
 - LD₅₀ nicotine determination in female
 - 71:412
 - lung neoplasms, from intrabronchial implanting of chromium compounds
 - 71:258
 - lung neoplasms, from nickel carbonyl and dust inhalation
 - 71:256
 - lungs, cigarette smoke effects on surfactant activity
 - 71:172, 225
 - mucous cell increase in
 - 64:269
 - neoplasm induction in
 - 64:143
 - offspring, nicotine and smoke effects on birth weight
 - 71:407
 - pregnant, aromatic compound stimulation of placental BP-hydroxylase activity
 - 71:414
 - pregnant, fetal wastage and neonatal death in nicotine and smoking
 - 71:411
 - pulmonary carcinoma induction following asbestos dust inhalation
 - 71:257
 - pulmonary changes from chronic nitrogen dioxide inhalation
 - 71:161, 220
 - pulmonary damage in
 - 64:269
 - respiratory tract, cigarette smoke inhalation effects
 - 71:268, 349, 353
 - sarcoma induction in
 - 64:266
 - skin painting, smoke condensates effect
 - 71:267, 340
 - tobacco allergy in
 - 64:319
 - trachea, cigarette smoke effects on
 - 71:343
 - tracheal ligation, cigarette smoke and papain effects on
 - 71:163
 - tracheobronchial tree, cigarette smoke effects on
 - 71:268, 346-349
- Reading ability
 - in children of smoking mothers
 - 71:407
- Rectal neoplasms
 - 64:103

- Registrar General of England and Wales
 - 64:134
- Relative risk ratios
 - amount smoked in
 - 64:161
 - Cornfield method in
 - 64:160
 - measure of
 - 64:183
- Religion
 - 64:244
 - cure of tobacco habit
 - 64:354
 - in prospective studies
 - 64:99, 101
 - and smoking habit
 - 67:54, 97
 - smoking prevalence by
 - 64:364
- Reserpine
 - nicotine cardiac stimulation blockage by
 - 71:57
- Residues
 - 64:145
- Resorcinol
 - 64:54
- Respiration
 - effect of nicotine, clinical and experimental studies
 - 67:26
 - rate
 - 64:266
- Respiratory function tests
 - 64:289-293, 297
 - body height effect on
 - 64:290
 - effect of smoking
 - 72:45
 - in ex-smokers
 - 67:100
 - smokers
 - 71:146-147, 206-214
 - smokers vs. nonsmokers by sex
 - 67:99
 - smokers vs. nonsmokers, twins
 - 67:103
 - of smokers with mild bronchitis
 - 69:39
 - by smoking history
 - 67:100
 - using radioactive xenon
 - 69:39
 - and young smokers
 - 67:100-101
 - see also Pulmonary function; Respiratory system
- Respiratory symptoms
 - 68:69, 70, 71
 - effect of air pollution and smoking
 - 74:90, 91
 - effect of air pollution exposure levels in telephone workers
 - 75:67
 - effect of asbestos exposure in smokers vs. nonsmokers
 - 73:41
 - effect of cigarette smoke
 - 68:73, 74
- pipe/cigar smokers and cigarette smokers vs. nonsmokers
 - 72:3, 40
- prevalence in cement and rubber industry workers, smokers vs. nonsmokers
 - 74:95, 96
- prevalence in children of parents
 - 75:102, 103
- prevalence in Duisburg, Germany, by and cigarette consumption
 - 73:39
- prevalence in ex-smokers
 - 73:39
- prevalence in pipe and cigar smokers
 - 73:217, 220, 221
- prevalence in smokers vs. nonsmokers
 - 73:55
- prevalence in smokers vs. nonsmokers
 - Bordeaux, France
 - 73:36
 - in school children
 - 67:69, 70, 71
 - in smokers vs. nonsmokers
 - 68:66, 67, 71; 75:62, 63
 - in smokers vs. nonsmokers by amount smoked
 - 73:37
 - summary of previous findings
 - 75:5
 - summary of previous findings on relationship to passive smoking
 - 75:88
 - summary of recent findings
 - 75:78
 - in women
 - 64:286
- Respiratory system
 - acute effect of cigarette smoke on human pulmonary function
 - 71:163, 166-169
 - animal, cigarette smoke instillation implantation effects on
 - 71:268, 346-348
 - animal, effect of cigarette smoke inhalation on
 - 71:268-269, 349-353
 - defense mechanisms in
 - 64:267, 268
 - effect of cigarette and cigar smoke bronchial reactivity
 - 71:164
 - effect of cigarette smoke on human ciliary function
 - 71:165, 221-224
 - effect of cigarette smoke on human pulmonary clearance
 - 71:164, 170
 - effect of smoking on
 - 67:141
 - glossary of terms used in testing
 - 71:215
 - histological changes in smokers
 - 64:270-274; 71:154-157
 - improvements in function following smoking cessation
 - 71:148, 149

irritation, prevalence in rubber industry workers, smokers vs. nonsmokers 74:96
 pathological changes in cigarette smokers 71:175
 postoperative complication in, of smokers vs. nonsmokers 71:174-176, 230
 pulmonary alveolar phagocytosis in smokers vs. nonsmokers 71:165
 pulmonary infarction in dogs inhaling cigarette smoke 71:271
 surface tension of, effect of cigarette smoke on 71:172, 225
 surfactant activity of, in smokers vs. nonsmokers 71:172, 225
 surfactants in, definition 71:172
see also Bronchi; Lungs
Respiratory tract diseases 64:263-302
 by amount smoked 67:97
 chronic, definition 64:288
 chronic, epidemiology 64:297, 298
 cigarette smoking and 64:276
 clinical evidence of 64:294
 definition of 64:289
 epidemiology of 64:297, 298
 etiology of 64:302
 infections, in emphysema development 67:111
 infections, prevalence in smokers 71:10, 176
 infections, smoking and 67:29; 71:172, 226-229; 72:3, 38
 non-influenzal, in smokers vs. nonsmokers 72:48
 pathological and cytological changes in, of smokers vs. nonsmokers 71:258-263
 role of constitutional factors in 67:102-104
 role of heredity factors in 67:102-104
 rural vs. urban dwellers 67:97
 smokers vs. nonsmokers, by age 67:100
 smokers vs. nonsmokers, by occupation 67:97
 by smoking characteristics 67:97-98
 by smoking classification 67:97-98
 in smoking-discordant twin pairs 67:102-104
 twin studies 67:102-104
 ventilatory function in, smokers vs. nonsmokers 71:175
 see also Lung diseases
Respiratory tract neoplasms
 carcinogenesis induction in animals 74:46, 47
 by country, in females 64:131
 experimental induction of 69:63-64
 mortality rates 67:147
 mortality trends in 64:136
 and smoking 67:10
 and smoking classification 67:147
 see also Lung neoplasms
Respondents
 age-adjusted death rates in 64:114
 mortality ratios in 64:116
Restricted activity days
 by age, sex, and smoking history 67:19-21
 definition of 67:19
Reticulosarcoma
 and cigarette smoke 67:148
 and tobacco tars 67:148
Retinal sensitivity
 to tobacco 64:341
Retinoblastoma 64:191
Retrospective studies 64:27, 28-31, 150-157, 160, 161, 198, 199
 association of diseases in 64:160, 161
 control groups in 64:181
 definition of 64:27
 inhalation patterns in 64:159
 laryngeal neoplasms 64:233, 234
 lung neoplasms, and smoking, methods 71:323-328
 lung neoplasms, duration of smoking in 64:158
 maternal smoking 64:343
 methods 64:152, 153, 154, 198, 199, 200
 mortality studies 64:150

- peptic ulcer
 - 64:337
 - reliability of
 - 64:180
 - risk ratios in
 - 64:160, 161
 - smoking characteristics in
 - 64:156
- Reverse smoking
 - 64:203, 204
 - effect on oral mucosa
 - 72:6, 69, 70
 - heat effects in
 - 64:204
 - leukoplakia and
 - 73:76
 - nicotine stomatitis and
 - 72:6, 69, 70
 - oral neoplasms and
 - 73:76
- Rhesus monkeys
 - 64:166
- Rheumatic heart disease
 - mortality from
 - 64:103, 325
- Rhinitis
 - 64:275
- Rhodesia
 - methods used in retrospective studies of
 - smoking in relation to lung neoplasms
 - 71:328
- Risk factors
 - in coronary heart disease
 - 72:16-18
- Risk ratios
 - calculation of
 - 64:183, 230
 - on cessation of smoking, in lung neoplasms
 - 64:187, 188
 - consistency of
 - 64:182, 183
 - by lifetime cigarette consumption
 - 64:161
 - in lung neoplasms
 - 64:187, 188
- RNA
 - binding of polycyclic hydrocarbons to
 - 73:86, 87
 - synthesis, effect of cigarette smoke on
 - 69:62, 63
- Rodents
 - carcinogenesis tests in
 - 64:142
 - ozone effect on
 - 64:142
- Roswell Park Memorial Institute
 - 64:174, 219
- Rubber
 - carcinogenic activity of
 - 64:147
- Rubidium-84
 - tracing capillary flow in coronary blood
 - flow
 - 71:59
- Rum
 - 64:62
- Running
 - effect of smoking
 - 73:243, 244
- Rural areas
 - 64:99
 - lung neoplasm incidence in, in Switzerland
 - 71:244
 - relationships of lung neoplasm to smoking, air pollution, and
 - 71:252-255
 - smokers in
 - 64:99, 364
- Rural populations
 - lung neoplasms in, suspected etiology of
 - increased
 - 71:276
- Rural vs. urban populations
 - bladder neoplasm prevalence
 - 64:225
 - mortality rates
 - 67:11
 - smoking and
 - 67:97
- Russia
 - atherogenic effects of nicotine on rabbits
 - in
 - 71:120
 - atherosclerosis autopsy studies in
 - 71:54
 - cigarette tar effects on rat tracheo-bronchial tree in
 - 71:348
 - gastric neoplasms, in Russian-born
 - 64:135
 - gastric neoplasms in Russian Jews
 - 64:135
- Rutin
 - structural formula of
 - 64:54
- Saliva
 - 64:203
 - interference in action of carcinogens on
 - oral cavity
 - 71:288
- Salivary gland neoplasms
 - 64:134
 - see also* Mouth neoplasms; Oral neoplasms
- Salivary glands
 - 64:271
- Sample selection
 - bias resulting from
 - 64:180, 181
- Sarcomas
 - anaplastic, tar induction of
 - 64:223
 - classification of
 - 64:174
 - formation following animal skin painting
 - with smoke condensates
 - 71:338, 340
 - induction in rats by cigarette smoke
 - injection
 - 71:346-347

induction of
 64:144, 176
 subcutaneous
 64:143
 Saslow Psychosomatic Screening Inventory
 64:367
 Saturated fats
 64:322
 Scholastic achievement
 64:370, 372
 School children
 smoking and respiratory systems in
 68:69, 70, 71
 School grade level
 smoking prevalence by
 64:361, 362
 Scotland
 respiratory symptoms in miners of
 64:288, 298
 Scotoma
 64:341
 Scottish Home and Health Department
 Standing Medical Advisory Committee
 64:304
 Scrotal neoplasms
 64:147
 Secondary infections
 64:272
 Sedation
 smoking effect as
 64:350
 Sedatives
 withdrawal treatment with
 64:352
 Selection bias
 in health studies
 64:180, 181
 Selenium
 carcinogenicity
 67:128
 in cigarette smoke
 67:128
 potential respiratory carcinogenesis
 68:92
 Senile keratosis
 64:203
 Sensory drives
 64:354
 Seven Countries Study
 epidemiologic study of smoking and
 CHD
 74:6
 Seventh Day Adventists
 coronary disease incidence in
 64:322
 laryngeal neoplasm prevalence in
 64:209
 lung neoplasm prevalence in
 64:155
 Sex
 acute diseases in smokers and non-
 smokers by
 67:22
 ages of cigarette smokers by
 71:6
 bed days by, and smoking history
 67:20-21
 bladder neoplasm mortality rates in
 United States by
 67:154
 bronchitis, prevalence rates by
 67:96
 cerebrovascular disease mortality rates,
 by age and
 67:66
 cerebrovascular disease mortality rates,
 by smoking classification and
 67:66
 cerebrovascular disease mortality ratios,
 by age and
 67:66
 cerebrovascular disease mortality ratios,
 by smoking classification and
 67:66
 chronic diseases in smokers and non-
 smokers by
 67:22
 coronary disease incidence rates and
 smoking history by
 69:21-22, 24
 coronary disease mortality rates, by
 67:25, 47, 50, 56; 69:13, 17
 coronary disease mortality ratios, by
 67:49; 69:13
 cough and smoking habit by
 67:98
 effect of, in alpha-1-antitrypsin defi-
 ciency emphysema
 71:151
 effect of, in lung neoplasms and tobacco
 use
 71:244, 329-333
 effect of, in mortality in cigarette smok-
 ers
 71:276
 effect of, on laryngeal neoplasm inci-
 dence development
 71:277
 emphysema mortality rates
 67:91
 esophageal neoplasm mortality rates
 67:150
 laryngeal neoplasm mortality rates
 67:148
 liver cirrhosis mortality rates, by
 67:184
 liver cirrhosis mortality ratios, by
 67:184
 lung neoplasm development by
 71:11
 lung neoplasm mortality rates by
 67:34, 134, 140; 71:252
 lung neoplasm mortality ratios by
 67:33, 134, 140
 mortality by, and smoking history
 67:23
 mortality rates of cigarette smokers by
 71:3
 pancreatic neoplasm mortality rates, by
 67:158
 pancreatic neoplasm mortality ratios, by
 67:158
 peptic ulcer morbidity rates, by
 67:182

- ratio, effect of maternal smoking on
73:135, 136
- ratio, in lung neoplasm mortality
74:40, 46
- ratio, in lung neoplasm mortality in
Norway and Finland
71:245-246
- restricted activity days by, and smoking
history
67:20-21
- and smoking habit
67:4
- stroke mortality rates by
69:13, 17
- stroke mortality ratios by
69:13
- tumor prevalence among smokers by
69:56
- Sex differentials
64:133
- in lung cancer
64:185, 186
- in smoking prevalence
64:363
- Sheep
 - pregnant, nicotine injection and smoke
inhalation effects on
71:414
- Sheet metal workers
neoplasm risks in
64:134
- Sheldon somatotyping method
64:383
- Shoe repairers
bladder neoplasms in
64:222, 224
- Side stream smoke
see Smoke streams
- Silica
64:271
- Silver nitrate
64:354
- Single-breath tests
smokers vs. nonsmokers
73:51
- Sinusitis
64:275
- in smokers and nonsmokers
67:22
- Sitosterols
64:52
- Skin
 - benzo(a)pyrene effect on
64:146
 - effect of tobacco extracts
72:105-107
 - reactions of, tobacco induced
64:319
 - tests of
64:143
 - tobacco antigens and
72:7, 104, 105
- Skin neoplasms
64:143, 144
- carcinogenic induction of
64:229
- carcinoma in situ
64:172
- experimentally induced by ci
smoke
67:144
- mineral oil induction of
64:229
- ultraviolet radiation induction of
64:144
- Skin testing
for reactions to tobacco
72:105-107
- Smog
64:295
- Smoke, cigar
 - benzo(a)pyrene content of
64:58
 - chemical constituents in
73:177-179
 - ciliotoxicity
73:218
 - effect of curing methods
73:218, 219
 - effect of pH on inhalation of
73:183
 - little, pH, compared to cigaret
cigar smoke
73:224, 228
 - tumorigenic activity in laborato
mals
73:210-214
 - see also* Smoke, tobacco
- Smoke, cigarette
 - 64:50-62
 - alteration of coronary blood flow
71:58
 - aromatic hydrocarbons in
67:127-128
 - benzo(a)pyrene content of
64:58
 - and bronchoconstriction in anima
68:72
 - bronchogenic carcinoma induc
dogs inhaling
71:269, 270
 - butylmethylnitrosamine in
67:128
 - cadmium levels in
71:154
 - carbon monoxide levels in
71:59
 - carcinogenic content of
75:48
 - carcinogenicity
67:15, 34, 144; 72:65, 66
 - carcinogenicity of components
mals
71:12, 277
 - cause of death in dogs from inhal
71:271
 - chemical constituents in, comp
pipe/cigar smoke
73:177, 178
 - ciliary activity
67:107-108, 140; 68:71, 72
 - ciliary depression by
64:61, 265, 267, 268, 270
 - ciliary inhibition
71:267

ciliotoxic effect, mechanism of action
 67:107
 cocarcinogenic effect on respiratory tract in rabbits
 72:67
 cocarcinogens in
 64:144
 composition of
 64:50-60
 and decrease in pulmonary macrophages, in guinea pigs
 75:77, 78
 deposition patterns of
 64:265
 effect of curing methods
 73:218, 219
 effect of nickel on induction of lung aryl hydroxylase
 71:256-257
 effect on adenosine triphosphatase
 67:108
 effect on alveolar macrophages
 69:42
 effect on apexcardiogram
 72:21
 effect on bacterial retention in hamsters
 73:54
 effect on breathing in guinea pigs
 72:46
 effect on bronchial epithelium
 67:107, 144-145
 effect on bronchial epithelium in dogs
 69:40; 73:49
 effect on bronchial mucosa
 67:30, 104-107, 144-145
 effect on DNA and RNA synthesis
 69:62-63
 effect on *Dunaliella bioculata*
 69:42
 effect on influenza virus in mice
 68:70, 71
 effect on lung AHH-activity
 74:50, 51
 effect on lungs
 67:106
 effect on lung surface tension in dogs
 72:48
 effect on nasociliary mucosa in donkeys
 72:47
 effect on oxidative enzymes
 67:108
 effect on phagocytosis in laboratory animals
 73:53, 54
 effect on phagocytosis in rabbits
 72:109
 effect on pulmonary clearance
 73:51-53
 effect on pulmonary macrophage function, in rabbits
 74:104
 effect on pulmonary physiology, in animals
 74:102
 effect on pulmonary surfactant
 67:110; 69:42
 effect on rat and mouse fetus, site of action
 73:121
 effect on respiratory tract, in rats
 74:104
 effect on tissue cultures
 69:42; 71:267, 343-345
 effect on tracheobronchial clearance, in donkeys
 75:78
 effect on vascular resistance
 67:61
 effect on ventricular fibrillation threshold in dogs
 73:13, 14
 endrin in
 64:62
 epidermoid neoplasms from
 64:144
 experimental induction of bronchial neoplasms
 67:144-145
 experimental induction of lung neoplasms by
 67:144-145
 experimental induction of tracheal neoplasms by
 67:144-145
 experimental studies in dogs
 73:13, 14
 experimental studies in laboratory animals
 72:21
 exposure magnitude to
 64:296, 297, 298
 extract, effect on pulmonary macrophages, in sheep lungs
 74:105
 formaldehyde gas in
 64:266
 gaseous deposition of
 64:265
 harmful constituents of
 72:8, 141-146
 heterocyclic nitrogen compounds in
 67:127
 high tar, risks in
 71:11
 inhalation by dogs, lung neoplasm development
 71:268-269, 272-274
 inhalation effects on animal respiratory tract
 71:268-269, 349, 353
 inhalation effects on hamster larynx
 71:281, 284
 inhalation methods
 69:62
 inhalation of, and coronary disease
 67:54
 inhalation of, effect on blood pressure
 67:54
 and leukemia
 67:148
 listing of identified or suspected tumorigenic agents
 71:264-267
 and lymphosarcoma
 67:148
 metallic constituents of
 64:55

- naphthylamine content, and bladder carcinogenesis
 - 68:105
- 2-naphthylamine identified in
 - 71:265
- negative ions in
 - 64:268
- neoplastic changes in animals inhaling
 - 71:238-239
- nickel carbonyl in
 - 69:62
- nickel in
 - 64:167
- nicotine content in
 - 67:34
- nitrosamines in
 - 67:127-128
- nonvolatile condensates of
 - 64:50
- phenols in
 - 64:54, 267; 67:127-128
- polonium-210 in
 - 67:128
- positive ions in
 - 64:268
- pyrolysis reactions in
 - 64:50
- radioactivity of
 - 64:145
- reduction of adverse effects in animals by phenylmethyloxadiazole (PMO)
 - 73:49, 53
- and reticulosarcoma
 - 67:148
- selenium in
 - 67:128
- skin neoplasm induction by
 - 67:144
- and sulphur dioxide, effect on glands in laboratory animals
 - 73:49
- suppression of immunoglobulin response, in cell cultures
 - 75:77
- TDE content of
 - 64:62
- tobacco amblyopia relationship to cyanide metabolism in
 - 71:435-436
- see also* Smoke, tobacco
- Smoke condensates
 - see* Tars, cigarettes; Tars, tobacco
- Smoke, pipe
 - benzo(a)pyrene in
 - 64:58
 - carcinogenicity
 - 67:147-148
 - chemical constituents in
 - 73:177, 178
 - ciliotoxicity of
 - 73:218
 - effect of pH on inhalation of
 - 73:183
 - mouth neoplasms experimentally induced by
 - 67:147-148
 - tumorigenic activity in laboratory animals
 - 73:210-214
 - see also* Smoke, tobacco
- Smokers
 - airway resistance in
 - 64:292, 293
 - alcohol consumption by
 - 64:385
 - allergic reactions in
 - 64:319
 - angina pectoris in
 - 64:325
 - arteriosclerosis in
 - 69:26
 - behavioral variables in
 - 64:112
 - bladder neoplasms in
 - 64:131, 132, 219, 222, 223, 224, 225
 - body weight of
 - 64:326, 384, 385
 - breathlessness in
 - 64:27, 286, 287
 - bronchitis prevalence in
 - 64:289
 - cholesterol levels in
 - 64:326, 385
 - chronic cough in
 - 64:27, 280, 281, 282, 283, 299, 302
 - ciliary effects in
 - 64:27, 34, 35, 61, 168, 169, 170, 172, 173, 267
 - constitutional differences in
 - 64:112, 326
 - coronary disease in
 - 64:322-325
 - current, mortality rates in
 - 64:95
 - current, mortality ratios in
 - 64:93
 - current, neoplasm risk in
 - 64:158
 - current, pulmonary fibrosis in
 - 64:274
 - epithelial changes in
 - 64:165, 167-173, 189, 263-275
 - forced expiratory flow rate in
 - 64:290, 291
 - heavy, risk ratios in
 - 64:161, 213, 232
 - heavy, urban-rural mortality in
 - 64:186, 194
 - hemoglobin levels in
 - 64:319
 - hereditary factors in
 - 64:385
 - I.Q. measurements in
 - 64:370
 - laryngeal neoplasms in
 - 64:131, 132, 133, 209, 211
 - lung function in
 - 64:27
 - lung neoplasms in
 - 64:118, 131, 132, 133, 149-196, 232
 - morphologic constitution of
 - 64:383-387

mortality rates in, from gastric neoplasms
 64:132
 mortality rates in
 64:99, 117, 118, 162, 209, 322, 323
 mortality rates in, from laryngeal neoplasms
 64:211
 nonrespondents among
 64:114
 occupational asbestos exposure and carcinogenesis
 67:35
 occupational uranium exposure and carcinogenesis
 67:35
 oral neoplasms in
 64:131, 132, 133, 202, 204
 as percentage of population
 64:114
 personality
 64:39, 326, 365, 368
 physical characteristics of
 64:326
 population of
 64:45
 psychological factors in
 64:112
 reduction of life expectancy
 69:3
 respiratory conditions in
 64:289
 risk ratios in
 64:160, 161, 222, 223, 232
 risk ratios in, in bladder neoplasms
 64:222
 risk ratios in, in lung neoplasms
 64:161
 serum cholesterol in
 64:326
 smoking patterns in
 64:177, 178, 179
 somatotype classification of
 64:383, 385
 sputum analysis of
 69:39-40, 57-58
 sputum production in
 64:27, 283-286
 urban-rural differences in
 64:99, 101
 U.S. incidence of
 64:178, 179
see also Passive smokers; Smokers, cigar; Smokers, cigar and pipe; Smokers, cigarette; Smokers, pipe
 Smokers, cigar
 amblyopia in
 64:341, 342
 atypical nuclei in male esophageal epithelium
 71:379
 bladder neoplasm mortality in
 64:219, 222, 223, 224, 235
 bladder neoplasms in
 71:293-294
 body weight of
 64:384
 carboxyhemoglobin levels in
 72:21-23
 cell rows and atypical cells in vocal cords of
 71:280, 359-360
 coal miners as
 64:299
 COPD morbidity in
 71:146, 197-198, 201-202, 204-205
 coronary deaths in
 64:323
 decreased neoplasm risk in
 64:37
 duodenal ulcers in
 64:37
 duration of smoking in
 64:36
 effects of smoke on bronchial reactivity
 71:164
 epithelial lesions in
 64:170, 173, 189
 esophageal neoplasm mortality ratios in
 71:290
 esophageal neoplasms in
 64:213, 217, 218, 234
 fibrosis in
 64:291
 forced expiratory volume in
 64:291
 gastric ulcers in
 64:37
 gingival neoplasms in
 64:202
 inhalation practices in
 64:36, 92, 188
 kidney neoplasms in
 71:294-295
 lack of risk in CVD
 71:67
 laryngeal neoplasm induction in
 71:12, 354-357
 laryngeal neoplasms in
 64:37, 192, 205, 209, 211, 212;
 71:281
 lip neoplasms in
 64:197, 202, 230, 240
 lung neoplasms in
 64:37, 150, 155, 159, 163, 170, 173,
 175, 188, 1
 lung neoplasms, incidence in rural Switzerland
 71:244
 lung neoplasms, mortality in
 71:11, 240-243
 morphological constitution of
 64:385, 386
 mortality rates in
 64:30, 36
 mortality ratios from COPD in
 71:142-143, 145
 mortality ratios from pancreatic neoplasms in
 71:298
 mortality ratios from peptic ulcer in
 71:424
 mortality ratios in
 64:86, 87, 107, 112, 163
 myocardial arteriole wall thickness in
 72:19
 myocardial infarction in
 71:32, 38-39

- oral neoplasms in
 - 64:37, 189, 192, 202
- pharyngeal neoplasms in
 - 64:202
- relationship of neoplasms of oral cavity with
 - 71:12, 361-365, 367-371
- relationship to infectious respiratory diseases
 - 71:227
- relative risk in esophageal neoplasm development
 - 72:68
- relative risk in laryngeal neoplasm development
 - 72:67
- relative risk in lung neoplasms development
 - 71:276; 73:67, 68
- respiratory diseases in
 - 64:274, 289
- risk of CHD
 - 71:8
- risk of COPD
 - 71:10
- risk ratios in
 - 64:31, 37, 231, 233
- tongue neoplasms in
 - 64:189, 202
- U.S. trends in number of
 - 64:26, 45
- see also* Smokers, cigar and pipe
- Smokers, cigar and pipe
 - causes of death in
 - 64:107
 - expected death rate in
 - 64:107
 - gastric neoplasm mortality in
 - 64:288
 - gastric ulcer in
 - 64:113
 - incidence of atypical nuclei in larynx
 - 69:59
 - incidence of coronary heart disease
 - 69:21, 24
 - incidence of gingivitis
 - 69:86
 - incidence of stomatitis nicotina
 - 69:87
 - liver cirrhosis in
 - 64:113
 - lung neoplasms in
 - 64:113
 - mortality ratios in
 - 64:107
 - observed deaths in
 - 64:107
 - oral neoplasms in
 - 64:113
 - thickness of vocal cords
 - 69:60
 - see also* Smokers, cigar; Smokers, pipe
- Smokers, cigarette
 - air pollution effects on
 - 64:194, 195, 276, 295-298, 301, 302
 - arterial occlusions in
 - 71:73
 - atherosclerosis in aortic and coronary arteries
 - 71:52-56
 - atypical nuclei in male esophageal epithelium
 - 71:379-380
 - bladder neoplasms in
 - 71:293-295
 - bladder neoplasms mortality in
 - 64:32, 37, 219, 234
 - bronchitis in
 - 64:102, 103, 301
 - cell rows and atypical cells in vocal cords of
 - 71:280, 359-360
 - cessation of smoking, effects on COPD morbidity
 - 71:146, 197, 199, 203-204
 - cessation of smoking, lowers lung neoplasm rate in
 - 71:11
 - changes in ventilatory function and pulmonary histology
 - 71:175
 - comparative risk for lung neoplasms
 - 71:237
 - coronary diseases in
 - 64:322
 - coronary diseases in, AHA pooling project
 - 71:28, 30, 39
 - coronary diseases risk by
 - 71:8, 23-25
 - coronary mortality in
 - 64:324
 - decline in, British physicians
 - 71:48
 - development of altered ventilatory function in young
 - 71:10
 - development of esophageal neoplasms
 - 71:12, 293
 - development of laryngeal neoplasms
 - 71:12
 - development of oral neoplasms
 - 71:12
 - development of second primary oral neoplasms in continuing
 - 71:287
 - effect of filters on emphysema development
 - 71:162
 - effect on cardiovascular system
 - 71:56-58, 107-118
 - effects of inhalation on bronchial reactivity
 - 71:164
 - effects on uterine activity in gravidic women
 - 71:408
 - emphysema in
 - 64:277-294
 - emphysema mortality in
 - 64:102, 103
 - epithelial changes in
 - 64:170, 173, 189
 - esophageal neoplasms in
 - 64:102, 103, 188, 212, 213
 - esophageal neoplasms, mortality ratios in
 - 71:290-291

excess mortality in
 64:108
 expected mortality in
 64:108
 forced expiratory volume in
 64:291
 histology and smoking relationship of
 lung neoplasms in
 71:246-249
 hypertension in
 64:325
 infant birth weight
 71:397-399
 inhalation effects on human pulmonary
 function
 71:163, 166-169
 inhalation patterns in
 64:159
 kidney neoplasms in
 64:102; 71:294-196
 laryngeal neoplasm induction in
 71:354-357
 laryngeal neoplasm mortality in
 64:32, 188, 205, 212, 234
 lung neoplasms, etiology
 71:239
 lung neoplasms in
 64:31, 37, 149-196, 229-233
 lung neoplasms, mortality in
 71:240-243-244
 mortality from cerebrovascular disease
 71:67-70
 mortality from neoplasms, by site
 64:149
 mortality rates affected by sex
 71:3
 mortality rates in
 64:35, 102, 106, 108, 109, 110, 115,
 162, 194, 3
 mortality ratios
 64:90, 93, 102, 103
 mortality ratios from COPD
 71:142-144
 mortality ratios from pancreatic neo-
 plasms in
 71:298
 mortality ratios from peptic ulcers in
 71:424
 nonrespondents, mortality in
 64:115
 oral neoplasms, mortality in
 64:102, 103, 131, 132, 196-205, 233
 otolaryngological symptoms in
 64:275
 peptic ulcer
 71:427
 peptic ulcer in, smoke effects on antacid
 therapy
 71:423
 percent of population as
 64:26
 percent of women of childbearing age
 71:389
 pharyngeal neoplasms in
 64:103, 202
 possible processes for increased mor-
 tality in
 71:4-5
 postoperative pulmonary complications
 in
 71:174, 230
 pulmonary surfactant activity in
 71:172, 225
 relationship in coronary and lower limb
 arteriosclerosis
 71:72
 relationship of asbestos in lung neoplasm
 mortality
 71:257
 relationship to infectious respiratory dis-
 eases
 71:172, 226-229
 relationship to laryngeal neoplasm devel-
 opment in
 71:281
 relationship to lip or oral cavity neo-
 plasms
 71:361-370
 relationship to lung neoplasms
 71:275, 276
 relationship with bladder neoplasms in
 men
 71:299
 relationship with dust on COPD develop-
 ment
 71:153
 risk gradients in, from bladder neoplasms
 64:223
 risk gradients in, from esophageal neo-
 plasms
 64:234
 risk gradients in, from laryngeal neo-
 plasms
 64:37, 211, 234
 risk gradients in, from lung neoplasms
 64:31, 37, 184, 185, 230
 risk of COPD in
 71:140
 stomach ulcers in
 64:103
 survey by age and sex
 71:6
 survey of U.S.
 71:6
see also Smokers
 Smokers, pipe
 amblyopia in
 64:39, 341, 342
 amount smoked, in mortality ratios
 64:86, 87
 atypical nuclei in male esophageal epi-
 thelium
 71:379
 bladder neoplasms in
 64:219, 222, 223, 235; 71:293-294
 body weight in
 64:384
 carboxyhemoglobin levels in
 72:21
 cell rows and atypical cells in vocal cords
 of
 71:280, 359-360
 COPD morbidity in
 71:146, 197-198, 201-205
 coronary mortality in
 64:323

development of chronic bronchopulmonary disease
 71:10
 development of esophageal neoplasms
 71:13, 293
 development of lung neoplasms
 71:11
 development of oral neoplasms
 71:12
 duodenal ulcers in
 64:37
 epithelial changes in
 64:170, 173, 189
 esophageal neoplasms in
 64:37, 212, 217, 218, 234
 esophageal neoplasms, mortality ratios
 71:290
 extroversion in
 64:366
 fibrosis in
 64:274
 forced expiratory volume in
 64:291
 gastric ulcers in
 64:37, 337
 gingival neoplasms in
 64:202
 inhalation by
 64:92, 188
 kidney neoplasms in
 71:294-295
 lack of risk in CVD
 71:67
 laryngeal neoplasms in
 64:37, 192, 209, 211, 212
 laryngeal neoplasms, induction
 71:12, 354-357
 lip neoplasms in
 64:32, 37, 188, 197, 204
 lung neoplasms in
 64:31, 37, 196, 233
 lung neoplasms, incidence in Norway
 71:244
 lung neoplasms, incidence in rural Switzerland
 71:244
 lung neoplasms, mortality in
 71:324-327
 morphology of
 64:385, 386
 mortality rates
 64:30, 36, 74, 194, 202, 222, 223
 mortality rates from COPD
 71:142-143, 145
 mortality ratios
 64:90, 91, 162
 mortality ratios from pancreatic neoplasms
 71:298
 mortality ratios from peptic ulcer
 71:424
 myocardial arteriole wall thickness in
 72:19
 myocardial infarction in
 71:32, 38-39
 neoplasm location in
 64:197
 oral changes in
 64:302
 oral neoplasms and
 64:37, 150, 189, 192, 202; 72:67
 peptic ulcer in
 71:427
 pharyngeal neoplasms in
 64:202
 psychosomatic disorders in
 64:367
 relationship to infectious respiratory diseases
 71:227
 relationship to laryngeal neoplasm development
 71:281
 relationship to lip neoplasms
 71:289
 relationship to oral cavity neoplasms
 71:361-364, 367
 relative risk in esophageal neoplasm development
 72:68
 relative risk in laryngeal neoplasm development
 71:67
 relative risk in lung neoplasm development
 71:276; 73:67, 68
 respiratory diseases in
 64:289, 299
 risk of CHD
 71:8
 risk ratios in, from neoplasms
 64:31, 37, 196, 209, 211, 231, 233, 235
 tongue neoplasms
 64:188, 189, 202
see also Smokers, cigar and pipe
 Smokers vs. ex-smokers
 atypical nuclei in larynx
 69:59
 coronary disease mortality rates, for men by age
 67:49
 coronary disease mortality rates, for men, by years stopped smoking
 67:49; 69:15
 coronary disease mortality rates, for men, compared to nonsmokers
 69:15
 coronary disease mortality rates for men, compared to nonsmokers
 69:15
 lung neoplasm mortality rates
 67:34, 137, 139
 morbidity rates
 67:15
 mortality rates
 67:9, 15
 peptic ulcer mortality rates by age
 67:181
 peptic ulcer mortality ratios by age
 67:181
 stroke mortality for men, compared to nonsmokers
 69:15

thickness of vocal cords
 69:60

Smokers vs. nonsmokers
 abortions, still births, and neonatal death
 71:390, 405-406
 acute diseases in
 67:22
 o-aminophenols in urine of
 69:64
 angina pectoris morbidity ratios
 67:59
 aortic aneurysm mortality
 69:16
 arteriosclerosis
 67:22; 72:19
 arteriosclerosis, mortality rates
 67:26
 attitudes
 67:190-191
 atypical nuclei in larynx
 69:59
 bladder neoplasms in
 71:293-295, 381-384
 bladder neoplasms, mortality rates, by
 age
 67:154, 155
 blood cholesterol levels, twin studies
 67:55
 blood factors of mothers and infants
 69:80
 body constitution
 67:99
 breathlessness in
 67:29, 286
 bronchitis mortality rates
 67:8, 29, 90-92
 carboxyhemoglobin levels
 67:100; 72:21-23
 cardiopulmonary function, in young
 male
 67:100
 cell rows and atypical cells in vocal cords
 of
 71:280, 359-360
 cerebrovascular diseases
 72:25
 cerebrovascular diseases mortality rates
 67:66; 71:67-70
 cerebrovascular diseases mortality ratios
 67:66
 chronic diseases in
 67:22
 coronary disease incidence
 69:18, 20-22
 coronary disease incidence and behavior
 type
 69:24
 coronary disease incidence rates, by age
 67:54, 65
 coronary disease morbidity ratios
 67:59; 71:24
 coronary disease morbidity ratios, and
 blood pressure status
 67:55
 coronary disease morbidity ratios, and
 lung function
 67:56
 coronary disease morbidity ratios, by age
 67:54
 coronary disease morbidity ratios, by
 blood cholesterol levels
 67:55
 coronary disease morbidity ratios, by
 personality characteristics
 67:57
 coronary disease morbidity ratios, by
 sociocultural mobility status
 67:57
 coronary disease mortality
 67:47; 71:21-22, 24, 26-29
 coronary disease mortality, by age
 67:50; 69:13
 coronary disease mortality, by amount
 smoked
 67:51; 69:13
 coronary disease mortality, by sex
 67:50; 69:13; 71:28-31
 coronary disease mortality, by smoking
 history
 67:51
 coronary disease mortality, for men
 67:27
 coronary disease mortality, for women
 67:28
 coronary disease mortality, in Swedish
 twins
 71:51
 coronary disease mortality ratios
 67:8
 coronary disease mortality ratios, by age
 67:49, 52; 69:13
 coronary disease mortality ratios, by
 amount smoked
 67:47-49; 69:13
 coronary disease mortality ratios, by
 blood pressure status
 67:52
 coronary disease mortality ratios, by sex
 67:49; 69:13
 cough in
 67:29
 Curschmann's spirals in sputum of
 69:39-40
 development of COPD in
 71:141, 145, 195-205
 differences in emphysema types in
 71:154, 156
 digestive tract neoplasm mortality rates
 67:147
 emphysema mortality rates
 67:8
 emphysema mortality ratios
 67:90-92
 esophageal epithelial cells with atypical
 nuclei in
 71:292
 esophageal neoplasm mortality rates, for
 men by age
 67:150
 esophageal neoplasm mortality ratios
 67:35, 150-151; 71:290-291
 excretion of tryptophan metabolites in
 71:297
 frequency of esophageal neoplasms in
 71:298

frequency of kidney neoplasms in
 71:238
 frequency of mouth and pharyngeal neoplasms in
 71:238
 frequency of urinary bladder neoplasms in
 71:238
 group characteristics in lung neoplasms and smoking in
 71:240, 244, 329-333
 3-hydroxyanthranilic acid urinary excretion in
 67:156
 3-hydroxykynurenine urinary excretion in
 67:156
 incidence of edentulism
 69:87
 incidence of gingivitis
 69:86
 incidence of periodontal disease
 69:85-86
 incidence of preeclampsia among pregnant women
 69:79
 laryngeal neoplasm mortality rates
 67:148; 71:237-238
 laryngeal neoplasm mortality ratios
 67:35; 71:278-279
 laryngeal neoplasms in, relationship to tobacco use
 71:354-357
 lung fibrosis development in
 71:161
 lung neoplasm mortality in uranium miners
 71:256
 lung neoplasm mortality rates
 67:8, 34, 47
 lung neoplasm mortality rates, by age
 67:132-138, 140
 lung neoplasm mortality rates, by sex
 67:136, 140
 lung neoplasm mortality rates, for men by age
 67:131-132, 134-135, 137-140
 lung neoplasm mortality rates, for men by amount smoked
 67:134-135, 137-140
 lung neoplasm mortality rates, for men by smoking characteristics
 67:134-135, 139
 lung neoplasm mortality rates, for men by smoking history
 67:134-135, 137-140
 lung neoplasm mortality rates, for women
 71:240-243
 lung neoplasm mortality ratios, by age
 67:134-140
 lung neoplasm mortality ratios, by sex
 67:136, 140
 lung neoplasm mortality ratios, by smoking classification
 67:139
 lung neoplasm mortality ratios, for men by age
 67:134-135, 137-140
 lung neoplasm mortality ratios, for men by amount smoked
 67:134-135, 137-140
 lung neoplasm mortality ratios, for men by smoking characteristics
 67:134-135
 lung neoplasm mortality ratios, for men by smoking history
 67:134-135, 137, 139
 lung neoplasm mortality ratios, for women
 67:34, 136
 lung neoplasm occurrence in asbestos workers
 67:143
 lung neoplasm occurrence in uranium workers
 67:143
 N-methylnicotinamide urinary excretion
 67:156
 morbidity rates, in United States
 67:3, 5
 mortality rates
 71:3
 mortality rates, by age
 67:79-10
 mortality rates, by occupation
 67:11
 mortality rates, for Canadian pensioners
 67:10
 mortality rates, for men by age
 67:12-13
 mortality rates, for U.S. veterans by age
 67:12-13
 mortality rates, for women by age
 67:12-13, 21
 mortality ratios, by age and sex
 67:12-13
 mortality ratios, for U.S. veterans by age
 67:12-13
 mortality ratios from pancreatic neoplasms in
 71:298
 mortality ratios, in United States
 67:8
 mortality ratios of COPD in
 71:142-144
 mouth neoplasm mortality rates
 67:146
 mouth neoplasm mortality ratios
 67:35, 146
 mucous gland abnormalities in
 74:97
 myocardial infarction morbidity ratios
 67:59
 myocardial infarction morbidity ratios, by physical activity levels
 67:56
 myocardial infarction relationships to physical activity
 71:44
 oral diseases and
 72:6

pancreatic neoplasm mortality rates, by age
 67:158-159
 pancreatic neoplasm mortality rates, by amount smoked
 67:159
 pancreatic neoplasm mortality rates, by sex
 67:158-159
 pancreatic neoplasm mortality rates, by smoking classification
 67:159
 paralysis agitans mortality rates
 67:8
 pathological and cytological changes in respiratory tract of
 71:258-263
 peptic ulcer in, correlated amounts of tobacco use
 71:427-428
 peptic ulcer morbidity rates, by sex
 67:182
 peptic ulcer mortality rates, for men, by age
 67:181
 peptic ulcer mortality ratios, for men, by age
 67:181
 pharyngeal neoplasm mortality rates
 67:146
 pharyngeal neoplasm mortality ratios
 67:35, 146
 postoperative hypoxemia in
 71:174-230
 postoperative pulmonary complications in
 71:174-175, 230
 postural hypoxemia mechanism in symptomatic
 71:147
 prevalence of neoplasms, by type of tumor, sex and
 69:56
 pulmonary alveolar phagocytosis in
 71:165
 relation between CHD and serum cholesterol level
 71:43
 relationship to infectious respiratory disease
 71:172, 226-229
 respiratory symptoms
 72:40
 respiratory symptoms by age
 67:29, 100
 respiratory symptoms by occupation
 67:97
 respiratory tract neoplasm mortality rates
 67:147
 serum lipids in
 71:41, 98-102
 small airways abnormalities in
 74:97, 98
 stomach neoplasm mortality rates
 67:157-158
 stroke mortality, by age
 69:13
 stroke mortality, by amount smoked
 69:13
 stroke mortality, by sex
 69:13
 stroke mortality, compared to ex-smokers
 69:15
 stroke mortality ratios, by age
 69:13
 stroke mortality ratios, by amount smoked
 69:13
 stroke mortality ratios, by sex
 69:13
 surfactant activity in lungs of
 71:172, 225
 thickness of myocardial arteriole walls
 72:19
 thickness of vocal cords
 69:60
 tracheal neoplasm mortality rates
 67:147
 type of lung neoplasms in male and female
 71:250
 urinary excretion of tryptophan metabolites
 69:64
 urinary tract neoplasm mortality rates, by age
 67:154
see also Smokers vs. nonsmokers, cigar; Smokers vs. nonsmokers, pipe
 Smokers vs. nonsmokers, cigar
 esophageal neoplasm mortality ratios
 67:35-36
 laryngeal neoplasm mortality ratios
 67:35
 mortality rates
 67:8
 and mouth neoplasm mortality ratios
 67:35
 and pharyngeal neoplasm mortality ratios
 67:35
 Smokers vs. nonsmokers, pipe
 esophageal neoplasm mortality ratios
 67:35
 laryngeal neoplasm mortality ratios
 67:35, 149
 mortality rates
 67:8
 mortality rates for Canadian pensioners
 67:10
 mouth neoplasm mortality rates
 67:35
 pharyngeal neoplasm mortality ratios
 67:35
 Smoke streams
 aluminum in
 64:55, 61, 62
 arsenic in
 64:55
 benzo(a) pyrene content
 72:123
 beryllium in
 64:55
 chromium in
 64:55

CO levels in mainstream cigar smoke
75:90

constituents of tobacco smoke
75:88-98

definition of
64:50

effect on nonsmokers
72:122, 123

Guthion in
64:62

nickel in
64:55

potassium in
64:55

Sevin in
64:62

sodium in
64:55

summary of previous findings
75:87, 88

tar and nicotine content
72:123

Smoke, tobacco
64:26, 33, 34, 50-62, 69-75,
142-146, 167, 168, 263-267

acenaphthene in
64:55

air cured and tumorigenicity
68:91

as air pollutant
72:7, 121, 122

alkylbenzene in
64:55

allergic and irritative components, effect
on nonsmokers
72:2, 128, 129

antigenic properties
72:104

aromatic hydrocarbons in
64:55; 67:127; 69:61

arsenic in
64:55, 61

benz(a)anthracene in
67:127

benzene in
64:55

benzo(b)fluoranthene in
67:127

benzo(j)fluoranthene in
67:127

benzo(k)fluoranthene in
67:127

benzo(a)pyrene in
67:127

benzo(e)pyrene in
67:127

beryllium in
64:55

bladder carcinogens in
69:64

and bronchogenic carcinoma
67:129-130

carcinogenic heterocyclics in
64:54

carcinogenic hydrocarbons in
64:55

carcinogenicity
64:143, 145; 68:90, 91; 69:62

chromium as
64:55

chronic toxicity of
64:73

chrysene in
67:127

clearance mechanism for
64:267, 269

cocarcinogens in
69:61

composition of
64:50-62, 263, 264

constituents of
64:51

constituents of, and bladder neoplasm
carcinogenesis
67:156

constituents of, effect on bronchial mu-
cosa
67:144-145

constituents of, lung neoplasms induced
by
67:144

cyanide in, and vitamin B-12 deficiency,
in tobacco amblyopia
67:40

deposition of
64:263-267

dibenz(a,j)acridine in
67:127

effect during pregnancy in laboratory
animals
73:114, 115

effect of constituents on passive smokers
75:88-98

effect on air pollution in aircraft
73:45

effect on bronchial epithelium
67:129

effect on macrophages
72:47

effect on mitochondrial function, in rat
liver
74:104

effect on nonsmokers, in aircraft
73:45

effect on stillbirth rate in laboratory
animals
73:125

and epidermoid carcinoma
67:129-130

exposure
64:272

filtration of, effect on bronchoconstric-
tor response in smokers
72:45

heterocyclic nitrogen compounds in
67:127

indeno(1,2,3-c,d) pyrene in
67:127

irritants in
72:109, 110

leukoplakia from
64:233

liver effect of
64:342

and lung neoplasms in animals
68:93

nicotine content of
 68:91
 nicotine-N-oxides in
 69:62
 nitrates in
 67:128
 N-nitrosamines in
 67:127
 organ toxicity of
 64:73
 papilloma formation in tracheobronchial
 mucosa
 67:129-130
 pH of, effect of leaf constituents
 73:224
 polonium-210 content, and carcino-
 genesis
 68:92
 polycyclic aromatic compounds
 64:26, 144
 potassium
 64:55
 potential source of N-nitrosamines
 68:91
 pyrolytic temperature effect in
 64:50
 retention of
 64263-267
 summary of previous findings on rela-
 tionship to passive smoking
 75:87, 88
 summary of recent findings
 75:108
 systemic toxicity of
 64:73
 tar content of
 68:91
 in tobacco amblyopia etiology
 67:40
 toluene
 64:55
 toxicity of
 64:73
 tumorigenic activity
 68:90, 91; 73:210-214
 tumor-promoting agents in, and neo-
 plasm pathogenesis
 67:35
 and vitamin B deficiency in tobacco
 amblyopia
 67:40
see also Smoke, cigar; Smoke, cigarette;
 Smoke, pipe
Smoking
 and absenteeism
 67:19
 and adenocarcinoma
 67:140-143
 and air pollution
 64:295-298
 and air pollution, effect on pulmonary
 function and COPD prevalence
 74:82, 83
 and alcohol consumption, in esophageal
 neoplasm formation
 67:152
 and alveolar bone loss
 69:85-87
 and alveolar cell carcinoma
 67:142
 and angina pectoris
 69:18
 and anoxia
 67:183
 and aortic aneurysm
 67:183
 and arrhythmia
 69:4
 and arteriosclerosis
 67:28; 69:4, 5
 and asbestos exposure, as factors in lung
 neoplasm development
 74:41-43
 association with other risk factors in
 CHD
 68:21; 74:6, 7, 17
 and asthma
 67:29
 and atherogenesis
 67:66
 and basal cell hyperplasia
 67:30
 and bed days
 67:20-22
 and behavior type
 69:20, 24
 and bladder neoplasms
 67:33, 36; 69:60; 72:68, 72-74
 and bladder neoplasms in men
 67:153
 and bronchitis
 69:4; 74:79
 and bronchitis morbidity
 67:6, 94, 99
 and bronchitis mortality
 67:3, 29, 90-92
 in bronchitis pathogenesis
 67:29-31, 96, 108; 69:37-40
 and carboxyhemoglobin levels in smok-
 ers
 67:183
 and cardiovascular diseases
 67:3, 25-28, 47-69; 69:3-5
 as cause of fires
 67:187-188
 as cause of traffic accidents
 67:187-188
 and cerebrovascular diseases
 67:27, 66
 and cerebrovascular diseases by age
 67:68
 and cerebrovascular thrombosis
 67:27, 68
 cigarette sales and CHD mortality rate
 68:16
 and coffee drinking, in myocardial in-
 farction etiology
 74:8
 and COPD etiology
 73:35, 36
 and coronary disease
 69:3-5, 20
 and coronary disease, age as factor
 74:6
 in coronary disease etiology
 67:26, 54

and coronary disease incidence rates
 67:54; 68:27
 and coronary disease, in women
 74:9, 10
 and coronary disease mortality
 67:10, 26-67
 in coronary disease patients
 67:26, 28
 in coronary disease patients, effect on
 blood pressure
 67:61
 in coronary disease patients, effect on
 heart function
 67:61
 in coronary disease patients, effect on
 heart rate
 67:61
 and coronary thrombosis mortality for
 men
 67:26
 and diet
 67:66
 and digestive tract neoplasms mortality
 67:30
 duration of,
 64:29, 31, 37, 187, 188
 duration of, and lung neoplasm increase
 64:31, 37, 158, 161, 163, 170, 187,
 188
 duration of habit and incidence of CHD
 68:17
 effect of abstinence in exercise per-
 formance
 73:241, 242, 246, 247
 effect on bladder neoplasm morbidity
 67:155
 effect on blood cholesterol levels
 67:55, 56
 effect on blood circulation
 67:26, 60-61; 69:11
 effect on blood circulation, and arterio-
 sclerosis pathogenesis
 67:61-62
 effect on blood circulation, and coro-
 nary disease pathogenesis
 67:62
 effect on blood coagulation
 67:64
 effect on blood lipids
 68:31; 73:11, 12
 effect on blood platelets
 67:64; 69:27-28; 74:18, 19
 effect on blood pressure
 67:54, 60
 effect on blood vessels
 67:111
 effect on bronchial epithelium
 67:104-106, 144
 effect on cardiac lactate metabolism
 73:13
 effect on cardiovascular system
 67:26, 60; 72:6, 13, 14
 effect on coronary vessels
 67:65
 effect on esophageal sphincter
 72:97, 98
 effect on esophageal tissue
 67:30, 150-153
 effect on free fatty acids
 69:27
 effect on gastric acidity
 67:182
 effect on gastrointestinal secretions in
 dogs
 72:6
 effect on heart function
 67:60
 effect on heart rate
 67:60
 effect on hemoglobin oxygen affinity
 69:29
 effect on larynx and true vocal cords
 69:59-60
 effect on leg blood mean-flow capacity
 73:22
 effect on leukocytes in guinea pigs
 72:46
 effect on lung function
 67:29, 55; 69:5
 effect on lungs
 67:104, 140-143
 effect on lungs in dogs
 72:46
 effect on mortality rates from eso-
 phageal neoplasms in Japanese males
 72:71
 effect on mucous membranes
 67:144
 effect on myocardium
 67:60
 effect on neoplasm recurrence at site of
 primary
 72:69
 effect on oxygen tension in arterial
 blood
 72:45
 effect on pentagastrin-stimulated gastric
 secretion
 72:97
 effect on peripheral circulatory system
 72:25, 26
 effect on plasma nicotine levels
 73:15-17
 effect on precapillary sphincters
 73:22
 effect on pulmonary clearance
 72:47
 effect on respiratory tract
 67:141
 effect on thrombus formation
 69:27-28
 effect on thrombus formation in coro-
 nary disease patients
 67:26
 effect on tryptophan metabolism
 67:36, 156
 effect on vascular resistance
 67:60
 effect on ventilation/perfusion relation-
 ships of lung
 69:39
 effect on vision
 67:183
 electrocardiogram patterns from
 64:319

and emphysema morbidity
 67:3, 6, 94, 99
 and emphysema mortality
 67:3, 29, 90-92
 in emphysema pathogenesis
 67:29-31, 96, 104, 106; 69:37-38
 and epidermoid carcinoma
 67:35, 140-143
 and esophageal neoplasms
 67:33, 149, 150-151
 and fertility history
 69:79-80
 genetic factors in
 64:190, 385
 and gingivitis
 69:85-86
 health hazards of, similarities of cigarettes with little cigars
 73:224, 225
 heartburn and
 72:97, 98
 histopathologic changes from
 64:300
 inhalation of cigarette smoke as measure of exposure to
 67:15
 interaction with other risk factors in CHD
 73:4-11
 and intermittent claudication
 74:14-16
 and kidney neoplasms
 69:60
 in laryngeal neoplasm etiology
 67:3, 148; 69:55
 in laryngeal neoplasm etiology in men
 67:33
 and liver cirrhosis morbidity
 67:39
 and liver cirrhosis mortality
 67:10, 36
 and lung neoplasms
 64:175-196; 69:4, 55-58
 and lung neoplasms etiology
 67:33-34, 140-144
 and lung neoplasms incidence
 68:94-99
 and lung neoplasms, in men
 69:57
 and lung neoplasms, in women
 67:10; 69:67
 and lung neoplasms morbidity
 67:3, 142
 and lung neoplasms mortality
 67:3, 10, 34
 and lung neoplasms, retrospective studies of, by smoking characteristics
 64:156
 as a major risk factor in peripheral vascular disease
 74:14-16
 and morbidity by age
 67:24
 and morbidity in United States
 67:6, 19
 and mortality
 69:3
 and mortality, British men
 67:10
 and mortality, British physicians
 67:5
 mortality, follow-up study
 67:8
 mortality from esophageal neoplasms
 68:102
 and mortality in United States
 67:5
 and mortality rates by sex
 67:7
 and mortality, U.S. veterans
 67:5
 and mouth neoplasms
 67:145
 and myocardial infarction
 69:4, 18
 and myocardial infarction incidence rates
 67:57
 and noncancerous oral diseases
 69:5-6, 85-87
 and oat cell carcinoma
 67:140-141
 and obesity
 67:66
 and oral neoplasms
 69:58
 and oral neoplasms incidence
 68:99, 100
 and pancreatic neoplasms
 67:36, 159; 69:60-61
 patterns
 64:368, 369
 and peptic ulcer
 67:39; 72:6, 97, 98
 and peptic ulcer morbidity
 67:39-40, 181-182
 and peptic ulcer mortality
 67:39-40, 180-182
 pleasure
 64:350
 population studies
 67:8-11
 and premalignant changes in larynx
 69:5
 prevalence of
 64:363, 364
 prevalence of, in nonwhites
 64:363, 364
 prevalence of in U.S. and Great Britain
 73:173, 174
 psychoanalytic explanation of
 64:367
 and pulmonary fibrosis
 67:107; 72:44
 rate
 64:98
 reduction of among British physicians, and reduced mortality
 67:15
 reduction of, effect on lung neoplasm mortality
 67:4
 relation to blood cholesterol and lung neoplasms
 69:57

- relation to lung neoplasms and stomach ulcers 69:57
- and respiratory tract infections 67:10
- and restricted activity 67:19
- status, errors of measurement in 64:111
- and stomach neoplasms 67:29, 36, 158
- and stroke 67:27
- and thrombosis 67:111
- tobacco amblyopia and 72:6
- trends for U.S. men, for years 1955, 1966, and 1970 74:40
- and tryptophan metabolites in urine 67:36
- type, esophageal neoplasms and 64:32, 33
- type, mortality ratios by 64:90
- type, neoplasm sites by 64:188
- type, oral neoplasm sites by 64:197
- type, retrospective neoplasm studies 64:201
- typology 67:189-191
- and undifferentiated carcinoma 67:140-143
- vasoconstrictive effects in normal subjects 74:16
- wish- for-adult-status as reason for 64:371
- withdrawal methods and 64:352
- in young people, effect on lung function 67:110
- in young people, effect on respiratory tract 67:31
- See also* Reverse smoking; Passive smoking; Smoking, bidi; Smoking, cigar; Smoking, pipe
- Smoking, bidi 64:211
 - esophageal neoplasms from 64:213
 - in neoplasm etiology in Bombay, India 72:69
- Smoking characteristics
 - bronchitis prevalence rates in men and 74:79
 - COPD prevalence rates in Yugoslavia and 74:79
 - dosage score and 67:14-15
 - and incidence rates of lung neoplasms for men 69:56
 - and incidence rates of lung neoplasms for women 69:56
 - and lung neoplasm mortality rates 69:57
 - lung neoplasm mortality rates, for men by 67:134-135, 139
 - lung neoplasm mortality rates, for women by 67:136
 - lung neoplasm mortality ratios, for men by 67:139
 - lung neoplasm mortality ratios, for women by 67:136
 - patients with lung or bladder neoplasms 68:104
- Smoking, cigar
 - autopsy studies, in smokers with emphysema, fibrosis, or thickening of arterioles or arteries 75:75
 - and bronchitis morbidity 67:94, 99
 - and bronchitis mortality 67:30, 94
 - CO levels in mainstream smoke 75:90
 - effect on blood lipids 68:31
 - effect on mortality and morbidity compared to cigarette smoking 73:171-173
 - and emphysema morbidity 67:94
 - and emphysema mortality 67:30, 94
 - in esophageal neoplasm development 73:197, 200-202
 - gastrointestinal disorders and 73:222
 - health consequences of 73:179
 - histological effects on bronchial epithelium 73:203, 204, 209
 - histological effects on esophagus 73:200
 - histological effects on larynx 73:197
 - histological effects on lungs 73:217
 - incidence of CHD 68:27
 - incidence of lung neoplasms in Switzerland 68:95, 96
 - inhalation patterns and 73:184-189
 - in laryngeal neoplasm development 73:197-199
 - in lung neoplasm development 73:203-206; 74:39, 40
 - and lung neoplasm mortality 67:34, 138-140

and lung neoplasm mortality ratios
 67:138-140; 73:203-205
 and mortality
 67:7
 mortality from esophageal neoplasms
 68:102
 mortality, in smokers vs. nonsmokers
 68:5
 mortality ratios from cardiovascular dis-
 eases and
 73:215, 216
 mortality ratios from COPD and
 73:217, 219
 mortality ratios from esophageal neo-
 plasms and
 73:197, 200
 mortality ratios from laryngeal neo-
 plasms and
 73:193, 196, 197
 mortality ratios from oral neoplasms and
 73:191, 193
 oral neoplasm development and
 73:193-195
 overall mortality rates by amount
 smoked
 73:180-182
 overall mortality rates from neoplasms
 73:189
 prevalence in Great Britain
 73:173, 174
 prevalence in United States
 73:173, 174
 relationship to neoplasms
 75:43, 44
 summary of previous findings on effects
 75:4, 13
 and tobacco amblyopia
 67:39
see also Smoking
 Smoking classification
 bladder neoplasms mortality rates by
 67:155
 bronchitis mortality by
 67:30
 bronchitis respiratory symptoms by
 67:98
 cerebrovascular disease mortality rates
 by age and sex
 67:66
 cerebrovascular disease mortality ratios
 by age and sex
 67:66
 cough by
 67:97
 digestive tract mortality rates by
 67:147
 emphysema mortality by
 67:30
 esophageal neoplasms mortality rates by
 67:50
 esophageal neoplasms mortality ratios by
 67:150
 laryngeal neoplasms mortality rates by
 67:147-149
 laryngeal neoplasms mortality ratios by
 67:149
 liver cirrhosis mortality rates in men
 67:184
 liver cirrhosis mortality ratios for men
 67:184
 lung neoplasms morbidity by
 67:33, 143
 lung neoplasms mortality rates by
 67:34, 137, 139-140, 143
 lung neoplasms mortality ratios by
 67:137, 139-140
 mortality rates by
 67:8
 mouth neoplasm morbidity by
 67:32
 mouth neoplasm mortality by
 67:35, 146
 pancreatic neoplasms mortality rates for
 men by
 67:159
 pancreatic neoplasms mortality rates for
 U.S. veterans by
 67:159
 pancreatic neoplasms mortality ratios for
 men by
 67:159
 peptic ulcer mortality rates for men by
 67:182
 pharyngeal neoplasms mortality by
 67:35, 146
 respiratory tract neoplasms mortality
 rates by
 67:147
 stomach neoplasms mortality rates by
 67:157-158
 stomach neoplasms mortality ratios by
 67:157
 tracheal neoplasms mortality rates by
 67:147
 urinary tract neoplasms mortality rates
 by
 67:154
 urinary tract neoplasms mortality ratios
 by
 67:154
 Smoking habit
 64:366
 appetite reduction by
 64:71, 355
 behavioral research
 67:188:192
 beneficial effects of
 64:32, 355
 and body constitution
 67:54
 British physicians
 67:9-10
 and cognition
 67:189-191
 compulsive nature of
 64:352
 and cultural characteristics
 67:54
 demographic factors in
 64:361-365
 and heredity
 67:53-54
 intelligence factors in
 64:370
 measurement of
 64:98

- modification of
 - 64:375, 376
- mortality rates associated with
 - 64:27
- nausea from
 - 64:71
- neuroticism and
 - 64:367
- and occupational physical activity
 - 67:56
- oral hypothesis of
 - 64:367, 363
- and perception
 - 67:189-191
- and personality characteristics
 - 67:57
- psychological determinants in
 - 64:40, 350
- psychosocial aspects of
 - 67:39, 188-192
- reasons for
 - 67:189
- and religion
 - 67:54
- social determinants in
 - 64:361-374
- and socioeconomic
 - 67:54
- see also* Tobacco habit
- Smoking** history
 - aortic aneurysm mortality rates by
 - 69:16
 - aortic aneurysm mortality ratios by
 - 69:16
 - and bronchitis prevalence rates
 - 67:96
 - and chronic diseases
 - 67:22
 - and coronary disease incidence rates
 - 69:21-24
 - and coronary disease mortality rates
 - 67:25-26; 69:13-14, 17
 - and coronary disease mortality rates, for ex-smokers
 - 67:51
 - coronary disease mortality ratios
 - 69:13, 15, 18
 - incidence of atypical nuclei in larynx by
 - 69:59
 - and laryngeal neoplasms
 - 67:35
 - and lung neoplasm morbidity
 - 67:33
 - and lung neoplasm mortality rates
 - 67:34, 135-137, 139-140
 - and lung neoplasm mortality rates for ex-smokers
 - 67:137, 139
 - and mortality
 - 67:7-9
 - and respiratory disease morbidity
 - 67:98
 - and respiratory function tests
 - 67:100
 - and stroke
 - 67:68
 - and stroke mortality rates
 - 69:13, 17
 - and stroke mortality ratios
 - 69:13, 15
- Smoking machines
 - 64:45
- Smoking, maternal
 - and abortion
 - 69:77-79; 71:13; 72:5, 84, 85; 73:123, 124
 - carboxyhemoglobin levels
 - 69:80
 - carcinogenic effects on fetus
 - 72:88
 - congenital malformations and
 - 73:136, 137
 - and development of bronchitis and pneumonia in infants
 - 75:103, 104
 - effect during pregnancy
 - 67:185-186; 72:5, 83-87; 73:103-142
 - effect on birth weight
 - 67:39-40, 185; 69:5, 77-78, 80; 72:5, 83-87; 73:103-114, 119-122
 - effect on body height of children
 - 72:88
 - effect on fetal growth rate
 - 72:5, 83-87
 - effect on fetal morbidity
 - 67:186
 - effect on fetal mortality
 - 67:185; 69:77-78; 73:124, 125
 - effect on gestation duration
 - 73:103-106
 - effect on infant mortality
 - 67:185; 69:77-78; 72:84-87
 - effect on infants growth rate
 - 69:78
 - effect on lactation
 - 73:138-141
 - effect on neonatal carboxyhemoglobin levels
 - 73:118, 119
 - effect on neonate
 - 67:39-40, 185
 - effect on neoplasm development in offspring
 - 72:87, 88
 - effect on placental ability to hydroxylate benzo(a)pyrene
 - 69:80
 - effect on placental metabolizing activity
 - 72:89
 - effect on pregnancy
 - 69:4-5, 77-81
 - effect on pregnancy, in Ireland
 - 69:79
 - effect on pregnancy, in Scotland
 - 69:79
 - effect on pregnancy, in Venezuela
 - 69:79
 - effect on sex ratio
 - 73:135, 136
 - epidemiological studies of effects
 - 69:77-80
 - preeclampsia and
 - 69:79; 72:84; 73:142
 - pregnancy toxemias and
 - 69:79
 - and prematurity
 - 67:185; 69:77, 79

- and prematurity, among Negroes
 - 69:78
- selective action on fetus of certain women vs. others
 - 73:131
- teratogenic effects
 - 77:87
- timing of influence on birth weight
 - 73:120, 121
- unwanted pregnancy and
 - 72:84
- see also* Infant mortality; Neonates
- Smoking, parental
 - effect on children
 - 72:129
- Smoking, paternal
 - effect on infant birth weight
 - 73:110, 111
- Smoking, pipe
 - and adenocarcinoma
 - 67:143
 - autopsy studies, in smokers with emphysema, fibrosis, or thickening of arterioles or arteries
 - 75:75
 - and bronchitis morbidity
 - 67:94, 99
 - and bronchitis mortality
 - 67:94, 99
 - effect on mortality and morbidity compared to cigarette smoking
 - 73:171-173
 - and emphysema morbidity
 - 67:94
 - and emphysema mortality
 - 67:34
 - and epidermoid carcinoma
 - 67:143
 - in esophageal neoplasm development
 - 73:197, 200-202
 - gastrointestinal disorders and
 - 73:222
 - health consequences of
 - 73:179
 - histological effects on bronchial epithelium
 - 73:203, 204, 209
 - histological effects on esophagus
 - 73:200
 - histological effects on larynx
 - 73:197
 - inhalation patterns and
 - 73:184-189
 - in laryngeal neoplasm development
 - 73:197-199
 - and lip neoplasms
 - 67:35, 145
 - in lung neoplasm etiology
 - 67:143; 74:39, 40
 - in lung neoplasm etiology by amount smoked
 - 73:203-206
 - and lung neoplasm mortality
 - 67:34, 139-140
 - and lung neoplasm mortality ratios
 - 67:139-140; 73:203-205
 - and mortality
 - 67:7
 - and mortality ratios
 - 64:86, 87
 - mortality ratios from cardiovascular diseases and
 - 73:215, 216
 - mortality ratios from COPD and
 - 73:217, 219
 - mortality ratios from laryngeal neoplasms and
 - 73:193, 196, 197, 200
 - mortality ratios from oral neoplasms and mouth neoplasms
 - 73:191, 193
 - and mouth neoplasms
 - 67:33
 - oral neoplasms development and
 - 73:193-195
 - overall mortality rates by amount smoked
 - 73:180-182
 - overall mortality rates from neoplasms and
 - 73:189
 - prevalence in Great Britain
 - 73:173, 174
 - prevalence in United States
 - 73:173, 174
 - pulmonary histological changes and
 - 73:217
 - relationship to cancer
 - 75:43, 44
 - sedation from
 - 64:350
 - stomatitis nicotina from
 - 64:271; 69:87
 - summary of previous findings on effects on smokers
 - 75:4, 13
 - and tobacco amblyopia
 - 67:39
 - see also* Smoking
- Snuff
 - 64:73, 349
 - effect on oral mucosa in hamsters
 - 72:70
 - lip neoplasms from
 - 64:202
 - oral lesions from
 - 64:203
 - oral neoplasms
 - 64:202, 233; 71:287, 361, 364-365
 - per capita consumption of, in U.S.
 - 64:45
- Social adjustments
 - in children of smoking mothers
 - 71:407
- Social stimulation
 - 64:32
- Socioeconomic level
 - smoking prevalence by
 - 64:362
- Socioeconomics
 - ii. COPD
 - 71:152-153, 216-217
 - and smoking habit
 - 67:54
- Sodium
 - in main stream smoke
 - 64:55

- Solanesol
 - 64:52
 - pyrolysis of
 - 64:53
 - structural formula of
 - 64:53
- Somatotypes
 - 64:372, 383, 384, 385, 386
- Soot
 - benzo(a)pyrene content of
 - 64:148
 - neoplasm induction by
 - 64:33, 147, 229
- South Africa
 - coronary death rate in
 - 64:320
 - esophageal neoplasms in, retrospective studies of tobacco use
 - 71:378
 - health surveys in
 - 64:186
 - methods of retrospective studies of lung neoplasms in
 - 71:328
 - occupational exposure and smoking relationship to COPD in
 - 71:219
 - serum lipid differences in smokers vs. nonsmokers in
 - 71:99
- Specificity
 - as measure of statistical association
 - 64:182-185, 204, 210, 225
- Spirometric test
 - 64:292
- Sports
 - smokers' participation in
 - 64:372, 373
- Spray exposure
 - in smokers vs. nonsmokers, by race and sex
 - 75:69, 70
- Sputum
 - 64:38, 282, 283-287, 301
 - effect of asbestos exposure in smokers vs. nonsmokers
 - 73:41
 - effect of filtered cigarettes
 - 73:55
 - effect of modified cigarettes
 - 73:37, 38
 - effect of plain vs. filtered cigarettes
 - 73:37, 38
 - in males by amount smoked and type of cigarette
 - 73:37, 38
 - prevalence in pipe and cigar smokers
 - 73:220, 221
 - in women
 - 64:231
- Squalene
 - 64:51
- Status striving
 - smoking and
 - 64:372, 373
- Stearic acid
 - suspected carcinogenic agent of cigarette smoke
 - 71:266
- Steel workers
 - 64:285, 299
- Sterols
 - 64:52
- Stigmasterol
 - 64:52
 - pyrolysis of
 - 64:59
- Stillbirths
 - abortions, and neonatal death and, in smoking and non-smoking mothers
 - 71:390, 405-406
 - effects of maternal smoking
 - 71:415; 73:124, 125
 - rates in blacks vs. whites
 - 73:124, 125
 - in smokers vs. nonsmokers
 - 73:124, 125
 - see also* Fetal death; Smoking, maternal
- Stimulants
 - 64:354
 - nicotine as
 - 64:38, 69, 70, 71, 317-320, 349-350
- Stockholm Prospective Study
 - epidemiologic study of smoking and CHD
 - 74:6
- Stomach neoplasms
 - mortality rates
 - 67:158
 - mortality rates, by age and amount smoked
 - 67:157-158
 - mortality rates, by age and daily tobacco consumption
 - 67:158
 - mortality rates, by smoking classification
 - 67:157-158
 - mortality rates, effect of cessation of smoking on
 - 67:158
 - mortality ratios, by age and amount smoked
 - 67:157-158
 - mortality ratios, by smoking classification and smoking
 - 67:36
 - and tobacco use
 - 67:33
- Stomatitis nicotina
 - 64:275, 302
 - and pipe smoking
 - 64:271; 69:87
 - reverse smoking and
 - 72:6, 69, 70
 - symptoms of
 - 64:271
 - see also* Leukoplakia
- Stramonium
 - 64:354
- Stress
 - 64:373, 374
 - socioenvironmental, and coronary disease incidence
 - 67:56

- Stroke
 mortality rates, by age
 69:13
 mortality rates, by age and sex
 67:67
 mortality rates, by amount smoked
 69:13
 mortality rates, by sex
 69:13
 mortality ratios, by amount smoked
 69:13
 mortality ratios, by sex
 69:13
 and smoking
 67:27, 28; 72:24, 25
see also Cerebrovascular diseases
- Strontium 90
 64:146
- Students, college
 smoking patterns in
 64:369
- Students, high school
 effect of smoking
 72:40, 41
 pulmonary function of smokers vs. non-
 smokers
 72:3
 respiratory symptoms
 72:40, 41
- Study populations
 representativeness of
 64:94
- Subcutaneous neoplasms
 64:143, 144
- Subglottis
 64:271
- Suburbs
 coronary diseases in
 64:322
- Sugar
 64:62
- Sulfonamides
 64:224
- Sulfur dioxide
 air pollution from
 64:295
 and cigarette smoke, effect on glands in
 laboratory animals
 73:49
 ciliastatic effect of
 64:268
 mucus alteration of
 64:268
 pollution levels in four U.S. locations
 75:65, 66
 toxicity of
 64:295
- Sulfuric acid
 carcinogen extraction by
 64:147
- Surfactant
see Pulmonary surfactant
- Surgery
 complications following, in smokers vs.
 nonsmokers
 74:92
- Survey of Tobacco Smoking Patterns in the
 United States
 64:187
- Sweden
 acute effects of cigarette smoke on
 human pulmonary function
 71:168
 blood pressure differences in smokers vs.
 nonsmokers in
 71:104
 CHD mortality and morbidity in
 71:97
 COPD morbidity in smokers in
 71:203, 205
 coronary mortality rates in
 64:320
 effect of cigarette smoke on animals'
 ciliary function in
 71:221-224
 genetic studies of twins in, smoking
 effects on
 71:50, 99
 laryngeal neoplasms in relationship to
 tobacco use
 71:356
 lung neoplasm mortality rates in
 64:176
 relationship of tobacco use and lip neo-
 plasms in
 71:361
 relationship of tobacco use and oral
 cavity neoplasms
 71:364
 retrospective studies of esophageal neo-
 plasms, by tobacco use
 64:214; 71:378
 retrospective studies, of oral neoplasms,
 by type of smoking
 64:198, 200, 201
 retrospective study, of laryngeal neo-
 plasms
 64:205, 206
 serum lipid differences in smokers vs.
 nonsmokers of
 71:99
 smoking and nicotine effects on human
 cardiovascular system
 71:115
 smoking and nicotine effects on human
 peripheral vascular system
 71:133
 tracheobronchial tree changes in smokers
 and nonsmokers in
 71:263
- Swimming
 effect of smoking
 73:242, 244
- Switzerland
 CHD morbidity and mortality in, smok-
 ers vs. nonsmokers
 71:95
 cigarette smoke effects on mice lung and
 kidney tissue in
 71:344
 cigarette smoke inhalation effects on
 mice respiratory tract
 71:351
 lung neoplasm incidence in cigar and
 pipe smokers of rural
 71:244

- lung neoplasm mortality rate in
 - 64:176
- lung neoplasms, methods of retrospective study of smoking in
 - 71:325
- serum lipid differences in smokers vs. nonsmokers of
 - 71:100

- Tachycardia
 - development in dogs induced by nicotine
 - 71:57
- Tars, cigarette
 - carcinogenic effect on animal oral cavities
 - 71:288
 - carcinogenicity
 - 67:34; 69:61; 71:11, 264, 265
 - carcinogenic properties on animal skin
 - 71:337-342; 73:210-214
 - as cause of bladder neoplasms, in rats
 - 74:58
 - content
 - 64:50; 67:34; 68:91
 - effect of instillation or implantation in animal tracheobronchial tree
 - 71:346-348
 - effect on RNA
 - 73:86
 - effect on tissue and organ cultures
 - 71:343-344
 - as harmful component of cigarette smoke
 - 72:142, 143
 - and nicotine content of cigarette smoke, and tumorigenicity
 - 67:15, 34
 - and nicotine content of cigarette smoke, as measurement of dosage
 - 67:15
 - N-nitrosamines in
 - 73:87, 88
 - reduction of
 - 69:61
 - retention in mouth
 - 69:62
 - role in experimental carcinogenesis
 - 73:80-84
 - role in respiratory tract carcinogenesis, in animals
 - 74:47
 - summary of previous findings on effects on smokers
 - 75:5
 - see also* Tars, tobacco
- Tars, tobacco
 - 64:50
 - alkaloid content of
 - 64:54
 - anticarcinogens in
 - 64:143, 144
 - application of, in carcinogenesis
 - 64:165
 - and bladder neoplasm carcinogenesis
 - 67:156
 - bladder neoplasms and
 - 64:219, 223
 - buccal retention of
 - 64:264
 - carcinogenicity
 - 64:33, 143, 146, 147, 165, 192; 67:128; 69:61; 72:65, 66
 - clearance of
 - 64:269
 - cocarcinogens in
 - 67:131
 - condensation temperature of
 - 64:50
 - definition
 - 72:143
 - dosage score as function of
 - 67:15
 - effect on respiratory symptoms and ventilatory capacity
 - 73:38
 - esophageal neoplasms and
 - 64:212, 213, 218
 - fatty acids in
 - 64:53
 - gastric neoplasms induced by
 - 64:228
 - and leukemia
 - 67:148
 - in little cigars, compared to cigarettes and cigars
 - 73:223-226, 228
 - and lymphosarcoma
 - 67:148
 - mouth neoplasm experimentally induced by
 - 67:147-148
 - nonvolatile fraction of
 - 64:50
 - pulmonary adenoma from
 - 64:165
 - retention of, in mouth
 - 64:264
 - and reticulosarcoma
 - 67:148
 - sarcoma induction in rats following instillation
 - 71:346
 - skin neoplasm induction by
 - 67:131; 71:238, 337-342; 73:210-214
 - sterol fraction of
 - 64:52
 - see also* Tars, cigarette
- Taste bud reflexes
 - 64:71
- Taylor's Manifest Anxiety Scale
 - 64:367
- TDE
 - 64:145
- Tea
 - 64:349
- Tecumseh Study
 - 64:284
 - incidence of CHD in cigarette smokers
 - 68:19
 - lung function differences in smokers and nonsmokers
 - 74:81

- Temperature effect
 - 64:50
- Ten-city mortality surveys
 - 64:135
- Tension
 - 64:353
- Teratogenesis
 - maternal smoking implications in
 - 71:407
 - in mice embryos, nicotine effects on
 - 71:411
- Terpenes
 - 64:51
- Terpenoids
 - 64:51, 52
 - as flavoring agents in cigarettes
 - 64:52
 - from pyrolysis of solanesol
 - 64:52
- Tetraethylammonium chloride
 - blockage of nicotine cardiac stimulation
 - by
 - 71:57
 - effect on nicotine pharmacology
 - 67:60
- Theobromine
 - 64:352
- Thiocyanate
 - 64:266
- Thorium
 - 64:145
- Thoron
 - 64:145
- Throat
 - effect of exposure to cigarette smoke, in
 - passive smokers
 - 75:99
 - effect of smoking
 - 64:275
- Thromboangiitis obliterans
 - allergic skin reactions in
 - 64:319
 - cessation of smoking, and remission
 - 71:74
 - cessation of smoking in
 - 64:326
 - definition
 - 71:73
 - tobacco allergy and
 - 72:111
 - treatment of
 - 64:326
- Thrombogenesis
 - effects of smoking
 - 68:32-43
- Thrombophlebitis
 - oral contraceptives and
 - 72:26
 - smoking and
 - 72:26
- Thrombosis
 - coronary
 - 64:321
 - effect of epinephrine on
 - 67:64
 - and emphysema
 - 67:111
 - plasma and
 - 69:27-28
 - smoking and
 - 67:26, 64, 65, 111; 69:27-28; 71:66, 130-132; 72:23; 73:19; 74:18, 19
- Thrombus formation
 - and smoking
 - 68:32-43; 69:27-28; 75:32
- Thumbsucking
 - 64:367, 368
- Tidal volume
 - acrolein effects on
 - 64:266, 267
- Tissue cultures
 - effect of cigarette smoke on
 - 69:62-63; 71:267, 343-345
- Tobacco
 - advertising, prohibition of
 - 64:8
 - allergic reaction to
 - 64:302
 - "angina"
 - 64:319
 - antigenic properties of
 - 64:319; 72:104
 - antigens, in smokers vs. nonsmokers
 - 72:107
 - anti-obesity effect of
 - 64:355
 - arsenic content of
 - 64:61, 62
 - arsenic spraying of
 - 64:61
 - beneficial effects of
 - 64:255, 355, 356
 - carcinogenicity of
 - 64:143
 - chemical composition of
 - 64:49, 50-60
 - cholesterol content
 - 72:24
 - controversy over
 - 64:5, 6, 7
 - curing methods, and incidence of respiratory infections in rats
 - 73:218, 219
 - denicotinized
 - 64:34, 349
 - effect on immune responses
 - 72:6, 107-109
 - flavoring in
 - 64:52, 62
 - flue-cured vs. air-cured, effect on respiratory system in animals
 - 73:217, 218
 - form used and relation to gingivitis
 - 69:86
 - history of
 - 64:5
 - humectants in
 - 64:62
 - irritants
 - 64:353
 - modification of taste of
 - 64:354
 - and mouth neoplasms
 - 67:145
 - in oral neoplasms
 - 64:198, 199, 200, 201

- and oral submucous fibrosis
 - 69:58
- pharmacologic, irritative, and allergic effects
 - 72:7, 109-111
- role in carcinogenesis
 - 69:62
- and stomach neoplasms
 - 67:33, 158
- see also* Tobacco additives; Tobacco extracts; Tobacco leaf components; Tobacco, pipe
- Tobacco Act of 1842
 - 64:62
- Tobacco additives
 - 64:62, 145
 - flavorings as
 - 64:62
 - humectants as
 - 64:62
 - prohibition of
 - 64:62
 - see also* Tobacco
- Tobacco alkaloids
 - see* Alkaloids, tobacco
- Tobacco amblyopia
 - see* Amblyopia, tobacco
- Tobacco chewing
 - 64:45, 211, 213, 349
 - decrease of
 - 64:45, 211
 - gingival neoplasms from
 - 64:202
 - laryngeal neoplasms from
 - 64:212
 - leukoplakia and
 - 73:75
 - lip neoplasms from
 - 64:202; 71:361-363, 365-366
 - oral neoplasms from
 - 64:233; 69:58; 71:361-363, 365-366; 72:69
 - per capita consumption of chewing tobacco, U.S.
 - 64:45
- Tobacco consumption
 - 64:5, 26, 29, 30, 35, 36, 45, 46, 85, 86, 87, 89, 155, 187, 188
 - bladder neoplasms, mortality rates by
 - 67:155
 - bladder neoplasms, prevalence by
 - 64:223
 - coronary diseases and
 - 64:106, 323
 - coronary diseases, mortality rates by
 - 64:324
 - cough and sputum prevalence by
 - 64:289
 - epithelial cell changes by
 - 64:231
 - errors of measurement of
 - 64:111
 - esophageal neoplasm risk ratio by
 - 64:213, 217
 - factors determining
 - 64:163
 - forced expiratory volume by
 - 64:289
 - gastric neoplasms mortality rate by
 - 64:228; 67:158
 - laryngeal neoplasms risk ratios by
 - 64:209
 - lung neoplasms mortality rates by
 - 64:137, 186
 - lung neoplasms risk by
 - 64:37, 196, 232
 - mortality rates by
 - 64:29, 105, 106, 111, 139, 180, 324
 - mortality ratios by
 - 64:85, 86, 105, 106
 - oral neoplasms gradients by
 - 64:202, 233
 - per capita, U.S.
 - 64:45
 - in pneumoconiosis
 - 64:291, 298
 - relative risk ratios by
 - 64:183
 - respiratory symptoms by
 - 64:289
 - stress factors in
 - 64:32, 373, 374
- Tobacco extracts
 - 64:143, 144
 - antigenic properties
 - 72:104, 105
 - carcinogenesis from
 - 64:143, 144, 165
 - effect on cell cultures
 - 73:85, 86
 - effect on skin
 - 72:105-107
 - irritants in
 - 72:104, 105
 - thromboangiitis obliterans and
 - 72:111
 - see also* Tobacco
- Tobacco habit
 - 64:349-354
 - cure of
 - 64:354
 - dependence on
 - 64:350
 - nicotine in
 - 64:32, 349
 - psychological drives in
 - 64:32, 350, 351
 - see also* Smoking habit
- Tobacco Industry Research Committee
 - 64:6
- Tobacco Institute, Inc.
 - 64:8
- Tobacco leaf components
 - antigenic properties
 - 72:104, 105
 - polonium-210 in
 - 67:128
 - presence of potassium
 - 71:266
 - see also* Tobacco
- Tobacco, pipe
 - definition and processing
 - 73:176
 - decrease in consumption
 - 64:45

- per capita consumption, U.S.
64:45
- see also* Tobacco
- Tobacco workers
 - coronary diseases in
64:322
 - health studies in
64:182
 - laryngeal neoplasms in tobaccoists
64:205
- Tokyo-Yokohama asthma
64:276
- Toluene
64:55, 59
- Tongue
 - hamster, C-14 labeled particulate deposition in
71:281-282
- Tongue neoplasms
 - cigar smoking in
64:189, 202
 - pipe and cigar smoking in
64:202
 - pipe smoking in
64:188, 189
 - retrospective studies in, by type of smoking
64:201
 - risk gradients in
64:233
 - see also* Mouth neoplasms; Oral neoplasms
- Tooth extraction
 - effect of smoking on healing of socket
69:87
- Toxicity
 - birth rate reduction from
64:343
 - from nicotine
64:73
 - from sulfur dioxide
64:295
 - threshold levels in
64:295
- Trachea
 - changes in, in smokers
64:167-172
 - hamster, C-14 labeled particulate deposition in
71:281-282
 - histopathology of
64:167-172, 271
 - mucus secretion in
64:268
 - mucus velocity, effects of smoking, in dogs
75:78
- Tracheal neoplasms
 - experimentally induced by cigarette smoke
67:144
 - mortality rates, by amount smoked
67:147
 - mortality rates, by smoking classification
67:147
 - smoking and
73:71
- Tracheobronchial tree
 - clearance, effects of cigarette smoke in donkeys
75:78
 - epithelial changes in
64:167-172
 - function
64:35
 - histopathologic changes in
64:167-173, 270-274 *passim*
 - secondary infection in
64:272
- Traffic
 - effect on air pollution in Boston
74:82, 83
- Traffic accidents
64:39, 344, 345
- Tranquilizers
 - 64:100, 101, 354
 - nicotine as
64:350
- Transit workers
 - breathlessness in
64:286
 - chronic cough in
64:281
- Treadmill performance
 - cardiovascular parameters in smokers vs. nonsmokers
73:243-245
 - effect of vitamin C
73:245
 - oxygen intake in smokers vs. nonsmokers
73:245
- Tricaprylin
64:143
- Triglycerides
 - coronary disease relationship to
71:65; 73:8
 - smokers vs. nonsmokers
71:99-100, 102
- Trout
 - hepatoma induction in
64:145
- Tryptophan metabolism
 - alteration in urinary tract neoplasms by smoking
71:13
 - alterations by smoking
71:297
 - carcinogenicity in mice bladders
71:296
 - disorders, and bladder neoplasms
67:36, 106
 - disorders, effect of cessation of smoking on
67:156
 - effect of smoking on
67:36, 156
 - effect of smoking on, and bladder neoplasms
67:36
 - relation of excretion in smokers and nonsmokers
71:297

- Tryptophan metabolites
 - carcinogenic, and smoking
 - 67:36
 - carcinogenic, in urine, and bladder neoplasms
 - 67:36
 - excretion of, by smokers
 - 69:64
 - intermediate, and bladder neoplasms
 - 67:156
- Tuberculosis
 - 64:276, 302
 - alcohol consumption in
 - 64:277
 - cigarette consumption in
 - 64:277
 - in smokers vs. nonsmokers
 - 71:172, 226-228
 - smoking and
 - 72:41
- Tumors
 - see Neoplasms; and specific neoplasm terms
- Twenty-five State Study
 - expected deaths, in
 - 64:110
 - lung neoplasm mortality in
 - 64:118
 - mortality ratios in
 - 64:110, 118, 149
 - observed deaths in
 - 64:110
- Twins
 - air pollution exposure levels and respiratory symptoms
 - 75:67
 - air pollution vs. smoking in bronchitis development in
 - 67:109
 - air pollution vs. smoking in emphysema development using
 - 67:109
 - angina pectoris development in, smoking effects on
 - 71:50-51
 - blood cholesterol levels by smoking habit in
 - 67:55
 - constitutional factors in bronchitis development in
 - 67:109
 - constitutional factors in emphysema development in
 - 67:109
 - coronary disease incidence rates in, with discordant smoking habits
 - 67:103
 - cough incidence rates, smokers vs. nonsmokers by age and sex in
 - 67:102
 - dizygotic, bronchitis morbidity prevalence rates for, with discordant smoking habits
 - 67:103
 - dizygotic, chronic cough in, with discordant smoking habits
 - 67:103
- genetic and environmental factors in angina pectoris in
 - 69:25
- genetic studies of smoking effects on
 - 71:49-52
- monozygotic, angina pectoris incidence rates in, by smoking habit
 - 67:59
- monozygotic, bronchitis morbidity prevalence rates for, with discordant smoking habits
 - 67:113
- monozygotic, chronic cough in, with discordant smoking habits
 - 67:103, 113
- monozygotic, respiratory symptoms in, with discordant smoking habits
 - 67:103, 113
- morbidity rates by smoking habit in
 - 67:103
- mortality from CHD, in smokers vs. nonsmokers
 - 75:14, 15
- neoplasm incidence in
 - 64:190
- predisposition to smoking in
 - 64:326
- role of heredity factors in respiratory diseases in
 - 67:102
- role of respiratory tract diseases
 - 67:20
- smoking and coronary heart disease in
 - 72:18
- smoking effects on mortality and morbidity in
 - 71:51
- smoking habits of
 - 64:190
- Ultraviolet rays
 - absorption determination of
 - 64:51
 - neoplasm induction by
 - 64:144
- Underachievement
 - 64:372, 373
- Unemployed
 - smoking in,
 - 64:363
- United Kingdom
 - bladder neoplasms in, methods in retrospective studies of smoking and
 - 71:382-384
 - blood pressure differences in smokers vs. nonsmokers in
 - 71:103, 104
 - British Perinatal Mortality Survey
 - 71:390, 395, 404, 415
 - cigarette smoke effects on animal ciliary function in
 - 71:221
 - cigarette smoke effects on human fetal lung and mice trachea
 - 71:344

cigarette smoke effects on human pulmonary function
71:168, 169

cigarette smoke effects on mice respiratory tract
71:352

cigarette smoke implantation effects on rat tracheobronchial tree in
71:346-347

comparison of abortions, stillbirths and neonatal deaths in smoking and non-smoking mothers
71:406

COPD morbidity in smokers in
71:195-197, 203, 204

human experimental data on smoking and pregnancy in
71:408

kidney and bladder neoplasms in smokers in
71:294

lung neoplasms mortality in males in England and Wales
71:240

maternal smoking and infant weight in
71:397, 399

methods of retrospective study of lung neoplasms and smoking in
71:324, 326

methods used in smoking study and human pregnancy
71:391, 394-395

mortality from cerebrovascular disease related to smoking in
71:68

mortality rates from COPD in, lack of increase
71:140

mortality ratios from esophageal neoplasms in
71:290

mortality ratios from laryngeal neoplasms in
71:278

mortality ratios from peptic ulcer in smokers and nonsmokers in
71:424

occupational exposure and smoking relationships to COPD in
71:218-219

peptic ulcer in, methods and results of retrospective and cross section studies of smoking and
71:425-428

physicians in, decline in cigarette smoking rates
71:48

physicians in, mortality from lung neoplasms in smokers and nonsmokers
71:241

pulmonary function in, cigarette smoke effects on
71:168

relationship of lung neoplasms to smoking, air pollution, and residence in
71:253-254

relationship of smoking and tuberculosis in
71:226

serum lipid differences in smokers vs. nonsmokers in
71:101, 102

smoking and nicotine effects on animal cardiovascular function in
71:107

smoking and nicotine effects on human blood lipids in
71:126

smoking and nicotine effects on human cardiovascular system in
71:115

smoking relationships to thrombosis in
71:131

United States

acute effect of cigarette smoke on human pulmonary function in
71:166-167, 169

arteriosclerosis mortality in
64:321

atherosclerosis autopsy studies in
71:53-55

bladder neoplasms in, methods and results in retrospective studies of smoking and
71:381-384

blood pressure differences in smokers vs. nonsmokers in
71:103-104

Bureau of the Census
64:177

CHD mortality and morbidity in smokers vs. nonsmokers in
71:30-35, 37, 93-94

chewing tobacco consumption, decrease in
64:45

chronic bronchitis studies in
64:271

cigarette consumption increase in
64:26, 45, 46, 185

cigarette smoke effects on animal ciliary function in
71:221-224

cigarette smoke effects on animal tissues in
71:343-345

cigarette smoke effects on pulmonary surfactants and surface tension
71:172, 225

cigarette smoke implantation effects on animal tracheobronchial tree
71:346-348

cigarette smoke inhalation effects on animal respiratory tracts
71:349-350, 352, 354

comparison of abortions, stillbirth, and neonatal death in smoking and non-smoking mothers
71:405-406

COPD development in
71:10

COPD morbidity in smokers
71:195, 196, 198-200, 201-202, 205

- Department of Agriculture
64:15
- Department of Commerce
64:15
- esophageal neoplasms in, retrospective studies of tobacco use
71:378
- esophageal neoplasms mortality in, in 1967
71:289
- Food and Drug Administration
64:8, 13, 15
- human experimental data on smoking and pregnancy in
71:391-395, 408-410
- human pulmonary function following cessation of smoking in
71:149
- inhalation practices in, in smokers
64:177
- kidney and bladder neoplasms in smokers in
71:293-295
- laryngeal neoplasms incidence in 1967
71:277
- laryngeal neoplasms in, relationships to tobacco use
71:278-279, 354-355
- lung neoplasms mortality rates
64:176
- lung neoplasms mortality rates in, smokers and nonsmokers in
71:240-243
- maternal smoking and infant weight
71:397-399
- methods of retrospective study of lung neoplasms and smoking in,
71:323-328
- mortality from aortic aneurysm related to smoking in
71:71
- mortality from cerebrovascular disease related to smoking
71:68-70
- mortality rates for bladder neoplasms in 1967
71:293
- mortality rates for COPD
71:139-140
- mortality rates for kidney neoplasms in 1967
71:296
- mortality rates for lung neoplasms expected in 1970
71:237, 239
- mortality rates for lung neoplasms in 1939 vs. 1967
71:239
- mortality ratios for COPD
71:142-145
- mortality ratios for esophageal neoplasms in
71:290-294
- mortality ratios for laryngeal neoplasms
71:278-279
- mortality ratios for pancreatic neoplasms in smokers and nonsmokers in
71:298
- mortality ratios for peptic ulcer in smokers and nonsmokers in
71:424
- neoplasm mortality increase in
64:229
- nonsmokers in, by age and sex
64:178
- occupational exposure and smoking relationships to COPD in
71:218-219
- Office of Science and Technology
64:8
- oral neoplasms incidence in, estimated for 1970
71:284
- peptic ulcer in, methods and results for retrospective and cross section studies of smoking and
71:425, 426-428
- peptic ulcer mortality in 1967 in
71:423
- polonium-210 levels in lungs of smokers in
71:335-336
- Public Health Service
64:6, 13, 127, 343
- relationship of human pulmonary histology and smoking in
71:155-157
- relationship of lung neoplasms to smoking, air pollution, and residence in
71:253-254
- relationship of smoking to infectious respiratory diseases in
71:227-229
- relationship of tobacco use and lip neoplasms
71:361-365, 367
- relationship of tobacco use and neoplasms of oral cavity
71:361-365, 367
- retrospective studies in, neoplasms
64:150-165, 197-202, 205-209
- serum lipid differences in smokers vs. nonsmokers in
71:98, 100, 101
- smokers in, by age
64:177
- smoking and nicotine effects on animal cardiovascular function in*
71:107-112
- smoking and nicotine effects on human blood lipids*
71:123-126
- smoking and nicotine effects on human cardiovascular system*
71:113-114, 116, 117-119
- smoking and nicotine effects on human catecholamine levels*
71:119
- smoking and nicotine effects on human peripheral vascular system*
71:133-134
- smoking relationship to thrombosis in*
71:130, 131
- surveys of cigarette smoking in*
71:6

- tracheobronchial tree changes in smokers and nonsmokers in 71:259-263
- white males in, mortality rates in 64:95
- white population in, mortality ratios in 64:132
- United States veterans 64:109, 174
 - chronic cough in 64:281, 282, 285
 - expected deaths in 64:109
 - mortality rates in 64:88, 293
 - mortality ratios in 64:109, 149, 174
 - nonresponse rate in 64:113
 - observed deaths in 64:109
 - respiratory performance in 64:297
 - smoker mortality rates in 64:115
- University of Minnesota Hospital 64:140
- Unsaturated fats 64:322
- Unsaturated fatty acids 64:53
- Uranium miners
 - lung neoplasms in 64:193; 67:143; 71:256
- Urban areas
 - contribution to lung neoplasm mortality 71:11
 - coronary disease incidence in 64:322
 - lung neoplasm rates in 64:186, 194, 195; 71:276
 - relationship of lung neoplasms, smoking, air pollution to 71:252-255
 - smoking prevalence in 64:99, 101, 364
- Urbanization 64:186, 232
- Urban populations
 - lung neoplasms in, suspected etiology of increased 71:276
- Urban vs. rural populations
 - bladder neoplasm prevalence 64:225
 - mortality rates 67:11
 - smoking and 67:97
- Urethan
 - neoplasm promotion by 64:142
 - neoplasms from 64:143, 144
 - pulmonary adenomas from 64:144
- Urinary tract diseases
 - see Urogenital diseases
- Urinary tract neoplasms
 - see Urogenital neoplasms
- Urogenital diseases 64:224
- Urogenital neoplasms
 - cigarette smoke condensate as cause, in animals 74:58
 - excretion of tryptophan in smokers vs. nonsmokers with 74:58
 - incidence in males and females by age 68:104
 - incidence in smokers vs. nonsmokers 74:58
 - mortality and smoking factors in bladder neoplasms 68:104, 105
 - mortality rates, by age 67:154
 - mortality rates, by amount smoked 67:154
 - mortality rates, by smoking classification 67:154
 - mortality ratios, by age 67:154
 - mortality ratios, by amount smoked 67:154
 - mortality ratios, by smoking classification 67:154
 - smoking and 69:60, 64; 75:50
 - summary of previous findings on relationship to smoking 68:89, 90; 74:57
 - see also Bladder neoplasms; Kidney neoplasms
- Uterus
 - cigarette smoking effects on, in pregnancy 71:408
- Vanillin 64:62
- Vascular diseases, occlusive 64:319
 - smoking and 73:21
- Vascular diseases, peripheral
 - carboxyhemoglobin levels and 72:26
 - epidemiologic studies 74:14-16
 - experimental studies 74:16
 - nicotine and 72:25
 - smokers vs. nonsmokers 72:26
 - smoking as a risk factor 72:2, 25, 26, 56; 73:19-23; 74:14-16
- Vascular reconstruction
 - effect of smoking 73:22, 23

- Vascular resistance
 - effect of cigarette smoke on
67:61
 - effect of histamine on
67:61
 - effect of nicotine on
67:60
 - effect of smoking on
67:60
- Vascular system
 - peripheral, smoking and nicotine effect on
71:9, 72-73, 75, 133-134
- Vasoconstriction
 - fetal weight reduction by
64:343
 - nicotine induction of
64:318
 - pulmonary, effects of cigarette smoking
68:75, 76
- Vegetable fibers
64:59
- Venezuela
 - maternal smoking and infant weight in
71:450
 - methods used in smoking study and human pregnancy
71:445
- Ventilation
 - effects on constituents of tobacco smoke
75:90-95
- Ventilatory function
64:35, 292, 300, 302
 - effect of exercise and smoking
73:244, 245
- Ventricular fibrillation
64:321
 - death from, nicotine effects on
71:36
 - effect of cigarette smoke in dogs
73:13, 14
- Ventricular hypertrophy
 - as a risk factor in CHD
73:8
- Ventricular premature beats
 - effect of cigarette smoking
75:20
- Veterans
 - see* Canadian veterans study; United States veterans
- Viruses
 - as etiologic agent in cancer
64:166, 230
 - influenza, cigarette smoke effects on resistance of mice with
71:173
 - influenza, nitrogen oxide effects on squirrel monkey resistance to
71:173
 - neoplasm induction by
64:142
- Vision
 - carboxyhemoglobin effect on
64:344
 - effect of carbon monoxide
72:126
- effect of smoking on
67:183
- Vitamin B complex
 - deficiency, and tobacco amblyopia
67:40, 183
- Vitamin B 12
 - deficiency,
64:212
 - deficiency, potentiation of cyanide in tobacco amblyopia
67:40, 183
 - in pregnant smokers vs. nonsmokers
73:119
- Vitamin C
 - effect on treadmill performance in smokers vs. nonsmokers
73:245
 - in milk of smoking mothers
73:141
 - in pregnant smokers vs. nonsmokers
73:119
- Vitamin D
 - and nicotine, effect on hypercholesterolemic rabbits
69:27
- Vocal cords
 - effect of smoking on thickness
69:59-60
 - hyperkeratosis in
64:271
 - see also* Larynx
- Walters
 - esophageal neoplasms in
64:134
 - oral neoplasms in
64:134
- Washington University study
64:174
- Water
 - hardness, and smoking as risk factors in CHD
73:9, 10
 - soluble fraction of cigarettes, suppression of immunoglobulin response
75:77
- Welsh miners
64:293, 294
- Western Collaborative Group Study
 - CHD risk factors, in smokers vs. nonsmokers
68:25, 26
 - incidence of myocardial infarction in younger male smokers
68:21
- White House Conference on Narcotics and Drug Abuse
64:355
- White Pekin duck
 - nature of phagocytized clearance products in
64:269
- Whites
 - cancer mortality in
64:135

esophageal neoplasms in
 64:218
 laryngeal neoplasm prevalence in
 64:209
 mortality rates
 64:133
 mortality ratios by sex
 64:133
 smoking patterns in
 64:363, 364
 Wire implantation
 64:166
 Withdrawal
 clinics
 67:191
 methods
 64:354
 symptoms
 64:352, 354
 see also Cessation of smoking
 Women
 autopsy studies, in smokers vs. nonsmokers with emphysema, fibrosis, or thickening of arterioles or arteries
 75:75
 blood pressure and smoking habits during pregnancy
 69:77-78
 CHD incidence in
 74:9, 10
 exposure to chemicals, fumes, sprays and dusts, in smokers vs. nonsmokers
 75:69, 70
 hypertension, in cigarette smokers with CHD
 68:22
 incidence of lung neoplasms
 68:97; 74:39, 40; 75:43
 incidence of lung neoplasms and smoking
 69:4, 57
 increase in mortality from lung neoplasms
 75:47
 mortality from lung neoplasms
 68:97
 mortality, in smokers vs. nonsmokers
 68:6, 8, 9
 mortality rates from lung neoplasms and asbestos exposure
 74:42, 43
 mortality rates from lung neoplasms, statistical sex ratio
 74:40, 45
 mortality rates, in smokers vs. nonsmokers
 74:9, 10
 myocardial infarction in pre- vs. postmenopausal
 74:10
 myocardial infarction, in Swedish smokers vs. nonsmokers
 75:14
 secular trends of lung neoplasm development in
 74:40
 sudden death rates in
 74:9, 10
 summary of previous findings on effects of smoking
 75:5-7
 trends in neoplasm incidence rates for selected sites in
 74:41, 42
 Working classes
 64:362
 Work-loss days
 definition
 67:19
 and smoking
 67:20-21
 World Health Organization
 64:350, 354
 classification of lung neoplasms
 64:173, 174
 Xenon
 radioactive, regional pulmonary function using
 71:147
 washout technique for detection of lung neoplasms
 74:43, 44