By: Harold F. Dorn, National Institutes of Health

The question of the effect of the use of tobacco upon health has been vigorously debated since tobacco was introduced into Europe approximately four centuries ago. A member of the royal house of England, King James I, who obviously was opposed to the use of tobacco, wrote a pamphlet, "A Counter Blaste to Tobacco," published anonymously in 1604. Typical of the more extreme assertions concerning the harmful effects of tobacco is the following quotation from "Doctor of Physick in Bathe" published by a Dr. Venner in 1650:

"I will summarily rehearse the hurts that Tobacco inferreth, if it be used contrary to the order and way I have set downe. It drieth the brain, dimmeth the sight, vitiateth the smell, dulleth and dejecteth both the appetite and stomach, destroyeth the decoction, disturbeth the humours and spirits, corrupteth the breath, induceth a trembling of the limbs, exsiceateth the windpipe, lungs and liver, annoyeth the milt, scorcheth the heart ..."

No substantial quantitative evidence was produced at that time to support this assertion nor indeed was any produced for nearly 300 years thereafter. Although numerous studies of the acute effects of nicotine subsequently were made, investigations of the possible relationship between the onset of specific diseases and the long continued use of tobacco date mainly from the past 30 years, the majority having been published during the past decade. References to the probable relationship between the use of tobacco and certain diseases can be found in the medical literature of the past century but these were based almost entirely upon clinical impressions and the experience of practicing physicians.

A rapid increase in the number of diagnosed cases of lung cancer began to attract widespread medical attention during the decade of the 1920's. At first, many believed that the observed increase in the number of diagnosed cases was due almost entirely to more accurate methods of diagnosis and more effective case finding. This opinion has gradually changed; nearly all who have carefully examined the evidence now agree that the observed increase cannot be accounted for solely by more thorough case finding and 1/ This study would not have been possible without the cooperation of the Veterans Administration. However, the Veterans Administration is not responsible for, nor does it necessarily endorse, any of the findings or conclusions of this report.

2/ This study was carried out in cooperation with Field Investigations and Demonstrations Branch, National Cancer Institute, Dr. R. F. Kaiser, Chief. Dr. W. S. Baum, Division of Indian Health, Public Health Service, assisted in the planning and initiation of the study. improved methods of diagnosis. However, existing data are insufficient to permit a reliable estimate of the proportion of the increase that may be attributed to an increase in the risk of developing lung cancer.

The dust from macadam roads, air pollution from the combustion of coal and petroleum products, special occupational hazards, and the use of tobacco, especially cigarette smoking, are the principal agents that have been mentioned as possible causes of the increase in lung cancer. Most of the early investigators selected the use of tobacco as the first to be studied. By the end of 1950, eight retrospective studies of the use of tobacco by patients with lung cancer and by persons without lung cancer had been published, four in the United States and four in Europe.

## Plan of Study

The present study was planned in the summer of 1952 as a prospective investigation of a defined population with the general objective of studying the relationship of the use of tobacco, residence, and occupation to mortality.

With the cooperation of the Veterans Administration, policyholders of U.S. Government Life Insurance were selected for study. This insurance was available to persons who served in the armed forces of the United States from 1917 to 1940. Most of the policyholders were veterans of World War I; the remainder first served after that date. Over 99 percent of the policyholders were men.

All persons with an active policy at the end of 1953 were included except for a few special groups such as persons with total and permanent disability. Beginning in January 1954 a questionnaire requesting information concerning the use of tobacco, usual occupation and industry was mailed to 291,800 policyholders. Usable replies were received from 198,926 persons or 68 percent of those included. A second questionnaire was mailed to the nonrespondents beginning in January 1957. Usable replies were received from an additional 50,000 policyholders, making a total of 249,000 or 85 percent of those included in the study for whom information concerning the use of tobacco, occupation, industry, and residence was available. The nonrespondents have been kept in the study and the same medical information is available for them as for the respondents.

Whenever a claim is filed for the payment of a policy, a copy of the death notice, usually a copy of the official death certificate, is sent to the Public Health Service. Additional medical information including verification of the causes of death entered on the death certificate, the procedures used to establish these diagnoses, whether the deceased had cancer even though it was not considered to be an underlying or contributory cause of death, and the histological type of cancer, is requested from the physician who signed the death certificate or from the hospital where the death occurred.

Verification of the cause of death is not requested if the death occurs outside the United States, is due to an accident, or is certified by a coroner. Replies have been received to more than 99 percent of the letters of inquiry.

## Basis of this Report

This report is based on the mortality experience during the two and one half year period, July 1954-December 1956, of policyholders for whom a tobacco-use history was obtained prior to July 1954. The experience during the first six months of 1954 has been excluded since the original questionnaire was mailed during this period. Persons who died before they received the questionnaire obviously had to be assigned to the nonrespondent group. It is reasonable to suppose that a larger proportion of persons who were seriously ill at the time the questionnaire was mailed failed to reply than actually did reply. This also tended to increase the death rate of the nonrespondent group.

As a result, the death rate per 1,000 of the nonrespondents during January-June 1954 was 23.2 per annum and during July-December 1954 it was 17.9 per annum. During 1955 and 1956 the annual death rate of this group was 18.3 and 18.8 respectively. Although the death rate of the entire group of policyholders was not affected, the experience of the first six months of 1954 has not been used in this report since the mortality rates of the nonrespondents were higher than normal while those of the respondents were lower than normal during this period.

The following data are based upon 478,952 person years of exposure, of which 89,774 were contributed by persons who had never smoked and 389,178 by persons who had smoked tobacco during their lifetime but not necessarily during 1954 to 1956. The number of person years exposure of persons with different types of smoking history is shown in table 1.

#### Characteristics of the Policyholders

Almost all of the policyholders were white males. Less than one half of one percent were females and only a negligible number of the remainder were nonwhite males. In age, they ranged from 30 years to more than 80 years. The vast majority--84 percent-were between 50 and 70 years of age; only two percent were more than 70 years old.

Eighty-two percent of the policyholders were white collar or skilled workers, 7 percent were semi-skilled or unskilled workers, and 6 percent were farmers or farm laborers. Roughly comparable percentages for the white male population aged 20 to 54 years with work experience from the 1950 Census of Population are 50, 35, and 13 respectively (2). It is clear that compared to the white male working population of the United States in 1950 a much smaller proportion of the persons in this study were semi-skilled and unskilled workers. This is not surprising since most of the policyholders were persons who had held whole life or endowment insurance policies for many years.

Since the policyholders were mainly from the

middle and upper socio-economic classes, their death rate from all causes during the study period was less than that for the white male population of the United States. Their average death rate for the three years, 1954-1956, was about 70 percent of that for the total white male population in 1955.

#### Smoking History

No attempt was made to obtain a precise estimate of the amount of tobacco used. Instead, each person was asked to place himself in one of six categories by amount of each form of tobacco used--cigarette, cigar, pipe, and chewing and snuff--both with respect to current use and maximum past use. The categories were comparable to those used by Hammond and Horn in the study carried out by the American Cancer Society and to those used by the National Cancer Institute and the Bureau of the Census in their study of the smoking habits of the population of the United States (3,4).

Finkner and associates of the Institute of Statistics, North Carolina State College investigated alternative methods of measuring the current daily number of cigarettes smoked by an individual (5). Among the methods compared were a lighter-counter, the questionnaire used in the National Cancer Institute-Bureau of the Census survey, and a questionnaire developed at the Institute of Statistics. With respect to the classification of individuals by categories of the average daily number of cigarettes smoked, they found that each of the two questionnaires gave results that differed from those obtained by using the lighter-counter. There was no way of determining which of the results was closest to the true classification. However the differences in classification were not sufficiently great to support the belief that the results reported here would have been materially changed if one of the alternative methods of classifying individuals by the average daily amount smoked had been used.

Another way of measuring the reliability of the replies to a smoking history questionnaire is to request a number of persons to complete the same questionnaire on two occasions sufficiently far apart to reduce the effect of memory carryover to a negligible level. This was inadvertently done at the time of the original mailing in 1954.

Some policyholders held more than one policy. The addressograph plates were arranged by policy number so that duplicate policies could not be readily identified when the questionnaires were addressed. At the time of the original mailing which extended over a period of nearly four months, instructions were given to identify and destroy the questionnaires for duplicate policies prior to mailing. By error, some duplicate questionnaires were mailed and completed copies were returned by 1714 policyholders.

The percentage agreement in the replies to selected items on the pairs of questionnaires are shown in table 2. Although some individuals wrote "duplicate" on one of the questionnaires, others gave no indication of sequence so that it was necessary to collate the punch cards for all coded questionnaires in order to identify the duplicates. The two questionnaires of each pair were coded independently.

About 90 percent of the 1714 persons were classified identically on the basis of replies to two questionnaires with respect to the amount of tobacco currently smoked, the number of years the current amount had been smoked, age started smoking each form of tobacco, and a summary grouping based on a comparison of current amount smoked and the maximum amount smoked. The agreement of replies to the question on the total number of years of use of tobacco in any form was 89.7 percent based on a classification into 11 groups.

No evidence of systematic differences in the replies to the two questionnaires was found except for the question on the current amount smoked. The matching of punched cards for duplicate questionnaires was not done until after the tabulations used in this report had been completed. One of each pair of punched cards including those for questionnaires marked "duplicate" was excluded from the tabulation.

When the two sets of punched cards were matched, the number of policyholders classified as never having used tobacco was slightly larger based on the set of punched cards used in tabulation than it was based on the duplicate cards. The percentage differences were 3 for pipe, 6 for cigar, and 9 for cigarette. In other words these data suggest that some of the persons included in the group of nonsmokers probably had smoked, at least occasionally, during part of their lifetime. No information is available to indicate whether those who completed the duplicate questionnaires were a representative sample, with respect to smoking history, of the entire group who replied. If they were, the above difference would have the effect of probably decreasing the mortality ratio so that the true difference in death rates between smokers and nonsmokers would be slightly greater than that shown.

Table 3 presents a comparison by smoking history of USGLI policyholders and the male population of the United States. The lifetime smoking histories of the two groups are very similar with respect to the percentages who have never smoked, smoked occasionally, and smoked regularly. The proportion reporting the use of multiple forms of tobacco is definitely greater among the policyholders. This is to be expected since each policyholder reported for himself whereas the smoking history of 42 percent of the men included in the National Cancer Institute-Bureau of the Census survey was obtained from another member of the family. Twenty-nine percent of the self-respondents reported that they had never smoked; the corresponding percentage for the total sample was 32. A self-respondent probably is more likely to report the use of a second form of tobacco, which could account for the difference in the relative number of users of two or more forms of tobacco in the two populations. Although there are differences in detail, the lifetime smoking histories of the two populations, taken as a whole,

are very similar.

Measures of Mortality The primary purpose of this study is to determine whether the death rate of persons who have used tobacco is greater or less than that for persons who have never used tobacco. A direct way of measuring the difference in mortality is to compute the ratio of the death rate of smokers to that of nonsmokers. In practice, this mortality ratio is calculated by dividing the number of observed deaths for any group of smokers by the number of expected deaths computed on the assumption that the death rate of that group is the same as the rate for those who have never smoked. The ratio of 1.32 shown in table 1 for persons who have used tobacco means that the death rate for these persons is 32 percent greater than the rate for persons who have never smoked.

The mortality ratio as used here is a measure of the relative excess mortality of smokers compared to nonsmokers. It provides no basis for judging the absolute magnitude of the numbers of deaths on which it is based. An alternative measure that reflects the absolute numerical difference in mortality is the excess number of deaths computed as the difference between the observed and the expected number of deaths. These two measures emphasize different aspects of the variation in mortality between two groups. In the following discussion the mortality ratio will be used when it is desired to call attention to relative differences in mortality while the excess number of deaths will be used to indicate the relative rank of any cause of death in comparison to other causes of death.

## Mortality by Smoking History

The death rate of persons who have smoked regularly is 36 percent greater than that for persons who have never smoked (table 1). The largest increase in mortality--58 percent--is for those who have regularly smoked only cigarettes. (fig. 1). Persons who have smoked regularly only cigars, a pipe, or both die at a rate only slightly greater than that of nonsmokers. Individuals with a history of regularly smoking cigars and/or a pipe in addition to cigarettes have a mortality rate 29 percent greater than that for nonsmokers. Their excess mortality is about one half that of persons who have smoked only cigarettes. Occasional smoking, irrespective of the form of tobacco used, does not increase the total death rate.

The higher mortality of regular smokers exists throughout the entire range of age--30 years and over--for which data are available (fig. 2). For all classes of smokers except those who have smoked only cigarettes, the excess mortality either decreases or disappears altogether after age 70 but this cannot be regarded as firmly established due to the small number of persons who were more than 70 years old at the start of the study (table 4).

#### Mortality by Amount Smoked

Persons who had ever smoked were requested to indicate which of five classes of amounts smoked most accurately described their smoking

36



Figure 1. Mortality of smokers and nonsmokers; ratio of observed to expected number of deaths; death rate of nonsmokers = 1.00.



Figure 2. Mortality of regular smokers and of nonsmokers by age and type of tobacco used.

habits with respect to each type of tobacco (a) at the time the questionnaire was filled out during the spring of 1954, and (b) when their use of tobacco was a maximum. Table 5 presents mortality ratios for persons currently smoking specified quantities of tobacco in 1954. All of these persons had smoked regularly at some time, even those who were smoking only occasionally at the time they completed the questionnaire.

The excess mortality of cigarette smokers is directly related to the average daily number of cigarettes smoked (fig. 3). Those who smoke two



Figure 3. Mortality of regular smokers by current amount smoked in 1954 and type of tobacco; ratio of observed to expected number of deaths; death rate of nonsmokers = 1.00.

packs or more per day have a death rate nearly twice that for nonsmokers. The data in table 5 suggest that the higher mortality ratio for cigarette-only-smokers than for cigarette-andother smokers is due in part to the fact that the latter smoke fewer cigarettes. After adjustment for differences in age and number of cigarettes smoked, the death rate for cigarette-only-smokers is 14 percent greater than the rate for persons who smoke cigars and/or a pipe as well as cigarettes. Without adjustment for amount smoked the relative difference in death rates is 20 percent.

Only very heavy cigar or pipe smokers experience a higher mortality than nonsmokers. The death rates for the heaviest cigar and pipe smokers, those currently smoking 9 or more cigars or 20 or more pipefuls per day, are slightly less than the rate for persons who smoke from one half to one pack of cigarettes per day. The mortality ratio is significantly greater than one only for persons who regularly smoke cigars only and for the combined total of cigar and pipe smokers.

Essentially the same relationship between mortality rates and amount smoked is shown when smokers are classified by the maximum amount smoked. Mortality ratios for persons who were smoking during the spring of 1954, classified both by current and maximum smoked, are shown in table 6.

For cigarette smokers, mortality ratios based on the maximum amount smoked are slightly smaller than those based on the current amount smoked but the increase of death rates with an increase in the amount of tobacco used remains unchanged. For cigar and pipe users mortality rates also increase slightly with an increase in the amount of tobacco smoked. The trend is consistent for each of the three groups shown in table 6 but the relative increase is small and is not statistically significant for any group by itself although it is for the total of the three groups.

The above analysis has been based on the experience of policyholders who were smoking one or more forms of tobacco when the questionnaire was completed early in 1954. There was an additional group of policyholders who formerly had smoked but who had stopped prior to 1954. The percentage who had stopped of the total number who had ever smoked regularly was as follows:

| Cigarette only      | 26 percent |
|---------------------|------------|
| Cigarette and other | 36 percent |
| Cigar only          | 24 percent |
| Pipe only           | 25 percent |
| Cigar and pipe      | 23 percent |

These percentages are based upon the number of persons who at one time had regularly used each form of tobacco shown and who had stopped smoking that form before 1954. However, they may have been smoking another form of tobacco. For example, 26 percent of the persons who had ever regularly smoked only cigarettes had stopped smoking cigarettes but some of them may have been smoking cigarettes but some of them may have been smoking cigarettes and cigars or a pipe or both had stopped smoking cigarettes but some of them may have been smoking cigarettes but some of them may have been smoking cigarettes but some of them may have been smoking cigarettes but some

Mortality ratios by maximum amount smoked for ex-smokers as just defined are presented in table 7. For cigarette smokers the ratios are somewhat less than those for persons who were still smoking but, with one exception, the ratios are all greater than unity. The difference between the death rate of persons who had smoked one pack or less per day and those who had smoked more than one pack per day is less than the corresponding difference for persons who were still smoking but the heaviest smokers had the highest death rate in both groups.

In contrast to cigar and pipe smokers who were still smoking these forms of tobacco, those who had stopped smoking cigars or a pipe had a higher death rate than persons who had never smoked, although for two groups, pipe smokers who had smoked less than 10 pipefuls per day and cigar and pipe smokers who had smoked 5 or more cigars per day, the difference is not statistically significant (fig. 4). Furthermore, for cigar smokers the mortality ratio for persons who had smoked less than 5 cigars per day is slightly, but not significantly, greater than the ratio for persons who had smoked 5 or more cigars



Figure 4. Mortality of ex-smokers by maximum amount ever smoked and type of tobacco; ratio of observed to expected number of deaths; death rate of nonsmokers = 1.00.

per day. These data suggest that many cigar and pipe smokers may have stopped smoking because of ill health but it is not obvious why this should be true for cigar and pipe smokers and not for cigarette smokers.

To summarize, the death rates for cigarette smokers are definitely greater than those for nonsmokers and this difference increases with the average daily number of cigarettes smoked for current smokers and for ex-smokers. Moreover the higher mortality exists whether the current amount smoked or the maximum amount smoked is used as a measure of amount.

The picture is not as clear for cigar and pipe smokers. The death rate for persons who were continuing to smoke was not appreciably higher than that for nonsmokers except possibly for the very heaviest smokers. By contrast, cigar smokers who had stopped smoking experienced mortality rates definitely greater than those for nonsmokers but these rates did not increase with the average daily number of cigars smoked. The death rates for ex-pipe smokers were highest for the heaviest smokers and were greater than those for nonsmokers.

Mortality of persons who had reduced the amount smoked

In addition to former smokers who had discontinued smoking when the histories were collected in 1954, some of the current smokers were using less tobacco than in the past. The percentage of current smokers who were smoking less than in the past was 11.7 for cigarette only, 19.9 for cigar only, and 7.2 for pipe users. These percentages refer to persons who were continuing to smoke the same form of tobacco but at a reduced rate; persons who had switched from one form of tobacco to another, for example, from cigarettes to pipe, are not included.

Policyholders who had ever smoked regularly

were grouped into three classes with respect to changes in smoking habits, (a) those who were currently smoking as much as ever, (b) those who were currently smoking less than in the past, and (c) those who had stopped smoking. Mortality ratios by maximum amount smoked for these three groups are shown in table 8. For those who were still smoking, the maximum amount was the current amount smoked but for those who had cut down or stopped smoking, the maximum amount refers to previous smoking habits. Mortality ratios for exsmokers and all current smokers are shown in table 1.

Looking first at the summary figures in table 1, it is evident that regular cigarette smokers who stopped smoking prior to 1954 have a lower death rate than those who continued to smoke. Nevertheless their death rate is 30 percent greater than that for nonsmokers. The greater mortality of men who regularly smoke only cigarettes is emphasized by the fact that the mortality ratio for those who had stopped smoking, 1.39, is slightly higher than the ratio, 1.35, for persons who were continuing to smoke cigarettes in combination with cigars or a pipe.

In contrast to ex-cigarette smokers, exsmokers of cigars and a pipe have a higher death rate than persons who continue to smoke these forms of tobacco. The death rate of those who were still regularly smoking cigars or a pipe at the beginning of 1954 does not differ significantly from that of persons who had never smoked; but the corresponding rate for ex-smokers ranged from 21 to 44 percent higher.

Turning to table 8 which shows mortality ratios for persons who had reduced the amount of smoking as well as for persons who had stopped, we find that, for regular cigarette smokers, those who had stopped smoking cigarettes have lower death rates than either those who continued to smoke as ever or who continued to smoke but at a lower rate than in the past (fig. 5). The latter group experienced the highest mortality, especially those who formerly had smoked more than a pack of cigarettes per day. However, irrespective of whether they had stopped smoking cigarettes, cut down on the number smoked, or continued to smoke as many as ever, the death rate of cigarette smokers was higher than that of nonsmokers.

Among policyholders who had regularly smoked only a pipe, the death rate is not significantly different for those who had stopped and those who continued to smoke at a reduced rate. The mortality ratios for both groups are significantly greater than unity for persons who had smoked 10 or more pipefuls per day but not for persons who had smoked less than this amount. Pipe smokers who were smoking as much as ever had a death rate no greater than that for nonsmokers. No difference in mortality rates exists for the two amount-of-use groups shown in table 8.

The mortality experience of cigar smokers is generally similar to that of pipe smokers. The highest death rates are found among those who have either cut down on the number of cigars smoked or have stopped smoking cigars. Those who



Figure 5. Mortality of persons who had reduced the amount of tobacco used by type of tobacco, amount of tobacco used, and amount of reduction; rate of observed to expected number of deaths; death rate of nonsmokers = 1.00.

continued to smoke as much as ever have a death rate no greater than nonsmokers.

Duration of Smoking History

It is worthwhile investigating whether a difference in the duration of smoking history could account for the higher mortality of excigar and ex-pipe smokers than that of persons who were still smoking at the beginning of 1954. If the action of tobacco is like that of many other agents known to induce specific diseases, its effect upon health should become more marked the longer it is used. At least there should be a minimum period of use necessary before any effect is noticeable and possibly a maximum period of use after which no increase in effect is perceptible.

Mortality ratios by the number of years of use of different types of tobacco separately for ex-smokers and for current smokers are shown in table 9. The death rate of cigarette smokers who have smoked for less than 25 years is not significantly higher than that for nonsmokers (fig. 6). This holds true both for ex-smokers and for current smokers (fig. 7). The same absence of any effect upon mortality is equally true for persons who have smoked more than a pack per day and for persons who have smoked a pack or less per day (table 10). In other words, among men who have smoked cigarettes for less than 25 years, the number of cigarettes smoked has no noticeable effect upon the death rate. This observation might not hold true if there were a sufficient number of deaths to subdivide the data for those smoking more than a pack per day.

Mortality ratios for men currently smoking more than a pack of cigarettes per day are greater than unity for durations of less than 25 years but the number of deaths is not large enough to ensure that this excess mortality is statistically significant. For ex-smokers of cigarettes, there is no evidence of a relationship between the maximum number of cigarettes formerly smoked and



Figure 6. Mortality of regular smokers who were currently smoking in 1954 by type of tobacco and number of years smoked; ratio of observed to expected number of deaths; death rate of nonsmokers = 1.00.



Figure 7. Mortality of regular ex-smokers by type of tobacco and number of years smoked; ratio of observed to expected number of deaths; death rate of nonsmokers = 1.00.

mortality for durations of less than 25 years. Unfortunately when the tabulations were

planned, the data for durations of 25 or more years were combined. Until another tabulation can be made it will not be possible to determine whether death rates increase with an increase in duration of smoking beyond 25 years.

The death rate for regular pipe smokers who were currently smoking is no greater than that for nonsmokers, even for men whose current rate was 10 or more pipefuls per day and who had been smoking a pipe for 25 or more years. The only group of ex-pipe-smokers with a mortality ratio significantly greater than unity were men who had smoked a pipe for 25 or more years before stopping.

The death rates for regular cigar users who were currently smoking are similar to those for current pipe smokers. The mortality ratio for men who were smoking 5 or more cigars per day and who had been smoking cigars for 25 or more years is on the borderline of significance but even so it reflects a death rate only 11 percent greater than that for nonsmokers.

The effect of amount of smoking and duration of smoking history upon health is more marked for ex-cigar smokers than it is for pipe smokers. All of the mortality ratios, except that for men whose maximum rate of use was 5 or more cigars per day and who had smoked from 15-24 years prior to stopping are greater than unity although some of the differences are not statistically significant due to the small number of deaths. The most puzzling aspect of the mortality of ex-cigar smokers is that the death rates are as high for men who have smoked less than 25 years as they are for men who have smoked 25 or more years. This reinforces the supposition that many men who stop smoking cigars may do so because of ill health.

#### Age Started

Another way of examining the effect of duration of smoking upon mortality rates is to classify persons by the age they began to smoke. Mortality ratios for regular ex-smokers and for regular current smokers by age started smoking are shown in table 11. For this purpose, the policyholders were classified by the age they started to smoke each form of tobacco; those who had smoked both cigarettes and cigars or a pipe were classified by the age they started to smoke cigarettes, those who had smoked cigars and a pipe were classified by the age they started to smoke cigars.

For regular cigarette smokers, irrespective of whether they had stopped smoking or were still smoking when the study was begun, the mortality ratios are greater than one and decrease with an increase in the age at which smoking was started (fig. 8). In other words, men who started to smoke cigarettes in their late teens or early twenties have a higher death rate than those who did not start to smoke until after age 25 or 30. Except for men who were continuing to smoke only cigarettes, the death rates for those who started to smoke after age 25 are not significantly greater than the death rate of nonsmokers.

The same relationship between age started



Figure 8. Mortality of regular smokers by age started and type of tobacco; ratio of observed to expected number of deaths; death rate of nonsmokers = 1.00.

smoking and mortality rates is found when current cigarette smokers are classified by the amount smoked. The heaviest smokers have the highest death rates for each age-of-starting group except for mixed tobacco users who started to smoke cigarettes after 25 years of age.

The death rates of ex-cigar and ex-pipe smokers exhibit the same trend by age started as do those for cigarette smokers but no consistent relationship between age started and mortality exists for men who were currently smoking cigars or a pipe even when they are classified by amount smoked.

#### Size of Community

The long established difference in mortality of rural and urban residents has gradually narrowed during recent years. For the United States as a whole the age-adjusted death rate for white males during 1949-1951 was only 10 percent greater for residents of central city metropolitan counties than for residents of nonmetropolitan counties. A similar small differential exists for the males included in this study.

On the basis of their residence in 1954, policyholders were classified as living in places of 50,000 or more population including the urbanized areas around each city as defined by the Bureau of the Census, 10,000-49,999 population, 2,500-9,999 population, or in rural areas. The death rate for persons who have never smoked or at most have smoked only occasionally is from 7 to 9 percent greater in urban than in rural areas. The rural-urban difference in death rates is smaller for regular smokers than for nonsmokers. However the absolute value of the urban excess in both instances is so small that residence can be neglected as an important factor in studying total mortality.

The relationship between smoking and mortality is similar for residents of each of the four types of communities (fig. 9). The death



Figure 9. Mortality of smokers and nonsmokers by size of community and type of tobacco; ratio of observed to expected number of deaths; death rate of nonsmokers and occasionally-onlysmokers for each region = 1.00.

rate is higher for men who have regularly smoked than for nonsmokers. Among regular smokers those who have smoked only cigarettes have the highest death rate while those who have smoked cigars and/or a pipe have the lowest rate. No consistent relationship between amount smoked and mortality exists for cigar or pipe smokers but men who have smoked more than a pack of cigarettes per day experience a higher death rate than those who have smoked one pack or less per day.

#### Geographic Region

Mortality ratios by region of residence in 1954 are presented in table 12. Inspection of these data show that the relationship between smoking history and mortality described above for the entire group of policyholders and for those living in rural and urban areas separately also exists in each geographic region of the United States.

#### Mortality By Broad Groups of Causes

Causes of death were classified according to the rules of the International Statistical Classification of Diseases, Injuries, and Causes of Death published by the World Health Organization. One underlying and a maximum of two contributory causes of death were coded. The selection of the underlying cause of death was based on the opinion of the deceased's physician except in instances where it was obvious the physician had misunderstood the intent of the question and had selected a terminal condition such as pulmonary failure or edema as the underlying cause of death. In addition, a separate code was provided for cases with cancer which the physician stated was not a contributory or underlying cause of death. Examples of these are cases with skin cancer or clinically quiescent cancer of the prostate discovered at autopsy, or cases with cancer who died suddenly from coronary artery disease.

The choice of one of several coexisting

diseases as the underlying cause of death frequently must be done arbitrarily and may not accurately reflect the complex of diseases that caused the death. For the purpose of this study, the important question is whether a given disease had ever occurred, and not whether this disease may have been chosen by some method as the underlying cause of death.

For comparability with the data from other published studies and with official vital statistics some of the following tables present mortality rates computed from underlying causes only. Each death was assigned to only one cause irrespective of the number of coexisting diseases. In other tables, the mortality rates are based upon both underlying and contributory causes. For example, if a policyholder had both diabetes and cancer of the lung at the time of death, he was counted twice, once in the group with diabetes and once in the group with diabetes of the lung. Consequently the sum of the number of deaths by cause in these tables is greater than the number of persons who died.

The expected number of deaths by cause were computed from the death rates for persons who had never smoked or who had smoked only occasionally in order to have a statistically more stable basis of comparison. The death rates for these two groups did not differ significantly either for all causes combined or for any individual cause. The crude death rates per 100,000 from lung cancer were 11 and 25 respectively but this difference is not statistically significant. For simplicity, the combined group will be referred to as having never smoked.

By far the greatest increase in the risk of developing a disease for smokers is that for lung cancer (table 13). Among the entire group of men who had ever smoked, there were 312 observed deaths from lung cancer compared with 52 expected if they had been no more likely than nonsmokers to develop this disease, a mortality ratio of 6.0 based on underlying causes only.



Figure 10. Mortality of smokers from broad groups of causes of death by type of tobacco; ratio of observed to expected number of deaths; death rates of nonsmokers and occasionally-onlysmokers = 1.00.

However, the size of the increased risk of dying from lung cancer varies widely among men who smoke tobacco in different forms, ranging from an excess of 33 percent for pipe smokers to 835 percent for cigarette-only-smokers (fig. 10). The mortality ratio for none of the three cigar and/or pipe smoking groups differs significantly from one; the ratio for the three combined is barely significant at the 5 percent level.

A sharp difference exists between the death rates from lung cancer for men who have smoked cigarettes and for men who have smoked cigars or a pipe. The chances of developing lung cancer are 9.35 times greater for regular cigarette smokers than for nonsmokers compared to an average risk of 1.60 times for regular users of cigars and/or a pipe.

For no other disease does the excess mortality among smokers approach that for lung cancer. The next highest mortality ratio is for a group of respiratory diseases including pulmonary tuberculosis, asthma, bronchitis, emphysema, pneumonia, and pleurisy. Although these diseases are important causes of morbidity, they are numerically unimportant as primary causes of death; only 118 deaths among smokers and 24 deaths among nonsmokers were due directly to this group of disease.

An increased death rate from the respiratory diseases is found only among regular cigarette smokers for whom the mortality ratio is 2.24. Similarly to lung cancer, the highest ratio, 2.76, is for persons who smoke cigarettes only. The death rate for cigar or pipe smokers is no higher than that for nonsmokers.

Nearly two-thirds of the deaths of persons who had used tobacco were attributed to diseases of the cardiovascular-renal system, including arteriosclerosis, rheumatic heart disease, coronary heart disease, chronic endocarditis, hypertension, and chronic nephritis. The risk of dying from one or more of these diseases is 31 percent greater for regular smokers than for nonsmokers. Again the risk is greater for regular cigarette users, especially those who have smoked only cigarettes, than it is for users of other forms of tobacco. There is no indication that regular cigar or pipe smokers have a higher death rate than nonsmokers.

The mortality ratios for cancer, exclusive of lung cancer, are similar to those for cardiovascular disease except that the ratios for cigar and pipe smokers are as high as those for cigarette smokers. The mortality from the individual forms of cancer will be discussed below.

#### Mortality from Specific Causes of Death

The data in tables 14, 16, 17, and 18 are based upon underlying and contributory causes of death and for cancer also include cases with this disease even though it was not considered to be a primary or contributory cause of death.

For regular cigarette smokers the diseases with a mortality ratio greater than 2.0, a signifying a death rate more than double that for nonsmokers are bronchitis, emphysema, and allied respiratory diseases, cirrhosis of the liver, ulcer of the stomach or duodenum, cancer of the prostate, and cancer of the esophagus and buccal cavity (table 14). Several studies have reported that heavy smokers also tend to drink alcoholic liquors excessively so that the increased death rate from cirrhosis of the liver may reflect the effect of alcohol rather than that of cigarettes. An increased mortality of cigarette smokers from the other diseases mentioned also have been reported by other studies. An explanation of the high mortality ratio for cancer of the prostate is not apparent.



Figure 11. Mortality of regular smokers of cigarettes only from specific diseases; ratio of observed to expected number of deaths; death rates of nonsmokers and occasionally-onlysmokers = 1.00.

The death rates from the principal cardio vascular diseases, including coronary heart disease, are from 33 percent to 63 percent greater for regular cigarette-only-smokers than for nonsmokers (fig. 11). No increase in mortality exists for chronic rheumatic heart disease, whose cause is known, or for chronic nephritis.

Mortality ratios for men who were regularly smoking cigarettes only by current amount smoked are shown in table 16. For several diseases the number of deaths is so small that the mortality ratios do not differ significantly by amount smoked. But for cancer of the lung and cancer of the buccal cavity and esophagus the increase in the death rate with an increase in the average daily number of cigarettes smoked is very marked (fig. 12). The death rate for men who regularly were smoking more than a pack of cigarettes per day is nearly 16 times the death rate for nonsmokers. A similar although numerically smaller increase in the mortality ratio with an increase in the number of cigarettes smoked is also found for cancer of the buccal cavity - lip, mouth, tongue, pharynx and esophagus.

The leading cause of death of the policyholders included in this study is coronary heart disease. The death rate from this disease is significantly greater than that for nonsmokers for each of the amount-of-smoking groups shown in table 16 but the difference is considerably less than that for cancer of the lung. Moreover the mortality ratio for men who were smoking more than a pack of cigarettes per day is no greater than the ratio for men smoking from half a pack to one pack per day although these ratios



Figure 12. Mortality of regular smokers of cigarettes only from specific diseases by current amount smoked in 1954; ratio of observed to expected number of deaths; death rates of nonsmokers and occasionally-only-smokers = 1.00.

are greater than that for light smokers - those smoking less than half a pack per day.

None of the mortality ratios for specific diseases for men who have regularly smoked only a pipe differ significantly from one except those for bronchitis and emphysema, 1.88, and coronary heart disease, 1.16 (table 17). For both diseases, the death rate for pipe smokers is less than that for cigarette smokers.



Figure 13. Mortality of regular smokers of a pipe only from specific diseases; ratio of observed to expected number of deaths; death rates of nonsmokers and occasionally-only-smokers = 1.00.

In general, the death rates of regular cigar smokers are less than those for regular cigarette smokers not only for all causes of death combined but also for most of the specific diseases shown in table 18. However, cigar smokers are more likely to die from diabetes, cancer of the prostate, and cancer of the intestinal tract than are cigarette smokers; for cirrhosis of the liver and cancer of the buccal cavity and esophagus the death rates for the two groups of smokers are practically equal. The mortality ratios for these diseases are significantly greater than one (fig. 14). 44



Figure 14. Mortality of regular cigar smokers from specific diseases; ratio of observed to expected number of deaths; death rates of nonsmokers and occasionally-only-smokers = 1.00.

The death rate from cancer of the lung for cigar smokers falls between those for pipe and cigarette smokers. Although it is significantly greater than the rate for nonsmokers, the excess is very much less than that for men who have smoked only cigarettes, the mortality ratios being 1.86 and 9.85 respectively.

#### Relative Importance of Causes of Excess Deaths

Up to this point the effect of the use of tobacco upon health has been measured by the ratio of the death rate of smokers to that of nonsmokers. The relative importance of a disease as a cause of death cannot be determined solely from the magnitude of the mortality ratio; for this purpose some index of the absolute number of deaths due to each disease is necessary.

The numerical value of this index depends upon the rules for selecting the underlying cause of death and the way specific diseases are grouped into cause-of-death categories. In practice, some cause-of-death categories usually include a single disease while others may include several diseases. Moreover, the relative rank of the cause-of-death categories varies with age at death so that the ranking for two populations will not be the same unless both the death rates and the percentage age distribution are the same. These limitations upon the use and interpretation of a ranking of causes of death should be borne in mind during the following discussion.

As the data in table 15 show there is no necessary relationship between the mortality ratio and the relative rank of a disease as a cause of death. Cancer of the lung with a mortality ratio of 9.35 caused 6.8 percent of the deaths of men who had regularly smoked only cigarettes; coronary heart disease caused 43.7 percent of the deaths but had a mortality ratio of 1.58. The death rate from bronchitis, emphysema, and allied conditions among cigarette-onlysmokers was nearly three times that for nonsmokers but these diseases are relatively unimportant as primary causes of death, accounting for only 2.5 percent of the total.

Another way of ranking diseases as a cause of death is by preentage of the total number of excess deaths assigned to each disease. The number of excess deaths in table 15 is the difference between the number of observed deaths and the number of expected deaths based on the death rate from each cause of death for persons who had never smoked or who had smoked occasionally only. This ranking is strongly affected by the mortality ratio.

The relative importance of coronary heart disease is the same for both methods of ranking; it is by far the leading cause of death and also the leading cause of the excess deaths. The change in relative importance is most striking for cancer of the lung which caused 6.8 percent of the total number of observed deaths but 16.8 percent of the number of excess deaths of men who regularly smoked only cigarettes. Lung cancer caused about one half as many deaths as all other forms of cancer combined but it caused twice as large a proportion of the number of excess deaths as all other forms of cancer.

#### Summary

1. The death rate from all causes of men who have smoked tobacco is 32 percent greater than that for persons who have never smoked.

2. Men who have regularly smoked only cigarettes have the highest death rate of all groups of smokers - 58 percent greater than the rate for nonsmokers.

3. The death rate from all causes of men who have regularly smoked cigars and/or a pipe is not appreciably higher than that of nonsmokers.

4. The excess mortality of regular cigarette smokers increases with the average number of cigarettes smoked per day. The death rate for cigarette-only-smokers who regularly smoke two or more packs per day is twice the rate for nonsmokers. Only the heaviest users of cigar and pipe tobacco experience a significant increase in total death rate and this increase is less than that for cigarette smokers.

5. Regular cigarette smokers who had stopped smoking cigarettes have a lower mortality rate than those who continued to smoke. Reducing the number of cigarettes smoked per day but still continuing to smoke regularly does not result in a reduction in the death rate.

6. The death rate of regular cigarette smokers who had smoked for less than 25 years is not significantly greater than that for nonsmokers except for those who were continuing to smoke more than a pack of cigarettes per day.

7. The greatest increase for smokers in the risk of developing a disease is for cancer of the lung. Regular smokers of cigarettes only have a death rate from lung cancer nearly 10 times that of nonsmokers. The death rate for men smoking more than a pack of cigarettes per day is 16 times that of nonsmokers.

8. Regular cigarette smokers also are subject to an increased risk of dying from cardiovascular diseases, from bronchitis, emphysema, and allied respiratory diseases, from ulcers of the stomach and duodenum, and from cirrhosis of the liver.

9. The death rate from coronary heart disease among regular users of cigarettes only is 63 percent higher than the rate for nonsmokers.

45

10. The leading cause of death among these men is coronary heart disease. Cancer of the lung caused 6.8 percent of the deaths of men who smoked only cigarettes but accounted for 16.8 percent of the number of excess deaths.

#### References

- 1. Cited in Annals of Eugenics II, 246, 1927.
- Moriyama, I. M. and Guralnick, L., "Occupational and Social Class Differences in Mortality", in <u>Trends and Differentials</u> <u>in Mortality</u> pp. 61-73 published by <u>Milbank Memorial Fund 1956.</u>
- Hammond, E. Cuyler and Horn, Daniel, "Smoking and Death Rates - Report on Forty-Four Months of Follow-Up of 187,783 Men", J. Am. Med. Assoc. 166,1159-1172, 1294-1308, 1958.
- Haenszel, William, Shimkin, Michael B. and Miller, Herman P., "Tobacco Smoking Patterns in the United States", U. S. Public Health Service, Public Health Monograph No. 45, 1956.
- Finkner, A. L., Horwitz, D. G., Foradori, G. T., Fleischer, Jack and Monroe, John, "An Investigation on the Measurement of Current Smoking by Individuals", North Carolina State College, Institute of Statistics, Mimeo Series No. 177, 1957.

#### Appendix

<u>Classification by Smoking History</u> Persons were classified by smoking history in accordance with the following definitions. <u>Used tobacco</u>: Persons who had smoked at least 5 to 10 packs of cigarettes or 50 to 75 cigars or 3 to 5 packages of pipe tobacco.

<u>Smoked occasionally only</u>: Persons who had never regularly smoked any form of tobacco but who had occasionally smoked one or more forms. Also included here are persons with unknown amount used either currently or in the past provided that the maximum amount of known use was occasional only. <u>Regular smoker</u>: Persons who at sometime during their lifetime had regularly smoked cigars, cigarettes, or pipe tobacco. These were further classified by the form of tobacco used and whether or not they were smoking at the start of the study in 1954.

<u>Regular smoker, cigarettes only</u>: Persons who had regularly smoked only cigarettes. They may have occasionally smoked cigars or a pipe; they had never smoked either of these regularly. <u>Regular smoker, cigarette and cigar</u>: Persons who had regularly smoked both cigarettes and cigars. They may have smoked a pipe occasionally but never regularly. Similar definitions were used for regular smokers of other combinations of tobacco. <u>Amount unknown</u>: Persons who stated they had smoked more than the minimum amount to qualify as a user of tobacco but who did not report the amount used either currently or in the past with sufficient accuracy to permit assignment to one of the groups of regular or occasional smokers. <u>Amount used</u>: In this report a classification by amount of tobacco used is based on the current amount used at the time the questionnaire was filled out in 1954. Regular smokers of (a) cigarettes and cigars, (b) cigarettes and pipe, and (c) cigarettes, cigars, and pipe were classified by the current number of cigarettes smoked. Regular users of cigars and pipes were classified by the current number of cigars smoked.

| Classification by C | ause of Death                                 |
|---------------------|---|
| <u>ISC_number</u>   | <u>Title</u>                                  |
| 162,163             | Cancer of lung                                |
| 140-205, except     |   |
| 162,163             | Cancer except lung                            |
|                     | Respiratory diseases                          |
| 001-008             | Respiratory tuberculosis                      |
| 241                 | Asthma  |
| 480-493             | Influenza and pneumonia                       |
| 500-502             | Bronchitis                                    |
| 527.1               | Emphysema without                             |
|                     | bronchitis                                    |
| 470-475; 527.0;     |   |
| 527.2; 510-526      | Other respiratory                             |
| - <b>,</b> -        | diseases                                      |
|                     | Accidents                                     |
| 810-835             | Motor vehicle accidents                       |
| 800-802: 840-962:   |   |
| 980-991             | Other accidents                               |
|                     |   |
| 970-979             | Suicide                                       |
|                     | Cardiovascular                                |
| 330-334             | Cerebral vascular lesions                     |
| 400-402             | Rheumatic fever                               |
| 410-416             | Chronic rheumatic heart                       |
| 420                 | Arteriosclerotic heart                        |
|                     | disease                                       |
| 421-422             | Nonrheumatic chronic                          |
|                     | endocarditis                                  |
| 430-434             | Other heart disease                           |
| 440-443             | Hypertension with mention<br>of heart disease |
| 444 - 447           | Hypertension without                          |
|                     | mention of heart disease                      |
| 450                 | General arteriosclerosis                      |
| 451-468             | Other circulatory                             |
|                     | system disease                                |
| 592-594             | Chronic nephritis                             |
|                     |   |

Remaining categories

Other diseases

### TABLE 1. MORTALITY OF SMOKERS AND NONSMOKERS

|                        | No. of<br>person  | Current Use |        |                   |  |  |  |
|------------------------|-------------------|-------------|--------|-------------------|--|--|--|
| Smoking History        | years<br>exposure | Total       | Smokes | Does not<br>smoke |  |  |  |
| Never smoked           | 89,774            | 1.00        |        |                   |  |  |  |
| lised tobacco          | 389.178           | 1.32        | 1.37   | 1.24              |  |  |  |
| Occasionally only      | 28,144            | .98         | .91    | 1.05              |  |  |  |
| Regular smoker         | 339,903           | 1.36        | 1.40   | 1.30              |  |  |  |
| Cigarette total        | 271,757           | 1.45        | 1.54   | 1.30              |  |  |  |
| Cigarette only         | 161,172           | 1.58        | 1.65   | 1.39              |  |  |  |
| Cigarette and other    | 110,585           | 1.29        | 1.35   | 1.21              |  |  |  |
| Cigarette and cigar    | 21,188            | 1.31        | 1.34   | 1.27              |  |  |  |
| Cigarette and pipe     | 53,168            | 1.36        | 1.41   | 1.26              |  |  |  |
| Cigarette, cigar, pipe | 36,229            | 1.20        | 1.26   | 1.11              |  |  |  |
| Cigar only             | 28,422            | 1.07        | .94    | 1.44              |  |  |  |
| Cigar and pipe         | 21,944            | 1.08        | 1.04   | 1.21              |  |  |  |
| Pipe only              | 17,780            | 1.10        | 1.05   | 1.25              |  |  |  |
| Amount unknown         | 21,131            | 1.06        | 1.43   | 1.05              |  |  |  |

Ratio of observed to expected number of deaths (all causes) by type of smoking history and current use, July 1954-December 1956

Expected number of deaths - computed by multiplying the number of person years exposure in each age group for each smoking history category by the age-specific death rates of persons who had never smoked.

## TABLE 2. RELIABILITY OF REPORTED SMOKING HISTORY

Percentage change in classification by selected items of smoking history between the original and a duplicate questionnaire received from 1714 policyholders

|   | No. of      | Percentage Agreement |       |      |  |  |
|---|-------------|----------------------|-------|------|--|--|
| Item  | Code groups | Cigarette            | Cigar | Pipe |  |  |
| Amount currently used<br>Years used current | 8           | 90.2                 | 89.7  | 93.8 |  |  |
| amount                                      | 12          | 90.7                 | 90.2  | 92.8 |  |  |
| Age started                                 | 8           | 91.0                 | 90.8  | 94.5 |  |  |
| Summary of use                              | 7           | 92.8                 | 91.0  | 93.7 |  |  |

| Smoking history          | USGLI | U.S.1/ |
|--------------------------|-------|--------|
| Total                    | 100.0 | 100.0  |
| Unknown <sup>2</sup> /   | 4.5   | 6.5    |
| Never smoked             | 18.7  | 20.3   |
| Smoked occasionally only | 5.9   | 5.2    |
| Smoked regularly         | 70.9  | 68.0   |
| Cigarette only           | 33.6  | 43.8   |
| Cigarette and cigar      | 4.5   | 3.1    |
| Cigarette and pipe       | 11.1  | 8.3    |
| Cigarette, cigar, pipe   | 7.5   | 2.3    |
| Cigar only               | 6.0   | 3.6    |
| Cigar and pipe           | 4.5   | 2.2    |
| Pipe                     | 3.7   | 4.7    |

## TABLE 3. -- LIFETIME SMOKING HISTORY Percentage who have ever smoked, U.S. males, 1955 and USGLI policyholders, 1954

1/ Tobacco Smoking Patterns in the United States, Public Health Monograph No. 45, page 57; data for males 35 or more years of age.

.

2/-USGLI policyholders--unknown amount smoked; U.S. males--not reported.

|        |    | TA     | BLE | 4. 1  | MORTAI | LITY | BY A | AGE AM | DNG  | SMOKE RS | S AND | NON  | -smokj | ERS  |   |          |      |
|--------|----|--------|-----|-------|--------|------|------|--------|------|----------|-------|------|--------|------|---|----------|------|
| Number | of | deaths | per | 1,000 | 0 per  | year | by   | smoki  | ng l | history  | and   | age, | Ju1y   | 1954 | - | December | 1956 |

|                        | Number |      |       |       | Deat         | h rate | per 1,00 | 0     |       |              |
|------------------------|--------|------|-------|-------|--------------|--------|----------|-------|-------|--------------|
| Smoking History        | of     | A11  |       |       |              |        |          |       |       | 75           |
|                        | deaths | ages | 30-39 | 40-49 | <u>50-54</u> | 55-59  | 60-64    | 65-69 | 70-74 | and over     |
| Never smoked           | 1179   | 13.1 | 0.7   | 2.9   | 6.6          | 9.0    | 14.8     | 21.6  | 35.8  | 70.0         |
| Used tobacco           | 6203   | 16.0 | 1.3   | 3.2   | 9.3          | 13.1   | 19.0     | 28.1  | 38.6  | 73.3         |
| Occasionally only      | 345    | 12.3 | 2.0   | 2.7   | 3.2          | 9.5    | 12.9     | 23.6  | 30.6  | 85.2         |
| Regular smoker         | 5564   | 16.4 | 1.3   | 3.4   | 9.8          | 13.6   | 19.8     | 28.9  | 39.6  | 72.6         |
| Cigarette total        | 4513   | 16.6 | 1.4   | 3.3   | 10.4         | 14.4   | 20.9     | 31.2  | 43.5  | 72.8         |
| Cigarette only         | 2771   | 17.2 | 1.2   | 3.4   | 10.4         | 15.3   | 22.9     | 33.4  | 49.8  | 84.7         |
| Cigarette and other    | 1742   | 15.8 | 1.8   | 3.1   | 10.4         | 13.0   | 18.1     | 28.8  | 37.4  | 62.9         |
| Cigarette and cigar    | 363    | 17.1 | 3.0   | 7.4   | 10.2         | 10.5   | 17.8     | 37.0  | 43.6  | 48.2         |
| Cigarette and pipe     | 805    | 15.1 | 1.4   | 2.0   | 10.1         | 14.1   | 19.3     | 28.3  | 34.9  | 73.5         |
| Cigarette, cigar, pipe | 574    | 15.8 | 2.2   | 4.5   | 11.0         | 12.8   | 16.7     | 24.5  | 36.3  | 62.5         |
| Cigar only             | 433    | 15.2 | 0.0   | 10.4  | 9.3          | 8.5    | 16.3     | 24.1  | 26.7  | 89.6         |
| Cigar and pipe         | 342    | 15.6 | 0.0   | 2.3   | 7.3          | 11.1   | 15.8     | 23.5  | 34.6  | 56.5         |
| Pipe only              | 276    | 15.5 | 1.0   | 1.9   | 2.0          | 11.8   | 17.2     | 20.6  | 32.4  | 71. <b>7</b> |
| Amount unknown         | 294    | 13.9 | 0.7   | 0.0   | 7.8          | 10.2   | 15.6     | 22.9  | 33.8  | 67.8         |

#### TABLE 5. MORTALITY OF REGULAR SMOKERS BY CURRENT AMOUNT SMOKED

|                      | Ratio o | f observed to  | expected |              |               | Nut           | nber of obser  | ved dea | ths   |               |
|----------------------|---------|----------------|----------|--------------|---------------|---------------|----------------|---------|-------|---------------|
|                      |         |                | Current  | number of c: | igarettes smo | ked per day   |                |         |       |               |
| Smoking History      |         | less than      |          |              | 40 or         |               | less than      |         |       | 40 or         |
|                      | occas'1 | 10             | 10-20    | 21-39        | more          | occas'1       | 10             | 10-20   | 21-39 | more          |
| Cigarette only       | .96     | 1.29           | 1.66     | 1.77         | 1.99          | 25            | 205            | 1019    | 663   | 137           |
| Cigarette and other  | 1.08    | .95            | 1.37     | 1.72         | 1.79          | 72            | 159            | 492     | 319   | 59            |
| Cigarette and cigar  | 1.08    | .90            | 1.30     | 1.75         | 2.71          | 13            | 35             | 91      | 56    | 19            |
| Cigarette and pipe   | 1.00    | 1.03           | 1.36     | 1.88         | 1.40          | 27            | 71             | 252     | 180   | 21            |
| Cigarette,cigar,pipe | 1.14    | .88            | 1.41     | 1.46         | 1.73          | 32            | 53             | 149     | 83    | 19            |
|                      |         |                | C        | urrent numbe | er of cigars  | smoked per o  | lay            |         |       |               |
|                      | occas'l | 1-2            | 3-4      | 5-8          | 9 or<br>more  | occas'1       | 1-2            | 3-4     | 5-8   | 9 or<br>more  |
| Cigar only           | 1.05    | .71            | 1.00     | .99          | 1.44          | 20            | 62             | 97      | 79    | 26            |
| Cigar and pipe       | .93     | 1.16           | .99      | .87          | 1.33          | 40            | 101            | 67      | 32    | 8             |
|                      |         |                | Curre    | nt number o  | f pipefuls s  | noked per day | γ              |         |       |               |
|                      | occas'1 | less than<br>5 | 5-9      | 10-19        | 20 or<br>more | occas'l       | less than<br>5 | 5-9     | 10-19 | 20 or<br>more |
| Pipe only            | . 86    | .96            | 1.12     | .98          | 1.21          | 6             | 44             | 73      | 45    | 29            |

# Ratio of observed to expected number of deaths (all causes) by type of smoking history and current amount smoked, July 1954-December 1956

Expected number of deaths - computed by multiplying the number of person years exposure in each age group for each smoking history category by the age-specific death rates of persons who had never smoked.

|                        | Current       | Maximum       |
|------------------------|---------------|---------------|
| Smoking History        | amount smoked | amount smoked |
| Cigarette only         |               |               |
| one pack or less       | 1.59          | 1.48          |
| more than a pack       | 1.81          | 1.75          |
| Cigarette and cigar    |               |               |
| one pack or less       | 1.16          | 1.12          |
| more than a pack       | 1.92          | 1.76          |
| Cigarette and pipe     |               |               |
| one pack or less       | 1.27          | 1.15          |
| more than a pack       | 1.81          | 1.72          |
| Cigarette, cigar, pipe |               |               |
| one pack or less       | 1.22          | 1.12          |
| more than a pack       | 1.50          | 1.54          |
| Cigar only             |               |               |
| less than 5            | .86           | .83           |
| 5 or more              | 1.07          | 1.11          |
| Cigar and pipe         |               |               |
| less than 5 cigars     | 1.08          | 1.01          |
| 5 or more cigars       | .93           | 1.14          |
| Pipe only              |               |               |
| less than 10           | 1.05          | 1.06          |
| 10 or more             | 1.06          | 1.11          |

TABLE 6. --MORTALITY OF REGULAR SMOKERS BY AMOUNT SMOKED Ratio of observed to expected number of deaths (all causes) by smoking history, current and maximum amount smoked for persons smoking in 1954.

Expected number of deaths based on the death rates of persons who had never smoked.

.

| TABLE 7. | MORTALITY   | OF   | EX-SMOKER  | SBYN   | MUMI XAN | AMOUNT   | EVER   | SMOKED |
|----------|-------------|------|------------|--------|----------|----------|--------|--------|
| Ratio    | of observed | to   | expected   | number | r of dea | aths (a) | ll cau | ises)  |
| by smo   | king histor | y ar | nd maximum | amour  | nt smoke | ed.      |        |        |

|                        | Mortality | Number   | of     |
|------------------------|-----------|----------|--------|
| Smoking History        | ratio     | observed | deaths |
| Cigarette only         |           |          |        |
| one pack or less       | 1.27      | 417      |        |
| more than a pack       | 1.52      | 304      |        |
| Cigarette and cigar    |           |          |        |
| one pack or less       | 1.26      | 107      |        |
| more than a pack       | 1.27      | 42       |        |
| Cigarette and pipe     |           |          |        |
| one pack or less       | 1.21      | 173      |        |
| more than a pack       | 1.31      | 81       |        |
| Cigarette, cigar, pipe |           |          |        |
| one pack or less       | .97       | 144      |        |
| more than a pack       | 1.50      | 81       |        |
| Cigar only             |           |          |        |
| less than 5            | 1.59      | 94       |        |
| 5 or more              | 1.33      | 56       |        |
| Cigar and pipe         |           |          |        |
| less than 5 cigars     | 1.29      | 62       |        |
| 5 or more cigars       | 1,19      | 31       |        |
| Pipe only              |           | 51       |        |
| less than 10           | 1.14      | 50       |        |
| 10 or more             | 1.53      | 29       |        |

Expected number of deaths based on the death rates of persons who had never smoked.

|                        | Ratio of obse | rved to expected | deaths  | Number      | of observed deat | hs      |
|------------------------|---------------|------------------|---------|-------------|------------------|---------|
| Smoking history and    | Current use   | Smokes less      |         | Current use | Smokes less      |         |
| maximum amount smoked  | is maximum    | than in past     | Stopped | is maximum  | than in past     | Stopped |
|                        |               |                  |         |             |                  |         |
| Cigarette only         | 1.53          | 1.90             | 1.37    | 1502        | 285              | 721     |
| one pack or less       | 1.44          | 1.64             | 1.27    | 847         | 92               | 417     |
| more than a pack       | 1.66          | 2.05             | 1.52    | 655         | 193              | 304     |
|                        |               |                  |         | _           |                  |         |
| Cigarette and cigar    | 1.40          | 1.18             | 1.26    | 155         | 40               | 149     |
| one pack or less       | 1.20          | 1.06             | 1.26    | 92          | 19               | 107     |
| more than a pack       | 1.85          | 1.31             | 1.27    | 63          | 21               | 42      |
| Cigarette and nine     | 1.34          | 1 43             | 1.24    | 385         | 129              | 254     |
| one pack or less       | 1.16          | 1.07             | 1.21    | 216         | 47               | 173     |
| more than a pack       | 1.69          | 1.78             | 1.31    | 169         | 82               | 81      |
|                        |               |                  |         |             |                  | •-      |
| Cigarette, cigar, pipe | 1.19          | 1.50             | 1.11    | 201         | 120              | 225     |
| one pack or less       | 1.11          | 1.19             | 0.97    | 122         | 50               | 144     |
| more than a pack       | 1.34          | 1.84             | 1.50    | 79          | 70               | 81      |
| Cigar only             | 0.86          | 1.06             | 1.48    | 159         | 69               | 150     |
| less than 5            | 0.76          | 0.93             | 1.59    | 84          | 27               | 94      |
| 5 or more              | 1.03          | 1.17             | 1.33    | 75          | 42               | 56      |
| Cigar and pipe         | 0.97          | 1.24             | 1.26    | 114         | 108              | 93      |
| less than 5 cigars     | 0.97          | 1.12             | 1.29    | 84          | 54               | 62      |
| 5 or more cigars       | 0.97          | 1.38             | 1.19    | 30          | 54               | 31      |
|                        |               |                  |         |             |                  |         |
| Pipe only              | 1.07          | 1.24             | 1.27    | 146         | 21               | 79      |
| less than 10 pipefuls  | 1.07          | 0.91             | 1.14    | 80          | 10               | 50      |
| 10 or more pipefuls    | 1.08          | 1.83             | 1.53    | 66          | 11               | 29      |

#### TABLE 8. --PERSONS WHO REDUCED AMOUNT OF SMOKING Ratio of observed to expected number of deaths by type of smoking history and maximum amount smoked

.

÷

Expected number of deaths were computed from death rates for persons who had never smoked.

Amount is maximum use for persons who had stopped or who smoked less than in the past and current use for those whose current use is maximum.

The ratios for those who had stopped differ slightly from the ratios for ex-smokers in Table 1 due to the fact that broader age groups were used for this table.

#### TABLE 9. MORTALITY BY DURATION OF SMOKING HISTORY Ratio of observed to expected number of deaths (all causes) by smoking history, duration of use, and current use

|                        | Mortali | ty Ratio |            | Number      | of Observe  | ed Deaths | _ |
|------------------------|---------|----------|------------|-------------|-------------|-----------|---|
| Smoking History        | Num     | ber      |            |             | Years       |           | _ |
|                        | - 15    | 15-24    | 25+        | -15         | 15-24       | 25+       | _ |
|                        |         |          |            |             |             |           |   |
|                        |         | Regula   | ar smokers | - Curren    | tly smoking | B         |   |
| Cigarette only         | 1.05    | 1.00     | 1.63       | 23          | 61          | 1952      |   |
| Cigarette and cigar    | 1.29    | 1.00     | 1.36       | 9           | 9           | 196       |   |
| Cigarette and pipe     | .50     | 1.22     | 1.39       | 5           | 22          | 517       |   |
| Cigarette, cigar, pipe | .78     | 1.46     | 1.30       | 7           | 19          | 309       |   |
| Cigar only             | 1.44    | .95      | .92        | 13          | 18          | 243       |   |
| Cigar and pipe         | .67     | 1.25     | 1.06       | 4           | 15          | 222       |   |
| Pipe only              | 1.57    | .93      | 1.07       | 11          | 13          | 168       |   |
|                        |         |          | Regul      | lar - Ex-Su | okers       |           |   |
| Cigarette only         | .97     | .91      | 1.58       | 72          | 92          | 552       |   |
| Cigarette and cigar    | 1.03    | 1.08     | 1.47       | 30          | 27          | 91        |   |
| Cigarette and pipe     | .84     | .62      | 1.53       | 27          | 24          | 202       |   |
| Cigarette, cigar, pipe | .95     | 1.21     | 1.17       | 55          | 47          | 116       |   |
| Cigar only             | 2.00    | 1.29     | 1.45       | 32          | 31          | 87        |   |
| Cigar and pipe         | 1.39    | .82      | 1.42       | 18          | 14          | 61        |   |
| Pipe only              | .81     | .93      | 1.53       | 13          | 13          | 49        |   |

Expected number of deaths based on death rates of persons who had never smoked.

.

Number of years is the number of years each specific form of tobacco had been used; for users of two or more forms duration refers to the first mentioned.

| TABLE 10. MORTALITY BY AMOUNT AND DURATION OF SMOKING HISTORY |
|---|
| Ratio of observed to expected number of deaths (all causes)   |
| by smoking history, amount used, duration of use, and         |
| current use   |

|                                  | Mortal | ity Ratio |           | Numbe     | r of Obser | ved Deaths |
|----------------------------------|--------|-----------|-----------|-----------|------------|------------|
| Smoking History                  |        |           | Number of | Years     |            |            |
| Amount Used                      | -15    | 15-24     | 25+       | -15       | 15-24      | 25+        |
|                                  |        | -         |           | •         |            |            |
| 01                               |        | Regu      | lar Smoke | rs - Curr | ently Smok | ling       |
| Cigarette only                   | 1 00   |           | 1 50      | 17        | 24         | 1020       |
| one pack or less                 | 1.00   | .92       | 1.52      | 1/        | 30         | 1038       |
| more than a pack                 | 1.20   | 1.14      | 1.78      | 0         | 25         | 914        |
| Cigarette and other              |        |           |           |           |            |            |
| one pack or less                 | . 55   | 1.23      | 1.16      | 11        | 32         | 541        |
| more than a pack                 | 2.00   | 1.29      | 1.68      | 10        | 18         | 481        |
| Cigar (including cigar and pipe) |        |           |           |           |            |            |
| less than 5 cigars               | 1.00   | 1.00      | 0.89      | 12        | 21         | 258        |
| 5 or more cigars                 | 1.67   | 1.33      | 1.11      | 5         | 12         | 207        |
|                                  |        |           |           |           |            |            |
| Pipe only                        |        |           |           |           |            |            |
| less than 10 pipefuls            | 1.50   | 1.00      | 1.03      | 9         | 9          | 92         |
| 10 or more pipefuls              | 1.00   | . 80      | 1.12      | 2         | 4          | 76         |
|                                  |        |           | Reg       | lar Ex-s  | nokers     |            |
| Cigarette only                   |        |           |           |           |            |            |
| one pack or less                 | .97    | .92       | 1.48      | 60        | 61         | 292        |
| more than a pack                 | 1.00   | .91       | 1.70      | 12        | 31         | 260        |
| Cigarette and other              |        |           |           |           |            |            |
| one pack or less                 | .91    | . 88      | 1.36      | 93        | <b>6</b> 6 | 259        |
| more than a pack                 | 1.12   | 1.14      | 1.47      | 19        | 32         | 150        |
| Cigar (including cigar and pipe) |        |           |           |           |            |            |
| less than 5 cigars               | 1.65   | 1.23      | 1.48      | 38        | 32         | 86         |
| 5 or more cigars                 | 2.00   | .87       | 1.38      | 12        | 13         | 62         |
|                                  |        |           |           |           |            |            |
| Pipe only                        |        |           |           |           |            |            |
| less than 10 pipefuls            | . 67   | .90       | 1.56      | 10        | 9          | 28         |
| 10 or more pipefuls              | .75    | 1.33      | 1.50      | 3         | 4          | 21         |
|                                  |        |           |           |           |            |            |

Expected number of deaths based on death rates of persons who had never smoked.

Number of years is the number each specific form of tobacco had been used; for users of two or more forms, duration refers to the first mentioned.

| • • • • • • • • • • • • • • • • • • • |      | Mortality | Ratio  |          | Number of Observed Deaths |            |       |     |  |
|---------------------------------------|------|-----------|--------|----------|---------------------------|------------|-------|-----|--|
| Smoking History                       |      |           | A      | ge Start | ed Smoking                |            |       |     |  |
| Amount Used                           | -20  | 20-24     | 25-34  | 35+      | -20                       | 20-24      | 25-34 | 35+ |  |
|                                       |      |           |        | Regu     | lar Ex-S                  | mokers     |       |     |  |
| Cigarette only                        | 1.51 | 1.29      | 1.08   | 1.20     | 393                       | 207        | 85    | 30  |  |
| Cigarette & other                     | 1.34 | 1.07      | 1.05   | 1.16     | 324                       | 162        | 89    | 43  |  |
| Cigar (including cigar                | 1    | 1         |        | 1        |                           |            | 1     |     |  |
| and pipe)                             | 1.59 | 1.47      | 1.26   | 1.00     | 65                        | 103        | 59    | 15  |  |
| Pipe only                             | 1.71 | 1.23      | 1.00   | 1.00     | 29                        | 27         | 14    | 8   |  |
|                                       |      | 1         | Regula | r Smoker | s - Curr                  | ently Smok | ing   | 1   |  |
| Cigarette only                        | 1.72 | 1.54      | 1.27   | 1.21     | 1144                      | 603        | 214   | 75  |  |
| one pack or less                      | 1.66 | 1.51      | 1.20   | 1.18     | 644                       | 391        | 147   | 58  |  |
| more than a pack                      | 1.80 | 1.61      | 1.46   | 1.31     | 500                       | 212        | 67    | 17  |  |
| Cigarette & other                     | 1.43 | 1.35      | 1.06   | 1.13     | 591                       | 307        | 125   | 70  |  |
| one pack or less                      | 1.28 | 1.21      | 1.10   | 1.04     | 358                       | 208        | 100   | 53  |  |
| more than a pack                      | 1.77 | 1.77      | 0.93   | 1.42     | 233                       | 99         | 25    | 17  |  |
| Cigar (including cigar                |      |           |        |          |                           |            |       | 1   |  |
| and pipe)                             | 1.01 | 0.98      | 0.94   | 1.14     | 129                       | 197        | 133   | 56  |  |
| less than 5 cigars                    | 1.12 | 0.96      | 0.86   | 0.98     | 99                        | 142        | 91    | 40  |  |
| 5 or more cigars                      | 0.75 | 1.04      | 1.20   | 1.78     | 30                        | 55         | 42    | 16  |  |
| Pipe only                             | 1.21 | 1.08      | .91    | 1.12     | 57                        | 65         | 42    | 28  |  |
| Less than 10                          |      |           |        |          |                           |            | 1     | 1   |  |
| pipefuls                              | 1.16 | 1.05      | 0.97   | 1.33     | 29                        | 39         | 28    | 24  |  |
| 10 or more pipefuls                   | 1.27 | 1.08      | 0.82   | 0.57     | 28                        | 26         | 14    | 4   |  |

TABLE 11. MORTALITY OF REGULAR SMOKERS BY AGE STARTED Ratio of observed to expected number of deaths (all causes) by smoking history, current use, age started, and current amount used.

Expected number of deaths based on death rates of persons who had never smoked. Age started is the age of starting to smoke each form of tobacco; for users of two or more forms, this refers to the first mentioned.

|                       |        | Mortality R | atio  | Observed Number of Deaths |        |         |       |      |  |  |
|-----------------------|--------|-------------|-------|---------------------------|--------|---------|-------|------|--|--|
| Smoking History       | North- | North       |       |                           | North- | North   |       |      |  |  |
| Maximum Amount Used   | east   | Central     | South | West                      | east   | Central | South | West |  |  |
| Cigarette only        | 1.47   | 1.60        | 1.53  | 1.55                      | 794    | 864     | 636   | 468  |  |  |
| one pack or less      | 1.28   | 1.55        | 1.39  | 1.50                      | 408    | 515     | 311   | 280  |  |  |
| more than a pack      | 1.73   | 1.69        | 1.70  | 1.62                      | 386    | 349     | 325   | 188  |  |  |
| Cigarette & other     | 1.19   | 1.39        | 1.29  | 1.23                      | 498    | 587     | 368   | 285  |  |  |
| one pack or less      | 1.03   | 1.21        | 1.14  | 1.17                      | 295    | 342     | 204   | 178  |  |  |
| more than a pack      | 1.53   | 1.77        | 1.55  | 1.37                      | 203    | 242     | 164   | 107  |  |  |
| Cigar only            | .93    | 1.15        | 1.16  | 1.14                      | 119    | 152     | 104   | 57   |  |  |
| less than 5 cigars    | .96    | 1.14        | .88   | 1.16                      | 68     | 90      | 44    | 36   |  |  |
| 5 or more cigars      | .91    | 1.17        | 1.50  | 1.11                      | 51     | 62      | 66    | 21   |  |  |
| Cigar and pipe        | 1.02   | 1.15        | 1.23  | 1.04                      | 108    | 106     | 81    | 47   |  |  |
| less than 5 cigars    | 1.00   | 1.13        | 1.21  | 1.00                      | 70     | 72      | 51    | 30   |  |  |
| 5 or more cigars      | 1.06   | 1.21        | 1.25  | 1.13                      | 38     | 34      | 30    | 17   |  |  |
| Pipe only             | 1.07   | 1.19        | 1.14  | 1.02                      | 87     | 87      | 57    | 42   |  |  |
| less than 10 pipefuls | 1.08   | 1.02        | 1.18  | 1.04                      | 54     | 48      | 33    | 27   |  |  |
| 10 or more pipefuls   | 1.07   | 1.50        | 1.09  | 1.00                      | 33     | 39      | 24    | 15   |  |  |

TABLE 12. MORTALITY BY SMOKING HISTORY AND GEOGRAPHIC REGION Ratio of observed to expected number of deaths (all causes) by smoking history, geographic region and maximum amount used.

Expected number of deaths based upon the death rates of those who had never used tobacco or had used tobacco only occasionally for each region separately.

#### TABLE 13. MORTALITY OF SMOKERS FROM BROAD GROUPS OF CAUSES

Ratio of observed to expected number of deaths by type of smoking history and cause  $\frac{1}{2}$ 

|   | R                    | atio of                  | observe                      | d to ex             | pected                     | deaths2           |                      | N                        | umber o                      | f obser             | ved dea                    | ths               |
|---|----------------------|--------------------------|------------------------------|---------------------|----------------------------|-------------------|----------------------|--------------------------|------------------------------|---------------------|----------------------------|-------------------|
| Smoking<br>History                          | Cancer<br>of<br>lung | Cancer<br>except<br>lung | Respira-<br>tory<br>diseases | Cardio-<br>vascular | Suicide,<br>acci-<br>dents | Other<br>diseases | Cancer<br>of<br>lung | Cancer<br>except<br>lung | Respira-<br>tory<br>diseases | Cardio-<br>vascular | Sufcide,<br>Acci-<br>dents | Other<br>Diseases |
| Never smoked or smoked<br>occasionally only | 1.00                 | 1.00                     | 1.00                         | 1.00                | 1.00                       | 1.00              | 17                   | 248                      | 24                           | 1017                | 97                         | 121               |
| Used tobacco                                | 6.00                 | 1.26                     | 1.66                         | 1.27                | .92                        | 1.38              | 312                  | 981                      | 118                          | 3983                | 294                        | 515               |
| Regular smoker                              | 6.64                 | 1.30                     | 1.80                         | 1.31                | .94                        | 1.41              | 299                  | 877                      | 112                          | 3556                | 261                        | 458               |
| Cigarette total                             | 8.32                 | 1.30                     | 2.24                         | 1.40                | .91                        | 1.48              | 283                  | 675                      | 101                          | 2887                | 203                        | 363               |
| Cigarette and others                        | 6.40                 | 1.31                     | 1.52                         | 1.24                | .79                        | 1.36              | 96                   | 290                      | 32                           | 1107                | 72                         | 145               |
| Cigarette only                              | 9.35                 | 1.30                     | 2.76                         | 1.53                | .99                        | 1.57              | 187                  | 385                      | 69                           | 17 <b>8</b> 0       | 131                        | 218               |
| Cigarette and cigar                         | 7.00                 | 1.42                     | 1.00                         | 1.23                | .94                        | 1.41              | 21                   | 64                       | 4                            | 227                 | 16                         | 31                |
| Cigarette and pipe                          | 6.29                 | 1.22                     | 2.25                         | 1.32                | .75                        | 1.49              | 44                   | 122                      | 18                           | 518                 | 33                         | 70                |
| Cigarette, cigar, pipe                      | 6.20                 | 1.35                     | 1.25                         | 1.14                | . 79                       | 1.16              | 31                   | 104                      | 10                           | 362                 | 23                         | 44                |
| Cigar only                                  | 1.50                 | 1.36                     | 0.43                         | 1.00                | .92                        | 1.38              | 6                    | 87                       | 3                            | 271                 | 22                         | 44                |
| Cigar and pipe                              | 2.00                 | 1.48                     | 0.40                         | 1.00                | 1.11                       | 1.12              | 6                    | 74                       | 2                            | 211                 | 20                         | 29                |
| Pipe only                                   | 1.33                 | 1.03                     | 1.50                         | 1.11                | 1.07                       | 1.10              | 4                    | 41                       | 6                            | 187                 | 16                         | 22                |
| Amount unknown                              | 2.00                 | 1.00                     | 0.75                         | 1.06                | .71                        | 1.45              | 6                    | 45                       | 3                            | 196                 | 12                         | 32                |

<u>1</u>/ Includes underlying causes only.

2/ Expected number of deaths - computed by multiplying the number of person years exposure in each age group for each smoking history category by the age-specific death rates from each cause of death of persons who had never smoked or who had used tobacco only occasionally.

## TABLE 14. MORTALITY OF REGULAR CIGARETTE SMOKERS FROM SPECIFIC DISEASES

Ratio of observed to expected number of deaths of persons who regularly smoked cigarettes only.

| N                            | o. of $Ob_{1}^{-}$ | Ratio to Ex-    |
|------------------------------|--------------------|-----------------|
| Disease serve                | d Deaths 1/        | pected Deaths2/ |
| Cancer of lung               |                    |                 |
| (162,163)                    | 197                | 9.85            |
| Cancer of prostate           |                    |                 |
| (177)                        | 52                 | 2.17            |
| Cancer of mouth.pharvnx      |                    |                 |
| econhama (140-148,15         | 0) 24              | 2.18            |
| Cencer of bledder (181)      | 29                 | 1.93            |
| Cancer of stomach (151)      | 30                 | 1.86            |
| Malienant lumphones          | 37                 | 2.00            |
| Antiguant Tymphomas          | 56                 | 1 70            |
|                              | 50                 | 1.70            |
| Cancer, other forms          | 00                 | 1.50            |
| Cancer of pancreas (15/      | ) 31               | 1.19            |
| Cancer of intestines         |                    |                 |
| and rectum (152-154)         | 94                 | 1.09            |
| Cancer of kidney (180)       | 16                 | 1.00            |
| Leukemia (204)               | 23                 | . 89            |
|                              |                    |                 |
| <b>Pneumonia (480-493)</b>   | 145                | 1.61            |
| Bronchitis, emphysema,       |                    |                 |
| etc. (500-527)               | 147                | 3.27            |
|                              |                    |                 |
| Arteriosclerotic             |                    |                 |
| (coronary heart              |                    |                 |
| disease (420)                | 1,420              | 1.63            |
| Nonrheumatic chronic         | •                  |                 |
| endocarditis (421-           |                    |                 |
| 422)                         | 135                | 1.55            |
| Hypertension with heart      |                    |                 |
| disease (440-443)            | 279                | 1.53            |
| Coneral Arteriosclarosi      |                    | 2.33            |
| (450)                        | o<br>2/2           | 1 / 6           |
| (450)<br>Emertencion without | 245                | 1.40            |
| hypertension without         |                    |                 |
| Heart disease (444-          | 00                 | 1 41            |
| 44/)<br>Comphenellow         | 02                 | 1.41            |
| Cerebrai Vascular            | 001                | 1 00            |
| lesions (330-334)            | 281                | 1.33            |
| Chronic nephritis            |                    |                 |
| (592-594)                    | 26                 | 1.04            |
| Chronic rheumatic            |                    |                 |
| heart disease (410-          |                    |                 |
| 416)                         | 42                 | . 84            |
|                              |                    |                 |
| Paralysis agitans (350)      | 9                  | . 36            |
| Other diseases of liver      | ,                  |                 |
| gallbladder and pan-         |                    |                 |
| creas (582-587)              | 45                 | 1.15            |
| Diabetes (260)               | 84                 | 1.18            |
| Ulcer of stomach and         |                    |                 |
| duodenum (540.541)           | 51                 | 2.83            |
| Cirrhoeie of liver (581      | ) 62               | 2 95            |

<u>1</u>/ Includes underlying and contributory causes of death.

\_2/ Expected number of deaths - computed by multiplying the number of person years exposure in each age group of regular smokers of cigarettes only by the age-specific death rates from each cause of death (including underlying and contributory causes) of persons who had never smoked or who had used tobacco only occasionally. TABLE 15. RELATIVE IMPORTANCE OF DISEASES CAUSING EXCESS MORTALITY AMONG REGULAR CIGARETTE-ONLY SMOKERS

| 1.                                  | Observe | ed Deaths | Observed Mi | nus Expected <sup>2/</sup> | Mortality |
|-------------------------------------|---------|-----------|-------------|----------------------------|-----------|
| Cause of Death <del>J</del>         | Number  | Percent   | Number      | Percent                    | Batio     |
|                                     |         |           |             |                            |           |
| Cancer of Lung                      | 187     | 6.8       | 167         | 16.8                       | 9.35      |
| Respiratory Diseases                | 69      | 2.5       | 44          | 4.4                        | 2.76      |
| Coronary Heart Disease              | 1212    | 43.7      | 944         | 44.8                       | 1.58      |
| Hypertensive Cardiovascular Disease | 148     | 5.3       | 53          | 5.3                        | 1.56      |
| Other Cardiovascular Diseases       | 420     | 15.2      | 119         | 11.9                       | 1.40      |
| Cancer except Lung                  | 385     | 13.9      | 88          | 8.8                        | 1.30      |
| All Other Diseases                  | 349     | 12.6      | 62          | 7.9                        | 1.29      |
| Total                               | 2770    | 100.0     | 966         | 6.92                       |           |
|                                     |         |           |             |                            |           |

1/ Underlying causes only.

2/ Expected deaths based on death rates of persons who had never smoked or who had smoked occasionally only. TABLE 16. MORTALITY OF REGULAR CIGARETTE SMOKERS FROM SPECIFIC CAUSES BY AMOUNT SMOKED Ratio of observed to expected number of deaths of persons who had regularly smoked cigarettes only by current amount smoked, July 1954-December 1956.

|                                 | Morta | lity Ratio  | <u>2</u> /  | Number     | of observ | ved death                               | , <u>1</u> |
|---------------------------------|-------|-------------|-------------|------------|-----------|---|------------|
| Disease                         |       |             | Current amo | unt smoked |           |   | _          |
|                                 | -10   | 10-20       | 21+         | -10        | 10-20     | 21+                                     | _          |
|                                 |       | • · · · · · |             |            |           |   |            |
| Cancer of lung (162,163)        | 5.50  | 10.00       | 15.80       | 11         | 70        | 79                                      |            |
| Cancer of prostate (177)        | 1.67  | 2.00        | 2.33        | 5          | 16        | 14                                      |            |
| Cancer of mouth, pharynx        |       |             |             |            |           |   |            |
| esophagus (140-148,150)         | 1.00  | 2.50        | 4.00        | 1          | 10        | 12                                      |            |
| Cancer of bladder (181)         | 1.00  | 1.83        | 2.75        | 2          | 11        | 11                                      |            |
| Cancer of stomach (151)         | 4.50  | 2.00        | 1.40        | 9          | 14        | 7                                       |            |
| Malignant lymphomas (200-203)   | 0.67  | 1.91        | 1.89        | 2          | 21        | 17                                      |            |
| Cancer, other forms             | 1.00  | 1.39        | 1.39        | 7          | 32        | 25                                      |            |
| Cancer of pancreas (157)        | 0.67  | 1.00        | 2.00        | 2          | 9         | 14                                      |            |
| Cancer of intestines and        |       |             |             | -          | -         | -                                       |            |
| rectum (152-154)                | 1.22  | 1.00        | 1.14        | 11         | 30        | 25                                      |            |
| Cancer of kidney (180)          | 1 50  | 1 17        | 0.75        | 3          | 7         | ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~ |            |
| Loukomia (20%)                  | 0.22  | 0.79        | 1 / 2       | 1          | 7         | 10                                      |            |
| Leukemia (204)                  | 0.35  | 0.78        | 1.45        | L          | ,         | 10                                      |            |
| Pneumonia (480-493)             | 1.70  | 1.78        | 1.82        | 17         | 57        | 40                                      |            |
| Bronchitis, emphysema,          |       |             |             |            |           |   |            |
| etc. (500-527)                  | 2.20  | 3.75        | 3.70        | 11         | 60        | 37                                      |            |
|                                 |       |             |             |            |           |   |            |
| Arteriosclerotic (coronary)     |       |             |             |            |           |   |            |
| h <b>ear</b> t disease (420)    | 1.32  | 1.76        | 1.75        | 120        | 539       | 387                                     |            |
| Nonrheumatic chronic            |       |             |             |            |           |   |            |
| endocarditis (421-422)          | 1.30  | 1.68        | 1.62        | 13         | 52        | 34                                      |            |
| Hypertension with heart disease |       |             |             |            |           |   |            |
| (440-443)                       | 1.32  | 1.34        | 1.63        | 25         | 87        | 75                                      |            |
| General arteriosclerosis (450)  | 0.84  | 1.62        | 1.46        | 16         | 97        | 57                                      |            |
| Hypertension without heart      |       |             |             |            |           |   |            |
| disease (444-447)               | 2.00  | 1.10        | 1.57        | 12         | 22        | 22                                      |            |
| Cerebral vascular lesions       |       |             |             |            |           |   |            |
| (330-334)                       | 1.54  | 1.27        | 1.46        | 37         | 95        | 73                                      |            |
| Chronic nephritis (592-594)     | _     | 1.00        | 1.14        | -          | 9         | 8                                       |            |
| Chronic rheumatic heart         |       |             |             |            | -         | •                                       |            |
| disease (410-416)               | 0.80  | 0.94        | 0.77        | 4          | 16        | 10                                      |            |
|                                 |       |             |             |            |           |   |            |
| Paralysis agitans (350)         | 0.33  | 0.11        | 0.17        | 1          | 1         | 1                                       |            |
| Other diseases of liver, gall-  |       |             |             |            |           |   |            |
| bladder and pancreas (582-587)  | 1.00  | 0.64        | 1.50        | 4          | 9         | 15                                      |            |
| Diabetes (260)                  | 0.62  | 0.96        | 1.39        | 5          | 24        | 25                                      |            |
| Ulcer of stomach and duodenum   |       |             |             |            |           |   |            |
| (540,541)                       | 1.50  | 3.67        | 2.60        | 3          | 22        | 13                                      |            |
| Cirrhosis of liver (581)        | 3.00  | 3.14        | 4.17        | 6          | 22        | 25                                      |            |
|                                 |       |             |             | -          |           |   |            |

 $\underline{1}$ / Includes underlying and contributory causes of death.

2/ Expected number of deaths based on the death rates from each cause of death (including underlying and contributory causes) of persons who had never smoked or who had used tobacco only occasionally.

#### TABLE 17. MORTALITY OF REGULAR PIPE SMOKERS FROM SPECIFIC CAUSES

Ratio of observed to expected number of deaths of persons who had regularly smoked a pipe only (lifetime history) July 1954-December 1956.

|                           | No. of    | Ratio of  |
|---------------------------|-----------|-----------|
| Disease                   | Observed  | Expected  |
|                           | Deaths 1/ | Deaths 2/ |
| Cancer of lung (162,163)  | - 4       | 1.33      |
| Cancer of prostate (177)  | 4         | 1.00      |
| Cancer of mouth, pharynx  |           |           |
| esophagus (140-148,150)   | ) 2       | 1.00      |
| Cancer of bladder (181)   | 3         | 1.50      |
| Cancer of stomach (151)   | 5         | 1.67      |
| Malignant lymphomas       |           |           |
| (200-203)                 | 3         | 0.75      |
| Cancer, other forms       | 13        | 1.62      |
| Cancer of pancreas (157)  | 3         | 0.75      |
| Cancer of intestines and  | -         |           |
| rectum (152-154)          | 10        | 0.83      |
| Cancer of kidney (180)    | 1         | 0.50      |
| Leukomia (20/1)           | 3         | 1 00      |
| Leuremia (204)            | 5         | 1.00      |
| $Prox_{0} = (/80 - /93)$  | 12        | 0.86      |
| Propobitio (400-493)      | 12        | 0.00      |
| brouchills, emphysema,    | 15        | 1 00      |
| ecc. (500-527)            | 15        | 1.00      |
| Artoriogolorotio (coronor | •••       |           |
| horrt diagona (420)       | 1/2       | 1 16      |
| Norzhouratie chronie      | 142       | 1.10      |
| Nourneumatic chronic      | 16        | 1 14      |
| endocarditis (421-422)    | 10        | 1.14      |
| Hypertension with heart   | 10        | 0.76      |
| disease (440-443)         | 19        | 0.76      |
| General arteriosclerosis  |           |           |
| (450)                     | 23        | 0.79      |
| Hypertension without hear | t         |           |
| disease (444-447)         | 5         | 0.62      |
| Cerebral vascular lesions | 1         |           |
| (330-334)                 | 33        | 0.97      |
| Chronic nephritis (592-   |           |           |
| 594)                      | 1         | 0.33      |
| Chronic rheumatic heart   |           |           |
| disease (410-416)         | 7         | 1.17      |
|                           |           |           |
| Paralysis agitans (350)   | 1         | 0.25      |
| Other diseases of liver,  |           |           |
| gallbladder and pancrea   | IS        |           |
| (582-587)                 | 4         | 0.67      |
| Diabetes (260)            | 5         | 0.50      |
| Ulcer of stomach and duo- | •         |           |
| denum (540,541)           | 5         | 2.50      |
| Cirrhosis of liver (581)  | 6         | 2.00      |
|                           |           |           |

 $\underline{1}$  / Includes underlying and contributory causes of death.

2/ Expected number of deaths based on the death rates from each cause of death (including underlying and contributory causes) of persons who had never smoked or who had used tobacco only occasionally.

#### TABLE 18. MORTALITY OF REGULAR CIGAR SMOKERS FROM SPECIFIC CAUSES

Ratio of observed to expected number of deaths of persons who regularly smoked only cigars or cigars and a pipe, lifetime history, July 1954-December 1956.

| No. of    | Ratio of  |
|-----------|---|
| Observed  | Expected,   |
| Deaths 1/ | Deaths 4  |
| 13        | 1.86  |
| 28        | 2.55  |
|           |   |
| ) 12      | 2.40  |
| 3         | 0.50  |
| 9         | 1.00  |
|           |   |
| 12        | 0.92  |
| 32        | 1.39  |
| 11        | 1.00  |
|           |   |
| 54        | 1.54  |
| 6         | 1.20  |
| 11        | 1.22  |
|           |   |
| 38        | 0.93  |
|           |   |
| 22        | 1.00  |
|           |   |
| ry)       |   |
| 373       | 1.05  |
|           |   |
| ) 39      | 0.98  |
|           |   |
| 85        | 1.16  |
|           |   |
| 74        | 0.91  |
| rt        |   |
| 29        | 1.26  |
| S         |   |
| 92        | 0.96  |
|           |   |
| 9         | 1.00  |
|           |   |
| 8         | 0.42  |
|           |   |
| -         | -   |
|           |   |
| as        |   |
| 22        | 1.38  |
| 55        | 1.90  |
| -         |   |
| 15        | 2.14  |
| 22        | 3.14  |
|           | No. of<br>Observed<br>Deaths 1/<br>13<br>28<br>13<br>28<br>12<br>32<br>11<br>54<br>6<br>11<br>38<br>22<br>cy)<br>373<br>39<br>85<br>cy<br>373<br>39<br>85<br>cy<br>373<br>9<br>85<br>74<br>ct<br>29<br>8<br>92<br>9<br>8<br>-<br>15<br>22 |

<u>1</u>/ Includes underlying and contributory causes of death.

2/ Expected number of deaths based on the death rates from each cause of death (including underlying and contributory causes) of persons who had never smoked or who had used tobacco only occasionally.