The Changing Cancer Death Rate*

Evelyn A. Potter, Biometrician

(From the Division of Cancer and Other Chronic Diseases, Massachusetts Department of Public Health, Boston 14, Massachusetts)

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Epidemiological studies of cancer may be misleading unless individual primary sites are considered separately. Data permitting such analytical investigations were not available in official mortality records prior to 1930, as only 7 classifications of cancer were subdivided by age and sex, except for the years 1914 and 1925. At the present time 30 sites of malignant neoplasms are listed in the vital statistics reports, but even now the cellular variations are not included. Since both the points of tumor origin and the pathologic histology influence the clinical and epidemiological aspects of cancers, consideration of both these factors is essential if one is to avoid the fallacy of mixed classification in the data.

Adjustment of death rates.—Between 1933 and 1944 the crude death rate from cancer for the white population in the Continental United States increased 1.7 per cent annually. The rise was not evenly distributed between the sexes as the rate for females increased 1.2 per cent annually, and that for males, 2.3 per cent. It is impossible to secure a correct picture of changes in mortality that may have occurred in any locality over a period of time unless the effect of a changing age composition in the population is taken into consideration. Therefore, the increased longevity of the population in the United States necessitated an adjustment of the crude death rates in order to compare the rates for a series of years.

When the cancer death rates of the white population for 1933 to 1944 in the Continental United States were adjusted to the age distribution of the total population of the United States, as enumerated in the census of 1940, the annual average increase in the rate for males was 0.76 per cent, while that for females decreased 0.38 per cent annually. These yearly average changes were computed from adjusted rates of all forms of cancer combined, and as the epidemiology of each entity differs the figures fail to portray the true situation. A better knowledge of existing conditions was obtained by studying cancer data by the site of origin. Twenty-two categories were used.

Combined primary sites.—It was impossible to separate deaths from cancer of the stomach from those of cancer of the duodenum for the entire period of observation, but inasmuch as gastric cancer cases represented approximately 98 per cent of the stomach-duodenum group in the years when separation was possible, the inclusion of duodenal cancer throughout this period did not greatly affect the figures and hereafter these cases will be referred to as the "gastric group."

The "buccal cavity group" was comprised of cancers of the lip, tongue, mouth, jaw, and unspecified parts of the area.

In the "other-respiratory group" 80 per cent were cancers of the bronchus; 15 per cent, of the mediastinum and unspecified parts; and the remainder, of the trachea and pleura.

Cancers of the vulva comprised nearly two-thirds of the "vulval-vaginal group."

Of the group consisting of ovaries, fallopian tubes, and parametrium, 99 per cent were ovarian cancers, and hereafter will be called the "ovarian group."

Trends of cancer death rates.—The adjusted rate for each of the 22 sites studied was allocated to one of three classes, depending on whether the adjusted rate showed an upward trend, a downward trend, or no significant trend. The annual percentage of change was obtained for sites with significant trends, using the method described by Gover (4).

The class showing downward trends included stomach, buccal cavity, skin, uterus, and liver. In the class exhibiting no significant trend were larynx (female), vulva-vagina, breast, scrotum, bladder, esophagus, kidney (female), and rectum (female). Those in the class showing upward trends were pancreas, testes, prostate, intestines, lung, pharynx, larynx (male), "other respiratory," ovary, rectum (male), kidney (male), and "all others."

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Table I: Average Annual Prevalence Change in the Frequency of Deaths From Cancer of Specific Sites Among Whites and Non-Hispanic Blacks (1940-1969)
The rates for the class showing the upward trend increased annually by 3.1 per cent for males and 2.5 per cent for females; that for the second class showed a downward trend of 2.4 per cent for males and 2.6 per cent for females; whereas there was no significant annual percentage of change in the third class.

Sites with an upward trend in mortality rate.—Among the cancers with an upward trend in rates, those of the lung, “other respiratory,” and pharynx showed the greatest increase. Pharyngeal cancer is included with the buccal cavity group in the Manual of the International List of Causes of Death, but inasmuch as its trend was at variance with that of the buccal cavity group, it was considered separately. Its high rate of increase more closely approaches that of the respiratory group.

The increase in the respiratory group and in that of the pharynx is significant enough to warrant speculation. Part of this apparent increase may be due to more accurate diagnosis. Also, it has been suggested that irritation from respiratory infections and inhaled irritants, including tar dust from the roads, may be of etiological significance.

Cancer of the ovary has shown a high rate of increase. A part of this may be the result of improved diagnosis.

Sites without significant rate trends.—The adjusted rates for most of the sites in the group without a significant trend were small. The principal exception was the rate for cancer of the breast (female). It is believed that this really belongs with the sites having declining rates, and if there were greater accuracy in the certification of primary breast cancer it would be classified in the downward trend group. A discussion of breast cancer is included in the section immediately following.

Sites with downward trends.—Mortality from cancer of the skin decreased 2.4 per cent annually for each sex, during the period of observation. This is not surprising, since the effects of education and improved methods of treatment would be expected to reduce the deaths from cancer of this accessible site.

Cancer of the buccal cavity showed an even greater reduction than that of the skin, i.e., 3.8 per cent for men and 3.4 for women. Here, too, cancer education and improved therapy are probably major causative factors, but in addition, one must consider the better dental hygiene and nutrition of recent years, the decline in syphilis prior to World War II, and the cooperation of members of the dental profession in urging individuals to seek a medical diagnosis for questionable oral lesions.

Better obstetrical care, cancer educational activities, and improved cancer therapy are partly responsible for the decrease in the death rate for uterine cancer. A fourth factor may be the declining birth rate, as the relationship between child-bearing and cancer of the uterus is well established. The Cancer Commission of the League of Nations concluded that “it is the fact of a pregnancy and not the number of pregnancies which is the predisposing factor in the production of cancer of the uterus,” and since a special report of the Census Bureau on fertility for the years 1910 and 1940 shows an increase in nulliparous women, a decrease in the death rates from cancer of the uterus might be expected.

Primary cancer of the liver is rare in this country. Dr. Shields Warren has stated that “Many cancers metastasize freely to the liver. Among these are cancers of the rectum and the stomach. These two examples, however, are no longer important sources of error as they are practically always recognized in the local manifestations and classified accordingly. However, there are cancers, such as those of the pancreas and breast, which may be overlooked, or treated and forgotten that do contribute to metastasis in the liver.” It is probable that the lowered death rate from cancer of the liver is due principally to a more accurate diagnosis of cancers of the pancreas and breast. Of course, cancers from sites other than those mentioned above involve the liver, but there is less probability of their being diagnosed erroneously as cancer of the liver.

If the assumption is made that most of the instances classified as primary cancer of the liver were actually secondary to primary cancer of other organs, it would seem reasonable to apportion and combine them with their sites of origin. It is believed that primary breast cancers comprise more than 50 per cent of those erroneously classified, but this figure has been used in order to be ultraconservative. Fifty per cent of the hepatic cancers were apportioned to the breast and new trends were computed. Cancer of the breast among women then showed a significant downward trend. The downward trend in liver cancer among females probably results from a real improvement in the mortality from breast cancer. If that is so, cancer of this site should be included in the downward trend class.

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1 Among 531 autopsy records of women who had metastases to the liver 36.5 per cent were found to be primary breast cancers. When the sites which might have been erroneously classified on the death records were segregated, cancer of the breast comprised nearly 70 per cent of this group.
With the increasing number of breast cases treated during the early stages, and with the greater number of 5-year cures, it seems reasonable that an improvement should be reflected in the mortality statistics, and it is believed that this has occurred.

Cancer education and improved medical and surgical service have been considered important factors in the reduction of rates for the sites just discussed. As for cancer of the stomach, however, the situation is different. The decrease that has occurred in the mortality from gastric cancer is far greater than could be expected to result from the general educational programs and from improved medical service. While a small part of this may have been the result of better classification, other factors must have been operating. In looking for an explanation, the findings of Stevenson seem pertinent (10).

In the Registrar-General's Decennial Supplement for 1931, Stevenson analyzed the cancer mortality statistics for England and Wales according to exposed and non-exposed sites; and then these groups were subdivided into 5 classes according to the economic status of the individuals, as determined by occupation. Cancers of the exposed areas showed the highest mortality in the unskilled classes and were classified as Group I. Cancers of the non-exposed sites were classified as Groups II and III, the former consisting of those sites with lowest mortality in the unskilled classes, and the latter, those sites showing no definite relationship between mortality and social class.

Stevenson and his colleagues (9) in reporting on these findings stated: "It thus appears that a large proportion, at least, of cancer mortality is of a highly preventable nature, for we must suppose that if the conditions of life of all sections of society could be assimilated to those of its upper ranks, mortality from cancer of the exposed sites would fall for all classes to the Class I level. Indeed, it is very possible that knowledge of the preventable causes accounting for the difference might provide the means of reducing if not eliminating these forms of cancer for all causes, for these causes might well be found to apply in varying degree to all sections of society."

Stevenson's Group I included cancer of the upper alimentary canal, larynx, skin, scrotum, penis, uterus, and of the vulva-vagina. Most of these sites fall into either the downward trend class of the present study or into that with no trend. It seems improbable that a downward trend in cancer of the stomach could be caused by control measures, although several of Stevenson's Group I sites could be so influenced. It would appear that the stomach might be the site that would best reflect any correlation between lowered incidence and improved standards of living.

The age at which carcinogenic influences have their inception is unknown, but the Kennaways (6) suggest that gastric cancer arising after the second 25 years of life may be predestined to occur by factors to which the body was exposed during the first 25 years. Hueper (5), in discussing occupational cancer, asserts that "The exposure time necessary for eliciting cancerous reactions in exposed workers varies greatly with the type and potency of the carcinogenic agent, with the intensity of exposure and with the susceptibility of the individual. The range is from six months to three or four decades, while the average exposure time is from five to fifteen years."

If the change in the rate for cancer of the stomach began around 1926, as reported by Dublin and Lotka (2), one might expect the changes that caused the decreasing incidence to have occurred about the turn of the century. Lombard and Docring (8), in discussing possible causative factors of gastric cancer, questioned whether irritation could be caused by hasty eating of monotonous, poorly prepared food, and further questioned whether such irritation might be the exciting cause of cancer of the stomach. According to the United States Department of Agriculture (12) "... diets have changed in this country in two generations. Analysis shows that the proportion of calories derived from milk, cheese, fruits, and succulent vegetables has actually doubled in 50 years. There has also been a slightly greater emphasis on sugars and fats."

It has been said that the greatest improvement in dietary habits has occurred in the lowest economic group. If the majority of people in the United States are securing a wider variety of properly prepared, nutritious food, one can at least consider the possibility of a real relationship between these factors and a decrease in gastric cancer.

The effect of cancer education.—The decrease in the rates for cancer of the stomach, uterus, skin, buccal cavity and liver was sufficiently great to cause a downward trend in the total female cancer rate. Inasmuch as a part of the improvement has been attributed to education it would be desirable to compare this trend with the one for Massachusetts, where intensive educational work has been of longer duration than for the country as a whole. Unfortunately many variables make such a comparison of doubtful value. A comparison between the trend for Massachusetts and that for the Registration
Area of 1900 would be more satisfactory. Such a study has been made by Lombard (7). "In the early part of the century the adjusted cancer death rates for both sexes were rising about two per cent per year in both the Registration Area of 1900 and Massachusetts. Shortly before this country entered the First World War the increase among females lessened, somewhat more in Massachusetts than in the Registration Area. A change occurred in the male rate around 1926 for both Massachusetts and the Registration Area. From then on the annual percentage increase was only about one-half its previous value. In the middle thirties, a downward trend was noted in Massachusetts among females and a few years later a similar drop occurred in the Registration Area of 1900."

If the assumption is made that the drop in the cancer rate is the result of cancer control activities, the earlier decline in the female rate for Massachusetts seems a logical occurrence, inasmuch as this state was the first to develop an integrated cancer control program. The later drop, which appeared in the trends for the United States, might be expected when one considers the increased cancer control activity that occurred as the result of the inauguration of the cancer program of the United States Public Health Service, that of several states, and the educational activities of the American Cancer Society.

SUMMARY

During the past 12 years the adjusted mortality rates for cancer of the stomach, buccal cavity, skin, uterus and liver have shown downward trends for the white population of the Continental United States. The rates for cancer of other sites, including pancreas, testes, prostate, intestines, lung and "other respiratory" sites, have shown upward trends; whereas for the larynx (female), vulva-vagina, breast, scrotum, bladder, esophagus, kidney (female), and rectum (female) no significant trend was apparent. The sites of origin showing downward rate trends may be divided into 2 categories: those that probably have been influenced by education and improved therapy, and one site (stomach) in which improvement may be the result of better living conditions.

ACKNOWLEDGMENT

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REFERENCES

14. WARREN, S. Personal Communication.
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