

A REVIEW OF THE CANCER STATISTICS IN ENGLAND
AND WALES AND IN SCOTLAND BETWEEN
1891 AND 1927.

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(With a Diagram.)

THAT the number of deaths ascribed to cancer has steadily increased within recent years no one will deny, but as to the causes which have produced the increase there is not the same unanimity of opinion. Thirty years ago cancer did not rank very high in the list of fatal diseases. In 1899 the total number of deaths from cancer amongst persons in England and Wales was 26,325 as against 60,659 allocated to tubercular disease. Nowadays, "the old order changeth yielding place to new." According to the most recent statistics issued by the Registrar-General, in 1929, the number of deaths assigned to cancer was 56,896 and to all forms of tuberculosis 37,990. In view of this large increase in the number of deaths allocated to cancer it seemed of interest to review the cancer statistics of the last thirty years in this country and in Scotland. No investigation of this nature would be complete without first drawing attention to the very important work already done by Dr Stevenson in the *Annual Reports of the Registrar-General*, particularly the report for 1917 in which he examined the incidence of cancer in particular sites. The statistics of cancer in Scotland have not, until recently, received quite the same amount of attention as those of England. In a paper read to the Medical Association in Edinburgh and afterwards published in the *Journal* of that society, Dr Dunlop, the Registrar-General, gave a detailed account of the mortality, according to sites, between the years 1911 and 1928. He compared the actual numbers of deaths in 1920-2 and in 1928 with the numbers that might be expected to occur on the basis of the cancer mortality in age groups which prevailed in 1910-12. His method of analysis conforms partly to that of indirect standardisation. The conclusions as stated in the paper were:

I. There has, during recent years, been an increase in the cancer death-rate.

II. Of the increase the larger portion, approximately three-quarters, has been due to the ageing of the population leading to larger numbers living in those ages in which the cancer death-rate is high.

III. Subject to an exception in the case of mammary cancer the portion of the increase in the observed frequency unexplained by the ageing may

with reason be attributed to better recognition of cancer, and therefore does not indicate any true increase in the incidence of the disease.

The basis for the second deduction was afforded by the following figures taken from Dr Dunlop's paper:

Actual cancer deaths in 1911	...	...	...	= 5002
Actual cancer deaths in 1921	...	...	...	= 5953
Expected number of cancer deaths in 1921 on the basis of the death-rates at ages prevailing in 1911				= 5799
Therefore the expected difference expressed as a percentage of the actual difference	...	...		= $\frac{797}{951} \times 100 = 83\%$

The factor which is regarded as accounting for this 83 per cent. of the total increase in the number of cancer deaths does not measure a variation in the age constitution of the population only, its value depends upon:

- (1) the increase of the population between the two censuses;
- (2) the change in the age constitution of the 1921 census as compared with that of 1911.

If the object of an investigator is to measure the gross amount of cancer in a community, it is right to take into account all the deaths from cancer no matter at what age they occur. But if his purpose is to measure the rate of increase of cancer which is independent both of mere size of population and of age constitution, then it is essential that particular attention be paid to the ages at which the disease is prevalent. As 93 per cent. of the total cancer deaths occur after age 35 years it is practically irrelevant to any discussion of cancer mortality to introduce the population living before this period of life. A much more serious objection to the method is, however, the confusion of absolute increase and change of age constitution. Deductions drawn from the absolute numbers of deaths are misleading unless the population is stationary. The total population of Scotland in 1911 was 4,760,904 and in 1921 it amounted to 4,882,497 or increased approximately 3 per cent. If, however, we regard, and correctly so, the population at age 35 years and upwards as our "cancer population," we find that in 1911 there were 1,600,773 persons at this period of life and in 1921 1,821,626, an increase of 14 per cent. Hence it follows that if we are discussing the increase in the cancer mortality in Scotland as determined by age any conclusions drawn from an enumeration of the deaths alone are misleading. The deaths must be related to the population among which they occurred before any reliable deductions can be made. Taking the data in Dr Dunlop's paper and confining them to the ages 35 years and upwards, the results expressed in terms of the crude death-rates amongst persons are:

Death-rate per 1000 persons aged 35 and over.

	Actual	Expected
1911	3.008	—
1921	3.167	3.084

from which we observe that between 1911 and 1921 the mortality from cancer increased from 3·008 to 3·167 or 5·3 per cent. approximately. If there had been no change in the age constitution of the population the expected death-rate in 1921 would have been identical with the actual death-rate in 1911, but, in the present instance, there is a difference of 0·076 between them. In other words the age constitution of the 1921 population in comparison with that of 1911 had become unfavourable to a low cancer mortality. Expressing the increase 0·076 in terms of the total increase 0·159, that is the difference between the actual death-rates in 1921 and in 1911, we find that the change in age constitution of the 1921 population was responsible for 48 per cent. of the total increase in the cancer mortality and that other factors such as better diagnosis or a real increase in the disease accounted for 52 per cent. of the increased mortality and not 17 per cent. as suggested.

DATA.

For the purpose of the present enquiry the cancer mortality in triennial periods of which the central year is a census year has been calculated for the separate sexes beginning at 1890–92, *e.g.* the arithmetical average was taken of the number of deaths at specified ages occurring during the years 1890, 1891 and 1892 and afterwards related to the population enumerated at the 1891 census. The investigation ended with the year 1927, as the *Annual Report* for England and Wales, although since published, was not available when the analysis was made. In utilising triennial periods we avoid the errors which must inevitably arise when estimates of population are made for years removed from the census year. In the last period 1923–7, which was made a quinquennial one, there was no option but to use an estimated population, and the estimated population in 1925 was regarded as representing, on the average, the exposed to risk over this period. The mortality from cancer of particular sites classified into certain broad groups as accessible and inaccessible has been discussed and compared for the various triennia beginning at 1901. Proceeding on the lines previously stated the death-rates in this paper have been confined to the ages 35 years and upwards. Further, to eliminate any variation that may have occurred in age and sex constitution of the populations in the two countries, and to secure comparability of the total mortality at age 35 years and upwards, the death-rates have been standardised. The population utilised for this purpose was that enumerated in England and Wales at the census of 1901, this being the population frequently used as a standard for international comparisons of mortality.

In Table I the standardised death-rates amongst males and females are given for the two countries for the various triennia beginning at 1890–2 and also the successive death-rates expressed as a percentage of those obtaining in the first triennium. In England the mortality amongst males was 1·667 per 1000 in 1890–2, being much lower than that for females, 2·498, but there was a more rapid increase in male cancer, as, at the end of the period under

review, we find that male cancer was 83 per cent. in excess of that in 1890-2, whilst that for females increased only 20 per cent. In fact female cancer had been fairly stationary since 1900-2, when it was 13 per cent. higher than ten years earlier. During the two following triennia the excess remained fixed at 16 per cent. The rise in the cancer mortality in Scotland has been more pronounced than in England and Wales. In 1890-2 the mortality amongst males was 99 per cent. of that of English males, whilst that for females was only 88 per cent. During the quinquennium 1923-7 the position was reversed, as the Scottish death-rates amongst males and females were 8 per cent. and 13 per cent. respectively in excess of the corresponding values in England and were 98 per cent. and 55 per cent. higher than those which obtained thirty years earlier in Scotland.

In view of the fact that the mortality amongst males from cancer has almost doubled during the last thirty years and also that the increase amongst males is greater than that amongst females, it may well be asked whether the acceleration of the changes in cancer mortality has varied at particular intervals over this period. To afford the requisite information on this point the standardised death-rates at ages 35 years and upwards amongst males in England and Scotland were plotted for a series of triennia beginning at 1871 (Diagram I). The males were selected because their mortality has shown the greater increase. The distribution of the values suggests that the amount of increase has been on the whole practically constant for each period, in other words that the values are linearly distributed. The straight lines along which the death-rates are the most closely concentrated were obtained by the method of least squares. The expected values deduced from the resultant equations are given in conjunction with the actual values in Table II and also reproduced in the diagram. It will be observed that the agreement between fact and theory is close.

Although there has been a vast increase in the mortality ascribed to cancer, opinions differ as to whether it denotes a real increase in the disease itself or whether apart from the effect of the ageing of the population it is merely expressive of improved certification of the cause of death. As far back as 1893 this question of the increase of cancer was discussed by scientific investigators. In that year King and Newsholme in a paper on "The Alleged Increase of Cancer," the statistics for which were based on data for Frankfort-on-Main, showed that cancer of the accessible parts, likely to be more generally recognised, had not increased in the course of years, while inaccessible cancer had increased fairly considerably. These findings were later confirmed by Willcox who brought the original investigation in Frankfort up to a more recent date. Hoffman, on the other hand, has maintained in his work on *Mortality from Cancer throughout the World* that the increase was real. Since he utilised only crude death-rates, that is he made no allowance for any possible variability in the age constitution of the populations under consideration, his evidence cannot be accepted as wholly conclusive. In the Registrar-General's *Annual*

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Report for 1926, Dr Stevenson draws further attention to this question of the increase of cancer as follows: "As classified in Table XLIV of the Review for 1926 practically half of the mortality of females in 1911-20 was from

Table I. Showing the standardised death-rate per 1000 amongst males and females aged 35 years and upwards in England and Wales and in Scotland.

Period	England and Wales				Scotland			
	Males		Females		Males		Females	
1890-2	1-667	100	2-498	100	1-657	100	2-188	100
1900-2	2-185	131	2-834	113	2-154	130	2-684	123
1910-2	2-606	156	2-890	116	2-649	160	3-159	144
1920-2	2-892	173	2-887	116	2-803	169	3-161	144
1923-7	3-052	183	2-989	120	3-277	198	3-388	155

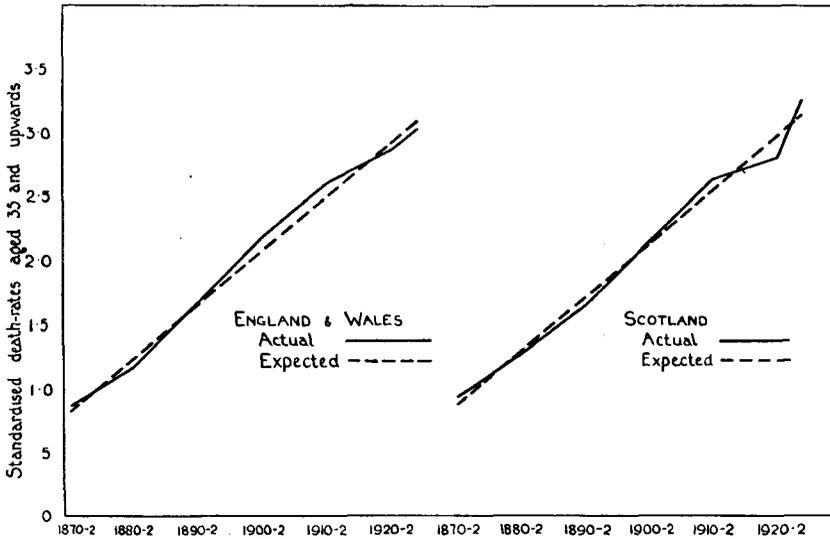


Diagram I.

Table II. Showing the actual and expected death-rate from cancer amongst males aged 35 years and upwards in England and Wales and in Scotland.

Period	England and Wales		Scotland	
	Actual	Expected	Actual	Expected
1870-2	0-861	0-836	0-941	0-888
1880-2	1-160	1-256	1-280	1-307
1890-2	1-667	1-676	1-657	1-726
1900-2	2-185	2-096	2-154	2-145
1910-2	2-606	2-517	2-649	2-563
1920-2	2-892	2-937	2-803	2-982
1923-7	3-052	3-105	3-277	3-150

$$y = 0.8358 + 0.4202 b$$

$$y = 0.8881 + 0.4188 b$$

cancer of accessible sites, but less than one-third that of males, and the increase since 1920 has been much greater in both sexes from growths of inaccessible than of accessible sites. If this change is to be explained as the result

of improvement in diagnosis it is evidently likely to apply chiefly to the sex providing the larger field for its application in the shape of inaccessible growths in which case the conversion of female into male excess of cancer mortality from 1924 onwards may well be apparent rather than real."

In view of this conflict of opinion it was deemed advisable to review the position as regards the mortality from cancer of particular sites over various periods. For this purpose the deaths in certain sites were classified into two main categories. It was thought better to treat the sites collectively rather than individually. By so doing we avoid any possible fluctuation in the mortality of particular sites due to a mere change of fashion in diagnosis such as the allocation of secondary manifestations to primary seats. The first group was composed of stomach, liver, oesophagus and intestines; the second comprised jaw, mouth, tongue, lip and rectum. Opinions may differ as to the inclusion of rectal cancer in the accessible group, but since Dr Stevenson assigns it to this group it was thought best to adhere to this classification. Cancer of the breast and uterus although assignable to the foregoing categories were treated separately. The initial period for which the statistics were analysed was taken as 1901-3 in England and 1902-3 in Scotland, as in the latter country no allocation of deaths to individual sites was made prior to 1902. The results are given in Table III.

Table III. *Showing the standardised death-rates per 1000 amongst males and females aged 35 years and upwards for certain sites classified as (1) inaccessible, (2) accessible, in England and Wales and in Scotland.*

		Inaccessible				Accessible				Uterus Females		Breast Females	
		Males		Females		Males		Females					
1901-3.	England and Wales	1.134	100	1.054	100	0.516	100	0.212	100	0.676	100	0.489	100
1902-3.	Scotland	1.168	100	1.141	100	0.410	100	0.169	100	0.467	100	0.388	100
1911-3.	England and Wales	1.379	122	1.193	113	0.635	123	0.224	106	0.604	89	0.532	109
	Scotland	1.550	133	1.477	129	0.497	121	0.203	120	0.533	114	0.475	123
1921-3.	England and Wales	1.428	126	1.143	108	0.653	127	0.229	108	0.533	79	0.560	115
	Scotland	1.622	139	1.513	133	0.551	134	0.176	104	0.492	105	0.510	132
1926-7.	England and Wales	1.510	133	1.186	113	0.652	126	0.225	106	0.506	75	0.579	118
	Scotland	1.850	158	1.594	140	0.573	140	0.178	106	0.523	112	0.553	142

Inaccessible group. We find that in England the most rapid increase in the mortality in the inaccessible sites occurred in the triennium 1911-13, as the mortality increased 22 per cent. amongst males and 13 per cent. amongst females. During the same interval in Scotland the rise has been more pronounced, and in the final period, 1926-7, the death-rate in this group exceeded that which existed twenty-five years earlier by 58 per cent. for males and 40 per cent. for females, the corresponding increments in England being 33 per cent. and 13 per cent. The contrast between the movements of the cancer mortality in this group amongst females in the two countries is worthy of notice—static in the one, steadily increasing in the other.

Accessible group. As regards the accessible group once again the most rapid movement occurred during 1911-13 when the mortality of males increased

23 per cent., but has remained at this level ever since; the increase amongst females was of smaller dimensions, *i.e.* 6 per cent. in the same period with little variability afterwards. In Scotland, on the other hand, the increase amongst males, though at first not quite so rapid as in England, continued, with the result that in 1926–7 accessible cancer was 40 per cent. greater than in the first period. The trend of the mortality amongst females was, apart from the high value during 1911–13, more or less identical with that in England.

Uterine cancer. As regards the seats of cancer which particularly affect women, breast and uterus, uterine cancer has steadily declined in England between 1901 and 1927 and, at the close of the period under review, the reduction amounted to 25 per cent. In Scotland the position has been quite different. Dr Dunlop has shown that in 1928 uterine cancer declined significantly as compared with 1911. It is interesting to note that this decline was not evident in Scotland up to 1927. During 1911–13 the mortality was 14 per cent. in excess of that in the previous period, between 1921–3 the death-rate declined, but still it was greater than that in 1902–3, and during the final period the excess was 12 per cent.

Cancer of breast. As regards cancer of the breast there has been a gradual increase in the two countries. In England the rate in 1926–7 was 18 per cent. higher than that prevailing twenty-five years earlier. In Scotland the increment has been more pronounced, as the mortality in our final period was no less than 42 per cent. above that which prevailed during 1902–3. To discover whether this decided increase, particularly in Scotland, was confined to any particular age period or was characteristic of all ages, the mortality in the individual age groups was examined and it was found that although the increase was fairly general it was more clearly defined at some ages. In the age group 35–45 the English mortality during 1926–7 was 14 per cent. greater than that in 1901–3, the corresponding excess in Scotland being 33 per cent. At ages 55–65 the relative position was much the same, whilst at ages above 65 the death-rate from cancer of the breast in England increased 23 per cent., the corresponding excess in Scotland being 50 per cent. It was at first thought that this increased mortality in Scotland might be attributable to the dilution of the female population owing to emigration from Ireland. If Irish women were prone to breast cancer this might offer a partial explanation. But it must be remembered that the Irish emigrant type invariably have large families, and as pointed out by Dr Stevenson in the *Annual Report* for 1913 breast cancer is usually more prevalent amongst the unmarried than the married women. To test the matter satisfactorily the mortality at ages from cancer of the breast amongst females in Ireland was calculated and it was found that the death-rates were lower than in either England or Scotland. Possibly hospitalisation of cases of breast cancer is carried out to a greater extent in England, and as surgical operation is a fairly successful line of defence in an illness of this description this procedure might afford a partial explanation of the divergency in the mortality between the two countries.

Reviewing the position as regards the increase of accessible and inaccessible cancer we find that in England there has been no appreciable difference between the amount of increase. In the 25 years under consideration the mortality amongst males in England from inaccessible sites increased 33 per cent. as against 26 per cent. for accessible parts. The corresponding rates for females were 13 per cent. and 6 per cent. respectively. In Scotland the increase amongst males for inaccessible cancer was 58 per cent. as against 40 per cent. for the accessible, but the increments for females were quite different as inaccessible cancer has increased by as much as 40 per cent., while the accessible has only advanced 6 per cent. Hence apart from the divergency for females in Scotland it is evident that the increase in the cancer death-rate is not easily attributable to a rising standard of diagnosis alone, but that some factor of actual increase in the disease, as revealed by mortality statistics between 1901 and 1927, has had its share.

REFERENCES.

- DUNLOP, J. C. (1913). Increase in national cancer death-rate and its causation. *Edinburgh Med. J.* July.
- HOFFMAN, F. L. (1915). *The Mortality from Cancer throughout the World*. Newark, New Jersey: Prudential Press.
- KING, G. and NEWSHOLME, A. (1893). The alleged increase of cancer. *Proc. Roy. Soc.* 4, 54. Registrar-General's *Annual Reports for the years 1913, 1917, 1926*.

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