BREAST CANCER ANOMALIES

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Received for publication August 21, 1970

SUMMARY.—The death rate from breast cancer among females in England and Wales which had been falling during 1951–59 at ages before 45 increased from 1960 to 1967; and at ages 45–64 there has been a progressive increase ever since 1955. Regional rates at the early ages were considerably higher in Greater London than in the north until 1961, but the difference then gradually disappeared; and at higher ages an excess in the south over that in the north and Wales has persisted at ages 45–64.

Whilst the total mortality from breast and uterine cancers combined has shown little regional variation, the proportion of breast cancer in the total has been consistently higher in the south than in the north, and possible implications of this are discussed. Breast cancer rates in the regions are positively associated with the dietary intake per person of butter, cheese, liquid milk and green vegetables but this in itself does not prove a causative connection.

SINCE it is incredible that during 1948–68 treatment of breast cancer has become less effective for survival or that certification of it as the cause of death has become appreciably more accurate, recent upward trends of age-specific death rates from the disease in England and Wales must indicate an increasing incidence of new cases and need serious attention.

One of the unresolved problems uncovered by epidemiological studies of breast cancer is the curious dip or flattening of the incidence curve which occurs, in Scandinavian countries most notably, about the age of the menopause. This may indicate a bimodal distribution arising from existence of two types of breast cancer occurring before and after the menopause and affected predominantly by activity of the ovarian and adrenal glands respectively (de Waard *et al.*, 1960). Indications that cancers appearing before middle age tend to be influenced by previous sex and marital history (Stocks, 1955) whereas those occurring later are often accompanied by hypertension and obesity support this hypothesis. If there is any truth in the dual nature of the associated factors one would expect that the relative trends of mortality over a period of years in different parts of the country might not be the same at ages under 45 as at later ages.

Comparison of the trends of death rates in England and Wales from 1947 to 1966 as indicated by the unbroken lines in Fig. 1 shows that whereas the rate at ages 25–44 was falling from 1951 to 1959 and has been rising considerably since, the rate at 45–64 has been increasing steadily since 1954. At ages 65 and over the rate hardly changed from 1951 to 1956 and then tended to fall slightly. Before this, during the period from 1921 to 1946, the death rates at 25–44 had risen slightly from about 115 per million during 1921–30 to 125 in 1947 and 128 in 1951, as seen in Fig. 1. Then followed a period with lower rates, around 121, until 1961

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FIG. 1.—Trends of breast cancer death rates from 1947 to 1966 in England and Wales, northern and north western regions and Greater London at different ages.

when mortality at this age started to rise to levels exceeding 133 in 1966–68. The recent 12% rise is surprising in view of the lower age at marriage and greater sexual freedom amongst adolescents since the last war, and the reasons for it call for investigation.

Why should the breast cancer death rate at ages 25–44 in England and Wales begin to increase after 1960 following a period of 10 years during which it was falling? There were 3996 deaths in 1964–68 whereas if the rate during the previous 10 years had continued the number would have been 360 less. If it is true that the rapidly growing breast cancers responsible for most of the deaths before 45 are influenced by ovarian activity it is relevant to see how the incidence of ovarian cancer has behaved. The mean annual rates per million women from this cause have been as follows since 1950:

Period	15–24	25–34	35–44	45–54	55–64
1950–53 . . .	5	13	59	206	286
1954–58 . . .	5	13	66	266	310
1959–63 . . .	4	15	58	195	317
1964–67 . . .	4	11	69	215	260

These show no tendency to increase. A possibility which needs to be kept in mind is the recent growth in the use of drugs designed to influence ovarian activity, which might conceivably affect the incidence of early breast cancer and a watch must be kept on the future course of this rate.

At ages 45–64 the death rate showed no consistent change from 1921 to 1947, the rates per million in 1920–22, 1930–32 and 1940–42 being 510, 565, 539 at age 45–54 and 799, 878, 835 at 55–64, falling again to 512 and 783 in 1950–52 (Pascua, 1956). A gradual rise in the 45–64 rate from 629 to 712 has occurred since 1950 as indicated by Fig. 1 and the rates at the foot of Table I. The reasons for this sustained increase are obscure, and since the expected number of deaths in 1964–67 if the rate had remained at 629 per million as in 1949–53 would have been 15,500 at ages 45–64 whilst the actual number of deaths was 17,554, they are of serious importance.

Regional differences in breast cancer mortality

Since mortality records of cancer of the breast in different parts of England and Wales became available it has been noticed that death rates were generally higher in the south than in the north or Wales. This was observed by Greenwood (1925) for the decade 1911–20, and when a series of maps for separate sites of cancer in 1921–30 were produced (Stocks, 1936) it was seen that the counties where the mortality at ages 25–64 expressed as a percentage of that expected from the distribution of the population by age and class of area exceeded 115 were Hereford, Bedford, Cambridge, Peterborough and West Suffolk, and those with indices below 90 were Northumberland, Durham, Staffordshire, Huntingdon and 10 Welsh counties. It was concluded that, “The local variation of breast cancer, though slighter than that found for other sites is still of such a nature as to require explanation.” Since no explanation of the low rates in the north-east and in Wales has been found and little attention has been paid to the regional distribution of breast cancer since 1930 the behaviour of rates since 1947 has been investigated below.

Fig. 1 depicts the trends of 5-year moving averages of the rates since 1947 in the north and north-west of England and in Greater London. At ages 25–44 mortality was relatively low in the *northern* region until 1960 but since then it has differed little from the national average. At ages 45–64 the rate remained consistently below 55 per million until 1958 compared with a national level of 62–65 and then increased rapidly to about 64 by 1966 whilst the national rate was rising to 72. At ages over 65 the rate declined from 115 per million in 1950 to 104 in 1961 (about 15% below the national average) but a rapid rise to 117 in 1966 then diminished the gap considerably.

In the *North Western* region the death rate at 25–44 was above the national average until 1951 but then fell below that level and has remained about 5% below ever since. At ages over 45 the rates have been consistently below average though higher than in the northern region. Contrasting with these northern rates, mortality in *Greater London* from breast cancer has exceeded the national levels at each age period and particularly during 1954 to 1959 at the early ages.

Table I shows the mean annual death rates in each of the regions (combining north midland with eastern and south-eastern excluding Greater London with southern) during the periods 1949–53, 1954–58, 1959–63 and 1964–67, and expresses them also in terms of the national rate taken as 100.

TABLE I.—*Death Rates of Females from Cancer of the Breast at Various Ages in the Regions of England and Wales during 1921–1967, and Indices in Terms of the National Rate Taken as 100*

Region (5)	Ages 25–44				Ages 45–64					Ages 65 and over			
	1949	1954	1959	1964	1921	1949	1954	1959	1964	1949	1954	1959	1964
	–53	–58	–63	–67	–30	–53	–58	–63	–67	–53	–58	–63	–67
	Mean annual death rates of females per million living												
Northern (1) .	119	106	124	133	523	544	524	600	640	1122	1125	1038	1139
East and West													
Ridings .	123	118	118	—	—	594	604	636	—	1251	1245	1214	—
North western (2) .	123	119	115	127	648	584	608	605	674	1220	1189	1184	1190
Wales .	119	111	125	129	—	620	620	642	672	1163	1184	1207	1193
North midland and													
eastern .	124	124	123	—	—	625	669	650	683	1248	1250	1257	—
Midland (3) .	118	130	130	142	652	644	645	703	802	1404	1380	1268	1295
South western .	126	131	120	126	651	617	661	677	723	1210	1283	1300	1294
South eastern and													
southern (4) .	130	124	121	133	714	667	618	757	720	1414	1235	1259	1326
Greater London .	130	137	128	138	—	687	691	783	795	1365	1332	1358	1299
England and Wales .	126	122	121	136	—	629	637	678	712	1281	1287	1232	1282
	Ratio to rate at same ages in England and Wales taken as 100												
Northern .	95	85	102	96	—	86	82	88	90	88	87	84	87
East and West													
Ridings .	98	97	97	—	—	95	95	95	—	99	99	100	—
North western .	101	95	95	93	—	94	95	89	95	95	92	96	93
Wales .	94	89	103	95	—	98	97	94	94	91	92	98	93
North midland and													
eastern .	104	101	97	—	—	99	105	97	96	94	97	102	—
Midland .	93	106	107	104	—	102	101	104	113	110	109	103	101
South western .	100	105	99	93	—	98	104	100	102	94	100	106	101
South eastern and													
southern .	104	101	100	96	—	106	97	112	101	110	107	102	103
Greater London .	104	112	106	101	—	109	108	116	112	105	105	110	101
England and Wales .	100	100	100	100	—	100	100	100	100	100	100	100	100

Notes (1) Northumberland, Cumberland, Durham, Westmorland, North Riding.

(2) Lancashire and Cheshire (with parts of Derbyshire).

(3) Shropshire, Hereford, Staffordshire, Warwick, Worcester.

(4) South-east (except Greater London) and southern region.

(5) Owing to changes in the standard regions some rates in 1964–67 were not available and others (in the south) are approximations. This applies also to 1921–30 for which the rates are taken from Registrar General's report for 1937 (Text volume, p. 187).

Looking first at the ratios at ages 25–44 relative to the national rate, indices below 100 are shown by Wales and the northern region until 1958, by the East and West Ridings of Yorkshire until 1963 and by the North West after 1954, whereas the south eastern, southern and London areas give ratios ranging from 101 to 112 until 1963 and the Midland (West) area showed indices of 104 to 107 after 1954.

At ages 45–64 low ratios between 82 and 96 in Wales and the northern regions have continued up to the present, averaging 8% below the national average, whereas in the two southern groups the average index has been 10% above the national level, with the midland and south-western regions intermediate. At 65 and over Wales and the northern areas showed ratios as much as 16% below, whilst those in the south averaged 5% above the national rate.

Whatever have been the factors responsible for producing lower breast cancer mortality in the northern part of England and in Wales than in the south at ages after 45, they have operated constantly since 1921 and there is no indication that

they have changed appreciably. A curious feature of the trends of death rates at ages under 45 in Table I is the virtual disappearance of the southern excess after 1958. The average of the absolute rates per million in the southern and south-west parts of England in 1949–58 was 130 compared with 118 in the 3 northern regions and Wales; but in 1959–63 the averages were 123 and 122 respectively, and in 1964–67 they both rose, to 132 and 130. Such a closure of the north/south gap makes unlikely any hypothesis of a lower susceptibility due to different ethnic origins of the populations, at any rate for the rapidly growing breast cancers. As Fig. 1 shows, however, no such disappearance has occurred of the north/south difference at ages 45–64 although at later ages there has been a recent narrowing of the gap. Attempts to explain the excess of stomach cancer in Wales by a special Celtic susceptibility have proved ill-founded in the past, and there is no reason to believe that the regional differences in the incidence of breast cancer arise from differing ethnic origins of the populations.

Relation to cancer of the uterus

Another problem is why the national rates of dying from the slow growing types of breast cancer has risen steadily at ages 45–64 since 1950 whilst the gap between the Greater London rate and northern rates has increased as seen in Fig. 1 and Table I. A factor which may be important in this connection is the curious inverse relation between incidence of breast and uterine cancers in the regions, as shown in Table II. Such an inverse relationship in the social classes of England and Wales was pointed out in 1938 (Registrar General) but relations of the same kind in the different regions have not been examined in any detail. The ratio of breast cancer death rate to uterine rate in England and Wales at ages 45–64 has more than doubled since 1921–30, from 1.17 to 2.55 (due perhaps to improved survival of uterine cases), and it rose in every region except Wales during 1949–63. In 1954–58 the ratio was below 1.88 in each northern region and Wales but exceeded 2.35 in every other region except the Midland (2.1).

Despite this regional contrast in the ratio the aggregate death rate from breast and uterine cancers ranged only from 889 to 980 per million with no sign of a significant regional pattern. This was true also in 1949–53 and in the whole period 1949–58 the coefficient of variation of the aggregate rates in the nine regions was only 2.7%. Such a constancy of regional distribution is remarkable for a pair of causes separately classified in the international list. In 1957–67 the southern areas showed some excess over the north in the aggregate rate.

Table II shows how the death rates from uterine cancer (which consists mainly of cervix cancer) have changed in recent years. At ages 25–44 the secular changes have not been large, but in contrast with breast cancer the rates in the northern areas and Wales have been higher than in the south in each time period. At ages 45–64 the national death rate has fallen from 345 in 1949–53 to 279 in 1964–67, and the average death rate in 1949–63 was 380 in the northern region compared with 273 in Greater London.

In a study of comparative mortality ratios at all ages from cervix cancer in the 48 county boroughs with over 100,000 population in 1950–52 (Stocks, 1955b) it appeared that in the four cities of the northern region the C.M.R.'s were 197, 183, 175 and 162, in six cities of the East and West Ridings they were 175, 172, 162, 141, 114, 109; and in 12 cities of the North West region they were 135, 134, 131, 126, 119, 118, 117, 111, 110, 106, 99, 97 and in the three Welsh cities 152, 129 and

TABLE II.—*Death Rates from Cancer of the Uterus in the Regions of England and Wales. Ratios to Breast Cancer Rates and Totals of the Two Sites*

Region*	Ages 25-44				Ages 45-64					Ages 65 and over		
	1949	1954	1959	1964	1921	1949	1954	1959	1964	1949	1954	1959
	-53	-58	-63	-67	-30	-53	-58	-63	-67	-53	-58	-63
Death rates from cancer of uterus (per million)												
Northern .	80	77	83	67	708	442	377	321	324	614	717	539
East and West Ridings .	60	60	80	—	—	430	354	297	—	698	601	596
North-western .	69	78	78	69	564	371	324	303	311	635	602	566
Wales .	76	75	75	99	—	393	352	351	358	605	569	548
North midland and eastern .	60	64	63	—	—	310	275	273	—	595	523	529
Midland .	75	60	67	67	509	326	335	278	287	606	557	523
South-western .	55	62	73	68	538	344	286	280	357	583	534	514
South-east and southern .	56	54	70	57	508	314	271	302	269	592	520	487
Greater London .	46	51	57	50	—	305	264	250	218	568	500	555
England and Wales .	55	60	71	60	—	348	302	288	279	610	559	538
Ratio of breast to uterine cancer rate												
Northern .	1.49	1.31	1.49	1.99	0.74	1.23	1.39	1.98	1.98	1.83	1.57	1.93
East and West Ridings .	2.05	1.97	1.44	—	—	1.38	1.80	2.14	—	1.79	2.07	2.04
North-western .	1.86	1.53	1.47	1.99	1.15	1.57	1.87	2.18	2.17	1.92	1.97	2.09
Wales .	1.57	1.47	1.67	1.30	—	1.55	1.82	1.97	1.88	1.92	2.08	2.20
North midland and eastern .	2.07	1.94	1.95	—	—	2.02	2.36	2.50	—	2.10	2.32	2.38
Midland .	1.57	2.17	1.94	2.12	1.28	1.98	2.10	2.88	2.79	2.32	2.48	2.42
South-western .	2.29	2.11	1.64	1.85	1.21	1.92	2.37	2.58	2.03	2.09	2.40	2.53
South-east and southern .	2.32	2.30	1.73	2.33	1.41	2.12	2.47	2.38	2.68	2.39	2.37	2.67
Greater London .	2.83	2.69	2.25	2.76	—	2.25	2.97	3.18	3.65	2.40	2.66	2.45
England and Wales .	2.29	2.03	1.70	2.27	(1.17)	1.79	2.19	2.34	2.55	2.10	2.32	2.28
Total death rate for breast and uterine cancer (per million)												
Northern .	199	183	207	200	—	1026	985	926	998	1736	1842	1577
East and West Ridings .	183	178	198	—	—	1024	958	933	—	1949	1846	1810
North-western .	197	197	192	196	—	955	932	908	985	1855	1791	1750
Wales .	195	186	200	228	—	1013	972	993	1030	1768	1753	1755
North midland and eastern .	184	188	186	—	—	935	944	923	—	1843	1773	1776
Midland .	193	190	197	209	—	970	980	981	1089	2010	1937	1791
South-western .	181	193	193	194	—	961	947	957	1080	1793	1817	1814
South-eastern and southern .	186	178	191	190	—	981	889	1059	989	2006	1755	1796
Greater London .	176	188	185	188	—	1001	962	1085	1064	1933	1832	1913
England and Wales .	181	182	192	196	—	977	939	966	991	1891	1846	1770

* See notes under Table I.

113. Only three of these 25 towns in the north and Wales had mortality ratios below 107, whereas 17 of the remaining 23 towns, in the south, east and midland regions, gave C.M.R.'s below 107 (the exceptions being Nottingham, Stoke-on-Trent, Coventry, and the seaports Plymouth, Portsmouth and Southampton). Some powerful factor enhancing mortality from cervix cancer was evidently operative in the north and Wales and in seaports generally.

FIG. 2.—Mean annual death rates in 1949-63 from cancers of the uterus and breast in the regions of England and Wales.

There was therefore up to 1963 a strong inverse relationship between mortality from breast and uterine cancers in the regions, as shown in Table II and Fig. 2, although the total rate for the two sites varied little. The northern excess in uterine cancer became less pronounced in 1959-63 but increased again in 1964-67. When looking for environmental factors to account for this regional pattern of uterine cancer it is noticeable that there is a strong resemblance to that for cardiovascular diseases, nephritis and bronchitis amongst women aged 25-54 in 1963-66. The rates for those diseases in the 15 Hospital Regions of England and Wales were analysed in connection with a geographical study of congenital malformations of the central nervous system (Stocks, 1970a) and the tabulation shows that the average death rates in the Newcastle, Manchester, Liverpool and Wales regions bear the following ratios to the average rate in the four Metropolitan regions comprising the south east of England. For chronic rheumatic heart 1.8, coronary disease 1.7, other heart diseases, vascular lesions of nervous system and nephritis 1.4, bronchitis 1.9, all other diseases 1.1. For uterine cancer at 45-64 in 1964-67 the ratio between the average rate in the northern, north west and Wales standard regions to that in Greater London was 1.6, and to that in the rest of the south-east and south it was 1.4. The explanation for the north-west/south-east distribution of cardiovascular diseases (illustrated by a map in the paper referred to) is not yet known but it is suspected that calcium or other constituents of water supplies may be responsible (Morris *et al.*, 1961), and if so this might account for the uterine cancer pattern also.

The remarkable constancy of the total death rates for breast and uterus at ages over 45 during 1949-58 despite the wide variations in the proportions of breast cancer in the regional totals suggests that there is a linkage between the susceptibilities to the two forms of cancer, that is that they may be controlled by the same gene. In that case a "choice" could be made as to which site is affected,

depending upon the exogenous factors to which the individual was being exposed and upon the degree of weakening of the potentiality of the gene to maintain the resistance to the development of cancer through its control mechanism (Gedda and Brenci, 1969).

A method by which it might be discovered whether the capacity for resistance to breast and uterine cancers is controlled by the same gene or by different and independent genes would be by studies of the life histories of monozygotic and dizygotic twin pairs. Supposing the same gene to be responsible for cancer susceptibility in the two sites, the frequencies of occurrence of breast and uterine cancers in pairs of MZ twins would show a larger proportion of cases in which the breast was affected in one twin and the uterus in the other than could occur by chance. This would reduce the degree of concordance between breast and breast and between uterus and uterus in the pairs but would produce a degree of concordance between breast in one twin and uterus in the other much larger than has usually been found between different cancer sites. This would not occur if different genes controlled breast and uterus cancers.

Very large numbers of twin pairs would be needed for such a study, but registers of twins are being built up in a number of countries for purposes of such investigations, notably by the Gregor Mendel Institute of Medical Genetics and Twin Research in Rome. A simultaneous examination of the apparent linkage between gastric and intestinal cancers could be made from the same data (Stocks, 1970b).

Assuming that certain genes control cancer susceptibility in more than one part of the body and that the frequency of such genes in the population is constant through the country, the higher incidence of uterine cancer in the northern areas and Wales would on this hypothesis result from excess of some extraneous factor operating there, and the lower rates for breast cancer would be a secondary result of the genetic linkage with uterus. Alternatively there might be an excess of some extraneous factor acting on breast cancer incidence in the south-east of England with resulting lower incidence of uterine cancer secondary to the genetic linkage. A possible factor of the second kind is discussed in the next section.

Dietary differences in the regions

Breast cancer death rates in 22 countries during 1962–66 were related with the mean annual intake of fat, sugar, carbohydrates and meat per head of the population by Hems (1970) taking into account also the birth rates, parity and frequency of blood group A. Correlation coefficients between mortality and fat consumption were 0.675 at ages of death from 65 to 69 and 0.545 at ages 40–44, and with sugar the coefficients were 0.796 and 0.618 respectively. Breast cancer mortality appeared to be associated also with parity and blood group A, but at the later ages 74% of the total variation was accounted for by fat and sugar consumption. In view of this an examination has been made below of the relations between the rates of consumption of articles of diet in the regions of England and Wales and breast cancer death rates at three age periods.

Table III shows the mean weekly intake of the articles of food per head of the population in the years 1957 and 1962 in seven regions of England and in Greater London, Wales and Scotland, expressed in terms of the averages in England and Wales taken as 100. These are calculated from the data given in the annual reports of the National Food Survey Committee of the Ministry of Agriculture,

TABLE III.—*Indices of Consumption of Various Foods During 1957 and 1962 in the Regions of England and Wales, Compared with Breast Cancer Mortality at Three Age Periods in 1954-63*

Region	Food intake weekly per head as percentage of average in England and Wales, in 1957, 1962 (mean annual)							Breast cancer in 1954-63% of national		
	Liquid milk	Butter and cheese	Other fats	Fresh green veg.	Fresh fruit	Pota-toes	Calcium content	Ages 25-44	Ages 45-64	Ages 65 up
Northern . . .	89*	82*	127*	68*	95*	94*	94	93	85	85
East and West Ridings . . .	88*	79*	127*	70*	86*	94*	92*	97	95	99
North-western . . .	101	96	110	63	83	102	99	95	92	94
North midland and eastern . . .	101	103	110	110	96	101	100*	99	101	100
Midland (west) . . .	102	100	95	110	90	110	103	106	102	106
South-western . . .	102	115	91	128	92	108	103	102	102	103
South eastern and southern† . . .	106	106	96	121	102	93	104	102	102	104
Greater London . . .	107	106	83	114	127	97	102	100	112	108
Wales . . .	90	104	85	100	99	107	99	97	95	95
England and Wales	100	100	100	100	100	100	100	100	100	100

* Year 1962 only (separate rates not available for 1957).

† Excluding London.

Fisheries and Food for the two years (Ministry of Agriculture, etc., 1959, 1964) In the right hand columns are shown the female death rates from breast cancer at three ages in 1954-63, also in terms of the national rate.

The regions with low breast cancer rates are (as was seen in Table I) the three northern regions and Wales where the relative mortality indices are below 100 at all age periods. Consumption of liquid milk is likewise below average in the Northern and Yorkshire (Ridings) region and in Wales (indices 89, 88, 90) and is highest in the south-east and Greater London (106, 107) where the breast cancer rates are also highest. Consumption of butter and cheese also is below average in the three northerly regions (with indices 82, 79, 96) corresponding with breast cancer levels. Other fats, in contrast, have very high intake levels in the north (127, 127, 110). Fresh green vegetables show very low consumption levels in the north (68, 70, 63) and high levels in the south and south-east. Fresh fruit consumption shows no important differences except in London, and for potatoes the west midlands, south-west and Wales have highest indices (107), with low levels in the north and south. Calcium content of the weekly food is low in the northern and Yorkshire regions (94, 92) but the indices for the other regions range only from 99 to 104.

Sugar intake, in year 1967, not shown in the table, was 91% of the national average in the northern region and London, 96 in Yorkshire and the south-east, 101 in the south-west, 103 in the north midlands, 109 in Wales, 115 in the north-west and 116 in the midland region, no resemblance to the distribution of breast cancer rates being apparent.

The notable feature of Table III is the positive association between intake of liquid milk, butter and cheese on the one hand and breast cancer mortality in the regions, and the negative association with other fats such as margarine.* This

* The mean weekly intake of butter in England and Wales in 1957, 1962 was 5.9 oz., cheese 3.1 oz., milk 4.9 pints and other fats 6.3 oz.

FIG. 3.—Mean weekly consumption of fats per person, correlated with breast cancer death rates in English regions and in Wales.

is shown graphically in Fig. 3. Such a statistical relationship does not in itself prove causation but the fact that a similar association appears between the national rates for all fats and breast cancer rates in 22 countries (Hems, 1970) as mentioned above makes it advisable to pay attention to this as a possible factor contributing to the peculiar regional variation in breast cancer incidence. Another notable feature of Table III is the strong positive relation between the regional intake of fresh green vegetables and breast cancer mortality which contrasts with some previous findings of negative relations with incidence of cancer of other sites (Stocks, 1933, 1957).

REFERENCES

- GEDDA, L. AND BRENCI, G.—(1969) *Acta Genet. Med. Gemellol.*, Rome, 4, 329.
 GREENWOOD, M.—(1925) 'Étude statistique sur le cancer du sein et d'utérus'. League of Nations Health Organisation, Ch. 333, Vol. 1, p. 36.

- HEMS, G.—(1970) *Br. J. Cancer*, **24**, 226.
- MINISTRY OF AGRICULTURE, FISHERIES AND FOOD—(1959, 1964) Annual Reports of the National Food Survey Committee for 1957, 1962. London (H.M. Stationery Office).
- MORRIS, J. N., CRAWFORD, M. D. AND HEADY, J. A.—(1961) *Lancet*, i, 860.
- PASCUA, M.—(1956) *Bull. Wld Hlth Org.*, **15**, 5.
- REGISTRAR GENERAL—(1938) Census of 1931, Occupational Mortality, Supplement.
- STOCKS, P.—(1933) *Ann. Eugen.*, **5**, 237.—(1936) *Rep. Br. Emp. Cancer Campn*, Supplement.—(1955a) *Schweiz. Z. Path. Bakt.*, **15**, 706.—(1955b) *Br. J. Cancer*, **9**, 487.—(1957) *Rep. Br. Emp. Cancer Campn*, Supplement.—(1970a) *Br. J. prev. soc. Med.*, **24**, 67.—(1970b) *Br. J. Cancer*, **24**, 215.
- DE WAARD, F., DE LAIVE, J. W. J. AND BAANDERS-VAN HALEWIJN, E. A.—(1960) *Br. J. Cancer*, **14**, 437.
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