Gastric Cancer in Wales

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In 1966 a study was reported (Ashley and Davies, 1966a) which showed an association between mortality from gastric cancer and 'Welshness', which was defined as membership of the genetic pool of Welsh people and was determined by the two parameters of Welsh speaking and the possession of a Welsh surname. The present study is an extension of the previous one and includes an attempt to assess the relative risk of death from this neoplasm in the Welsh and non-Welsh people of Wales respectively.

The standardized mortality ratios (SMR) for gastric cancer were calculated for males and females for the several counties and county boroughs of Wales for the six-year period 1958 to 1963 inclusive

100,000 population and under 50,000 population it was higher than in towns between 50 and 100,000 in population and was lowest in rural districts (Table II). The proportion of the population living in

TABLE II
STANDARDIZED MORTALITY
RATIOS, 1963-5

	Males	Females
Towns > 100,000	115	109
Towns 50-100,000	93	92
Towns < 50,000	98	98
Rural areas	88	93

TABLE I
STANDARDIZED MORTALITY RATIOS FOR STOMACH
CANCER, 1958-63

Areas	Males	Females	Adjusted for Urban/Rural Distribution	
			Males	Females
Anglesey	150	120	164	124
Brecon	93	105	103	111
Caernarvon	160	258	171	269
Cardigan	152	152	167	161
Carmarthen	131	160	144	168
Denbigh	147	113	159	118
Flint	117	133	126	139
Glamorgan	130	140	134	143
Merioneth	124	177	135	186
Monmouth	121	142	126	146
Montgomery	115	145	125	152
Pembroke	136	146	147	153
Radnor	48	84	53	89
Cardiff	123	135	107	124
Merthyr Tydfil	111	178	121	193
Newport	103	132	90	120
Swansea	143	166	124	152

(Table I). The expected number of deaths was calculated from the age and sex specific death rates for the whole of England and Wales at 5-year intervals. The SMR for gastric cancer varies within England and Wales according to the nature of the area in which the population lives: in towns of over

each type of area in the counties of Wales was determined from the Registrar General's Report on Welsh Speaking in Wales (1962) for each county and for the four county boroughs, and the SMR expected on the basis of the urban/rural distribution was calculated. From this an adjusted SMR was calculated for each of the counties and county boroughs; these are recorded in the last two columns of Table I.

Inspection of the Table shows high values for the adjusted SMR in Anglesey, Caernarvon, and Cardigan, and low values in Cardiff, Newport, and the county of Radnor. The adjusted SMRs for the whole of Wales were 132 and 153 for males and females, respectively. In the high Welsh area, the counties of Anglesey, Caernarvon, Cardigan, Carmarthen, and Merioneth, the adjusted SMRs were 159 and 185; in the low Welsh area, the counties of Monmouth and Radnor and the towns of Cardiff and Newport the adjusted SMRs were 110 and 129; in the remaining intermediate area the adjusted SMRs were 134 and 142.

There was a very strong correlation ($r = +0.59$) between the SMRs for males and for females in the 13 counties and 4 county boroughs of Wales. The SMRs for the two sexes were therefore combined for the final calculations (Table III); the small county of Radnor, which has an unusually low SMR and is a farming county looking towards the

Received May 3, 1968.

TABLE III
SMR FOR GASTRIC CANCER, AND
PROPORTION OF WELSH SPEAKING

Area	Combined SMR	% Welsh Speaking	% Welsh
Anglesey	146	75.5	84
Brecon	107	27.1	54
Caernarvon	205	68.5	76
Cardigan	164	75.0	83
Carmarthen	154	74.9	83
Denbigh	141	34.8	70
Flint	131	19.0	38
Glamorgan	137	17.3	35
Merioneth	156	76.3	85
Monmouth	134	3.4	17
Montgomery	137	32.0	64
Pembroke	149	24.5	45
Cardiff	114	4.7	24
Merthyr Tydfil	148	19.8	40
Newport	103	2.1	10
Swansea	136	17.3	35

English county of Shropshire, has been excluded. Table III also shows the percentage of people in each area who, at the census of 1961, claimed to be Welsh speaking (Registrar General, 1962). There is a highly significant correlation (by Spearman's rank correlation method ($r = +0.78$ $p < 0.01$)) between the adjusted SMR for the two sexes combined and the proportion of Welsh speakers in the population.

The relation between the proportion of an area who are, by inheritance, Welsh, and the proportion who are able to speak the Welsh national language, is not constant in the various parts of Wales. An unpublished examination of the surnames of Wales, based on a survey of the electoral registers of the whole of the Principality has shown three groups of local authority areas corresponding quite closely to the areas of high, intermediate, and low Welsh speaking, in which the proportion of Welsh surnames bears different relations with the proportion who can speak Welsh. In the high Welsh area the proportion with Welsh names is approximately equal to the proportion of Welsh speakers; in the intermediate Welsh area the proportion with Welsh names is approximately three times the proportion of Welsh speakers; in the low Welsh area the proportion with Welsh names is approximately 10 times the proportion of Welsh speakers. On the basis of these data and on the observation that people in the intermediate and low Welsh areas are more likely to have an appreciable proportion of non-Welsh ancestry, a value for Welshness was estimated for each area separately. In the five counties of the high Welsh area the proportion of Welshness was assessed as 111% of the proportion of Welsh speakers, i.e. it was assumed that the Welsh speakers amounted to 90% of the Welsh in the population.

In the intermediate area the proportion of Welsh was assessed as twice the proportion of Welsh speakers, and in the low Welsh area the proportion of Welsh was assessed as 5 times the proportion of Welsh speakers. These assessed proportions of Welsh are included in Table III rounded off to the nearest whole number.

From these data, the adjusted SMR and the proportion of 'Welsh' in the population values for the adjusted SMR for the Welsh and for the non-Welsh components of the population have been determined by the method of least squares. The derived SMR for the Welsh in Wales is 170 and that for the non-Welsh is 110. Calculating back from the derived SMRs and comparing with the observed adjusted SMRs, the only two areas in which there is a significant difference are Caernarvon in which the observed SMR is unduly high and Breconshire in which it is unduly low. Similar separate calculation for males and females show derived SMRs of 164 for Welshmen and 98 for non-Welshmen and of 179 for Welsh women and 125 for non-Welsh women. The observed SMR is significantly high in women in Caernarvonshire and significantly low in both sexes in Breconshire.

The recent publication by the Registrar General (1967) of tables of mortality by sex and age for gastric cancer in the counties and county boroughs of Wales for the years 1959 to 1963 has made it possible to calculate the relative mortality rates from this disease for the age periods 45 to 64 and over 65 years. These are shown for the two standard regions of Wales and for the high, intermediate, and low Welsh zones of Wales (Table IV). In each instance the rate was higher than was expected both for males and for females. Wales I, which comprises the industrial South East of the Principality, has generally a lower mortality rate than the region Wales II, which includes most of the Welsh speaking part of the country. In the case of the younger women the rate for Wales I was greater than that for

TABLE IV
RELATIVE MORTALITY RATES FOR GASTRIC
CANCER BY AGES
(England and Wales = 100)

	Males		Females	
	45-64 yr.	65+ yr.	45-64 yr.	65+ yr.
Wales I	129	122	140	136
Wales II	142	143	122	140
Zone				
'High' Welsh	130	147	146	149
'Intermediate' Welsh	135	131	135	135
'Low' Welsh	130	111	127	133

Wales II but this difference did not reach statistical significance. A gradient of rates is seen through the three zones of Wales in the older men and in both groups of women, but is not seen in the younger group of men in whom it may be suggested that genetic intermingling has begun to take effect.

Discussion

This analysis confirms the previous finding of an association between high liability to gastric cancer and 'Welshness', and allows an estimate to be made of the extent of this excess liability. In either sex the chance of developing gastric cancer seems to be about 70% higher in the Welsh than in the non-Welsh of Wales. A check on this value can be made from the data of Tables V and VI of the previous paper (Ashley and Davies, 1966a). Combining these two tables a total of 562 individuals was available for study, 313 of these (55.6%) had Welsh surnames, while, from the survey data, 252.5 (45%) would have been expected.

If the proportion of people with Welsh names in the population is w the proportion with non-Welsh names will be $(1-w)$. If k is the chance of developing gastric cancer in those with non-Welsh names and ak is the chance of developing gastric cancer in those with Welsh names the total number of cases of gastric cancer will be:

$$a k w + k(1-w),$$

and the proportion of patients with Welsh names in the group of patients with gastric cancer will be:

$$\frac{a k w}{a k w + k(1-w)};$$

the factor k cancels out of this equation and by substituting 0.45 for w , the expected proportion and 0.556 for the observed proportion a may be calculated as 1.53, i.e. the mortality in those with Welsh names relative to those with non-Welsh names is 153. This value is slightly lower than that calculated from the data for the counties and county boroughs because there is a proportion of 'Welsh' people who do not have names regarded as typically Welsh and a proportion of 'non-Welsh' people who have Welsh names.

The apparent excess of deaths from this cause in the county of Caernarvon and the deficiency in the county of Brecon remain unexplained. Both could be due to local environmental factors, such as the pollution of water supplies by effluent from spoil tips in North Wales (Howe, 1960). The analyses presented here reduce the disparities in the incidence of this tumour in the various parts of Wales and leave smaller areas, especially the county of Caernarvon, on which attention may be focused.

The smaller differences observed in the younger age-group than in the older support the concept that the difference in liability to gastric cancer is genetic in origin, as the older individuals, almost all born in the nineteenth century, may represent the generation of maximum separation of the Welsh and non-Welsh, a separation that is reducing in extent with the greater mobility of the population.

The data presented here and in the previous paper confirm that there is an increased liability to gastric cancer in the Welsh compared with the non-Welsh who live side by side with them in Wales and share the environment and occupations of Wales. The difference between males and females is small in the case of the 'Welsh' but is significantly large in the case of the 'non-Welsh'. It is probable that the non-Welsh members of the Welsh community, both those with Welsh surnames and those who are Welsh speaking, include a significant number of women who are of Welsh ancestry who have married men from outside the Principality and brought them back to Wales. This is particularly true in the 'low Welsh' areas where the assessed proportion of 'Welsh' among the women is probably too low.

The mechanism by which the difference in susceptibility is mediated is unknown. It does not seem to be related to the excess of gastric cancer in patients who are of blood group A (McConnell, 1966), as there is no excess of this blood group among those who have Welsh surnames (Ashley and Davies, 1966b).

It is unlikely that the excess of gastric cancer is related to a reduced general fitness of the Welsh people in respect of resistance to carcinogens, as there is no excess of cancer of the lung (Ashley and Davies, 1966c) or of cancer of the colon and rectum (unpublished) in the Welsh. Presumably there is either an increased susceptibility of the gastric epithelial cells to ingested carcinogens or a reduced ability of the reticuloendothelial system to defend the body against the abnormal cells of incipient gastric cancer.

Summary

Data on the distribution of gastric cancer in Wales are analysed. It is concluded that genetic variation plays an important role in the higher frequency of this tumour in the Principality, and that the risk of gastric cancer is approximately 70% higher in the Welsh than it is in the non-Welsh.

This work was carried out with a research grant from the Welsh Hospital Board. I am indebted to the Registrar General for some data additional to that in the Tables.

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