

THE BALANCE OF THE SEXES IN GREAT BRITAIN

By W. S. HOCKING, O.B.E., F.I.A.
of the Government Actuary's Department

It is well known to actuaries that more boys than girls are born, but that female mortality rates are lighter than those of males. The interaction of these two features of demography on the sex constitution of the general population is, however, less widely appreciated. Attention does not appear to have been drawn to the significant changes that the progressive improvements in vitality of the last seventy or eighty years and variations in the sex ratio at birth have introduced into the population of Great Britain.

2. The statistics which follow are derived mainly from the records for England and Wales, because a series of mortality tables covering the period from 1871-80 to 1930-32 is available. The latest mortality table constructed (that for 1942-44) relates, however, to the whole of Great Britain;* but comparison of the various factors for England and Wales and for Great Britain as a whole in 1930-32 shows that the inclusion of Scotland introduces no significant differences in the results. Registration in England and Wales commenced in 1837, and a life table was constructed on the basis of the deaths recorded during the years 1838-54. The results derived differ so markedly, however, from those obtained for later periods (perhaps because of incomplete registration) that they have been omitted as being unreliable for comparative purposes.

3. The masculinity of births, as measured by the ratios of male births to female births in England and Wales and, in recent years, in Great Britain, is set out below:

Period	Masculinity ratio	
	<i>England and Wales</i>	<i>Great Britain</i>
1871-75	1.039	—
1876-80	1.038	—
1881-85	1.038	—
1886-90	1.036	—
1891-95	1.036	—
1896-00	1.035	—
1901-05	1.037	—
1906-10	1.039	—
1911-15	1.038	—
1916-20	1.051	1.051
1921-25	1.047	1.048
1926-30	1.043	1.043
1931-35	1.051	1.051
1936-40	1.054	1.054
1941-45	1.062	1.061
1946	1.061	1.061
1947	1.061	1.060
Jan.-June, 1948	1.060	1.061

* The various English Life Tables, relating to the mortality of England and Wales, have been published by the Registrar General. Those for Great Britain in 1930-32 and in 1942-44 were compiled in the Government Actuary's Department.

There was a slight downward trend in the latter part of the nineteenth century, but during the present century there has been a much more pronounced upward swing. It has been suggested that relatively more boy babies are born during and shortly after a major war, and it is the fact that a peak of 1·060 was reached in 1919, immediately after the 1914-18 war, and another of 1·066 in 1944, towards the end of the last war, but even if war periods are ignored it is clear from the above proportions that masculinity has increased significantly of recent years.

4. There is a possible factor contributing towards this upward tendency since 1900 which has not, I believe, previously been put forward. During the twentieth century there has been an astonishing fall in mortality rates at the young ages. The infantile death-rate (under age 1) in England and Wales has fallen in the case of boys from ·161 in 1900-02 to ·048 in 1945-47, i.e. by ·113, and in the case of girls from ·131 to ·037, i.e. by ·094. Thus, more young boys' than young girls' lives have been saved by advances in medical skill. It seems reasonable to argue, therefore, that this process has not started only at the point of birth, but that a number of babies that previously would not have been live births have also been saved by improvements in medical technique, etc., and that these 'extra' lives include rather more boys than girls. Support for this theory is afforded by the fact that the field from which the saved lives are drawn, viz. the stillbirths (whose numbers have been recorded by the Registrar-General only since 1927), is preponderantly male. Thus, the ratio of male to female stillbirths averaged no less than 1·192 in the eighteen years from 1928 to 1945 (the latest year for which statistics have so far been published), whereas in the same period the masculinity ratio for live births was 1·054. Moreover, the male/female sex ratio among stillbirths has fallen from 1·234 in 1928-30 to 1·166 in 1943-45, whilst the proportion of stillbirths to total births has dropped in the same period from 4·0% to 2·8%. All these facts point to the probability that proportionately more boy babies than girls are now surviving who would not have been live births under earlier conditions.

5. The second factor in the balance of the sexes is the relative probability of survival, and in the following table the ratios of the values of ${}_xp_0$ for females to those for males are set out for specimen ages on various life tables.

Table 1. Ratios of female to male values of ${}_xp_0$ by various life tables

Age x	England and Wales							Great Britain	
	1871-80	1881-90	1891-1900	1901-10	1910-12	1920-22	1930-32	1930-32	1942-44
1	1·035	1·036	1·038	1·031	1·026	1·023	1·019	1·019	1·013
5	1·039	1·042	1·042	1·035	1·029	1·026	1·022	1·022	1·015
15	1·041	1·045	1·042	1·034	1·029	1·025	1·023	1·024	1·017
25	1·042	1·045	1·045	1·038	1·033	1·029	1·027	1·027	1·020
35	1·050	1·049	1·052	1·047	1·040	1·034	1·030	1·030	1·024
45	1·072	1·070	1·073	1·064	1·056	1·050	1·042	1·042	1·035
55	1·124	1·115	1·120	1·106	1·093	1·080	1·075	1·074	1·070
65	1·199	1·195	1·198	1·189	1·176	1·155	1·148	1·146	1·170
75	1·315	1·327	1·328	1·337	1·342	1·328	1·350	1·345	1·375
85	1·547	1·611	1·594	1·631	1·679	1·702	1·818	1·800	1·898

6. It will be seen that the proportionately greater chance of female survival that has been established by age 1 increases only very slowly thereafter until age 25 (or, more recently, until age 35), but then commences to rise with

increasing rapidity. Moreover, for any given attained age there was relatively little difference in the ratios until the early years of this century, but since then, with the reduction in mortality, the relative superiority of female vitality has been roughly halved at the younger adult ages, and for children reduced to little more than one-third of the earlier figures. For the whole span of life up to age 70 and beyond, however, there has been an increase in the relative longevity of women.

7. Bringing together the ratios in paragraphs 3 and 5, and working out intermediate values, where necessary, from the original data from which Table 1 was compiled, it is found that during the latter part of the nineteenth century the higher proportion of male births was neutralized by excess male mortality within twelve months or so of birth. In the twentieth century, however, with the rise in the masculinity of births and the fall in the relative excess of female survival, the age at which the number of survivors of the births would be equal advanced rapidly, being age 25 on 1901-10 experience, 35 on 1910-12, 45 on 1920-22 and 47 on 1930-32 experience for both *England and Wales* and *Great Britain*. On the 1942-44 mortality experience the 6.3 % excess of births would result in more male than female survivors as far as age 54, and even if the 6.3 % is regarded as abnormal owing to war conditions and the immediate pre-war excess of 5.4 % is taken as the present normal level the cross-over age is still as high as 51. This striking difference from nineteenth-century conditions is a feature which has not, I believe, been commented on hitherto, at least in this country.

8. The third factor that merits consideration is the relation between the expectations of life at birth, for this measures the extent to which, assuming that the mortality rates of the period remain unchanged, the female population is being built up to a greater degree than that of males because women survive longer. The complete expectations of life at birth, and the sex ratios for the various life tables are as follows:

Area	Period	e_0		Ratio of female to male
		Male	Female	
<i>England and Wales</i>	1871-80	41.35	44.62	1.079
	1881-90	43.66	47.18	1.081
	1891-00	44.13	47.77	1.082
	1901-10	48.53	52.38	1.079
	1910-12	51.50	55.35	1.075
	1920-22	55.82	59.58	1.071
	1930-32	58.74	62.88	1.070
<i>Great Britain</i>	1930-32	58.40	62.47	1.070
	1942-44	62.74	67.54	1.077

It will be seen that the lengthening of the life span has proceeded more or less *pari passu* for the two sexes. There was a downward tendency in the ratio of the female to the male expectation from 1901-10 to 1930-32, but this tendency has been sharply reversed on the 1942-44 table. It is probable that this table is affected by war conditions (though deaths directly attributable to the war were eliminated), and too much significance should not therefore be attached to this last ratio.

9. The masculinity of births, the relative expectations of life of the sexes, the resultant of these two factors, and the actual ratios of the sexes in the enumerated populations for the various periods examined are summarized in Table 2.

Table 2. The balance of the sexes at various periods

Area	Period	Ratio of male to female births during period	Ratio of female to male value of $\bar{e}_0$ based on life table for period	Ratio of females to males in ultimate stationary population based on mortality of period $\frac{[4]}{[3]}$	Actual ratio of female to male population during period
(1)	(2)	(3)	(4)	(5)	(6)
England and Wales	1871-80	1.038	1.079	1.039	1.054
	1881-90	1.037	1.081	1.042	1.059
	1891-00	1.036	1.082	1.044	1.066
	1901-10	1.038	1.079	1.039	1.068
	1910-12	1.040	1.075	1.034	1.068
	1920-22	1.051	1.071	1.019	1.096
	1930-32	1.047	1.070	1.022	1.088
Great Britain	1930-32	1.046	1.070	1.023	1.087
	1942-44	1.063	1.077	1.013	1.077

It will be seen from column (5) that, whereas in the later years of the nineteenth century greater female longevity outweighed masculinity at birth by rather more than 4%, by the 1920's this excess (which may be looked upon as the long-term tendency resulting from the experience of the period under review as regards the relative numbers of the sexes at birth and relative male and female mortality) had fallen to the neighbourhood of 2%. In 1942-44 it is possible that both sex ratios were abnormally high on account of war conditions, but if a reasonable adjustment be made for this point the ratio in column (5) would not be greatly altered from its level of under 1½%.

10. It remains to comment on the difference between the ratios in column (5) and column (6) of Table 2. The ratios of the sexes in the enumerated populations of the successive periods are always considerably higher than those based on the birth and mortality rates of the periods. There are at least three reasons to account for these differences:

- The enumerated ratios are the result of past conditions, whereas the ratios in column (5) are those which would ultimately be reached if the birth and mortality rates of the periods under review were experienced indefinitely in future.
- The ratios in column (5) make no allowance for migration, which, at any rate until 1914, consisted predominantly of males, whereas the enumerated populations, of course, reflect the results of emigration.
- The mortality tables take no account of war mortality, which also has mainly affected males and is automatically allowed for in the enumerated populations.

The excess of enumerated females over males grew slowly (probably owing mainly to emigration) until the beginning of the 1914-18 war. That war

resulted in a sudden jump in the excess from under 7% to over 9½%. Since then the excess has diminished, in spite of the occurrence of the 1939-45 war, and with the tendency for a closer balance of the sexes among migrants and the possibility that future wars will also affect the sexes more equally, it may perhaps be anticipated that this downward tendency will continue, though it is unlikely that it will, at any rate for many years, reach a state of such close equality as is indicated by the final ratio in column (5) of Table 2. It is, nevertheless, of interest to notice that the natural forces of birth and death are tending to produce so nearly an equal balance of the sexes.

11. While there is an over-all tendency to equal numbers of males and females in the population, the proportions in the various age-groups differ widely, as will be seen from Table 3, which sets out the ultimate male and female populations on *Great Britain* 1942-44 mortality rates, assuming the continuance of the average numbers and the sex ratio of births which actually occurred in those years.

Table 3. Stationary population, assuming *Great Britain* 1942-44 mortality, and 407 thousand male and 383 thousand female births per annum

Ages last birthday	Males (ooo's)	Females (ooo's)	Ratio of females to males
0-4	1912	1823	·953
5-14	3761	3596	·956
15-24	3702	3548	·958
25-34	3607	3469	·962
35-44	3489	3377	·968
45-54	3270	3227	·987
55-64	2806	2934	1·046
65-74	1972	2325	1·179
75-84	865	1256	1·452
85 and over	150	312	2·080
All ages	25534	25867	1·013

Thus, at ages under 35 in this ultimate population males exceed females by some 4%, and at all ages under 55 there are more men than women. After age 55, however, there is an excess of women which increases rapidly until at ages over 85 there are more than twice as many women as there are men. For all ages, as already shown in column (5) of Table 2, the ratio of females to males in the ultimate population would be 1·013. (This table should, of course, not be regarded as a forecast of the probable ultimate size and constitution of the population of Great Britain. It is put forward merely as an illustration of the tendencies of the natural forces that appear to be at work.)

12. The following is a summary of the main conclusions of the above note.

- (a) It is suggested that the recent rise in masculinity at birth may be associated with the reduction in the numbers of stillbirths, which are predominantly male (paragraphs 3 and 4).
- (b) The age at which masculinity at birth is balanced by excess male mortality has advanced from about age 1 in the late nineteenth century to over age 50 on recent experience (paragraphs 5 to 7).
- (c) There is a tendency towards a balance of the sexes in the ultimate population, and this equality has been closer in recent years (paragraphs 8 to 11).