

RISK OF STILLBIRTH IN TWIN PREGNANCY RELATED TO SEX AND MATERNAL AGE

AN ANALYSIS OF 90,386 TWIN MATERNITIES

BY

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It is well known that in every country with reliable vital statistics more male than female children are born each year, and that the sex ratio of stillbirths is considerably higher than that of related live births. By means of data from the Annual Reports of the Registrar-General for England and Wales and for Scotland it has recently been demonstrated (Lowe and McKeown, 1950) that the sex ratio of total births decreases with maternal age, whereas the sex ratio of stillbirths increases. It was suggested that this relationship to age is due to changes in the relative proportions in each maternal age group of different causes of stillbirth, each of which has its own sex ratio.

Since July, 1938, the Annual Reports of the Registrar-General for England and Wales have presented the results of twin maternities by sex, type of birth (live or stillborn), and maternal age, although cause of stillbirth is unfortunately not recorded. Between July, 1938, and December, 1948, 90,730 twin maternities were notified, for 344 of which maternal age was not specified. We are unaware of any reference in the literature to the sex of twin stillbirths in relation to the age of the mother, and this communication presents an analysis of 90,386 twin maternities for which the necessary data are available.

TABLE I
SEX RATIOS OF SINGLE AND TWIN STILLBIRTHS RELATED TO MATERNAL AGE
(England and Wales, July, 1938, to December, 1948)

Type of Stillbirth		Maternal Age (years)							Total Stillbirths*
		Under 20	20-24	25-29	30-34	35-39	40 and Over	All Ages*	
Single ..	Percent. Male ..	51·2	52·8	53·8	54·3	54·0	54·5	53·74	209,428
	Standard Error ..	±0·6	±0·3	±0·2	±0·2	±0·3	±0·4	±0·11	
Twin ..	Percent. Male ..	60·4	57·1	54·9	55·8	54·7	54·1	55·56	11,292
	Standard Error ..	±3·0	±1·1	±0·9	±0·9	±1·0	±2·0	±0·47	

* In this and all subsequent Tables (except Table IV), 6,138 single and 114 twin stillbirths, for which maternal age was unspecified, have been excluded.

SEX RATIOS OF TWIN STILLBIRTHS AND SINGLE STILLBIRTHS COMPARED

The sex ratio* of twin stillbirths (55·56) is higher than that of single stillbirths (53·74) and the difference (1·82±0·48) is highly significant. This difference, however, is not the same at all maternal ages; the sex ratio of single stillbirths increases regularly with advancing maternal age, whereas twin stillbirths show a fairly consistent decrease (see Table I and Fig. 1).

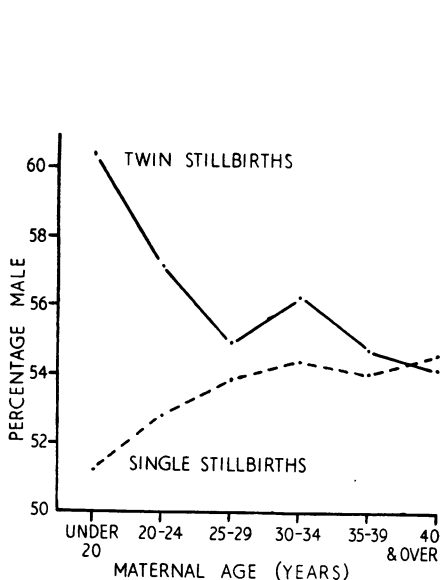


FIG. 1.—Sex ratio of single and twin stillbirths related to maternal age.

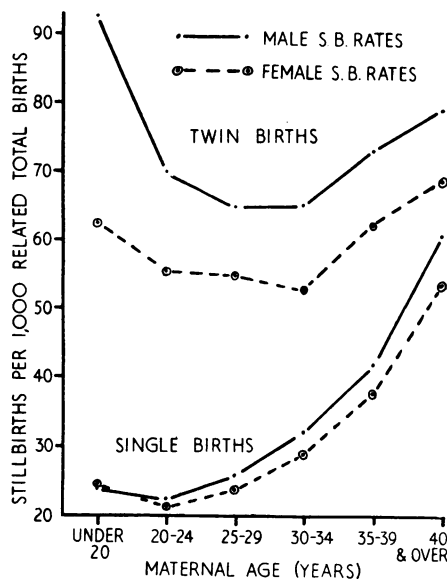


FIG. 2.—Sex specific stillbirth rates (single and twin) related to maternal age.

Before proceeding to a more detailed examination of this difference, we should note that a direct comparison of the numbers of male and female stillbirths (i.e. the sex ratio) is influenced by the related number of total births, as it does not take into account the respective numbers of each sex at risk. A more precise measure of sex difference is provided by relating the number of male and female stillbirths in each maternal age group to the number of male and female foetuses at risk in that age group. Sex specific stillbirth rates are given in Table II (overleaf, see also Fig. 2 above), and we may note that:

- (1) At all ages, stillbirth rates are higher in twin births than in single births. The difference is very much greater in the younger than in the older mothers.
- (2) For twin births, male stillbirth rates are consistently higher than female rates (particularly in the case of younger mothers).
- (3) For single births, there is little difference between the male and female stillbirth rates of young mothers, but as maternal age increases the risk to the male foetus becomes progressively greater than the risk to the female.

* The sex ratio is expressed as the percentage of males $\left(\frac{M}{M+F} \times 100\right)$.

TABLE II

SEX SPECIFIC STILLBIRTH RATES* (SINGLE AND TWIN) RELATED TO MATERNAL AGE
(England and Wales, July, 1938, to December, 1948)

Type of Stillbirth		Maternal Age (years)							Total Stillbirths
		Under 20	20-24	25-29	30-34	35-39	40 and Over	All Ages	
Single	Male	23·7	22·1	25·5	31·8	41·5	60·1	29·7	112,539
	Female	24·2	21·0	23·3	28·5	37·4	53·0	27·2	96,889
Twin	Male	92·1	69·9	64·6	64·8	72·4	78·5	68·2	6,274
	Female	62·3	55·1	54·8	53·3	61·9	68·1	56·5	5,018

* Rates are expressed as the number of stillbirths per 1,000 related total births
(e.g. sex specific still-birth rate of twin males = $\frac{\text{Number of twin male still-births}}{\text{Total number of twin males}} \times 1,000$).

In short, in young mothers the risk of stillbirth is much higher for twins than for single births; the increased risk is particularly marked in the case of males. In older mothers the increased risk though still present is greatly reduced, being about the same for males and females.

STILLBIRTH RATES IN LIKE- AND UNLIKE-SEX TWIN MATERNITIES

A separate examination of stillbirth rates of monozygous and dizygous twins cannot be made unless we accept the assumptions implicit in the method of twin identification described by Weinberg (1903). This method has frequently been used to give the incidence of monozygous and dizygous twins by maternal age, but its use in the calculation of stillbirth rates involves assumptions which are open to criticism. We can, however, separate two groups:

- (i) monozygous and dizygous pairs (like-sex)
- (ii) dizygous pairs only (unlike-sex).

The following points emerge when stillbirth rates are calculated for these two groups by maternal age (see Table III and Fig. 3, opposite):

- (1) Stillbirth rates for like-sex pairs are consistently higher than for unlike-sex pairs.
- (2) At all maternal ages the risk to the male foetus, in both like- and unlike-sex pairs, is considerably higher than the risk to the female.
- (3) Unlike-sex twin stillbirth rates are lowest for mothers under 25 years and, as in the case of single births, increase with maternal age. Stillbirth rates for like-sex twins have the same relation to maternal age as the rates for all twins, and are lowest in the middle of the reproductive period.

In interpreting the age trend of the stillbirth rate of like-sex twins the following points may be noted:

TABLE III

SEX SPECIFIC TWIN STILLBIRTH RATES (LIKE- AND UNLIKE-SEX PAIRS) RELATED TO MATERNAL AGE (England and Wales, July, 1938, to December, 1948)

Type of Twin Stillbirth		Maternal Age (years)						Total Stillbirths
		Under 25*	25-29	30-34	35-39	40 and Over	All Ages	
Like-sex	Male	80.8	70.3	70.1	78.3	81.3	74.4	4,443
	Female	62.0	60.6	58.2	66.6	71.9	61.9	3,497
Unlike-sex	Male	51.0	53.8	55.9	63.0	73.5	56.7	1,831
	Female	41.7	44.4	45.3	54.8	61.3	47.1	1,521

* Numbers do not justify separation of stillbirths to mothers under 20 years from stillbirths to mothers aged 20-24 years.

- (a) Like-sex twins include both monozygous and dizygous pairs.
- (b) The proportion of monozygous pairs changes with maternal age, and is lowest in the middle of the reproductive period. (Jenkins, 1927; Guttmacher, 1937; Yerushalmy and Sheerar, 1940; Waterhouse, 1950.)
- (c) The fact that stillbirth rates are consistently higher for like-sex than for unlike-sex twins suggests that stillbirth rates are also higher for monozygous than for dizygous twins.

If conclusion (c) is justified, and if dizygous like- and unlike-sex pairs have similar stillbirth rates, a possible explanation of the increased stillbirth rates of like-sex twins at low and high ages may be suggested. They may be accounted for by the greater incidence of monozygous twins, and may be compatible with a monozygous stillbirth rate which, though higher, exhibits the same age trend as unlike-sex stillbirths.

STILLBIRTH RATES IN SINGLE, TWIN, AND TRIPLET MATERNITIES

Further support for the belief that stillbirth rates are higher for monozygous than for dizygous pairs is available in Table IV (overleaf). Stillbirth rates are here given for individuals (male or female) occurring alone in single maternities, or in association with other foetuses (of like or different sex) in multiple maternities. Although the numbers are small in the case of triplets, the results for the two sexes are (with one exception) quite consistent.

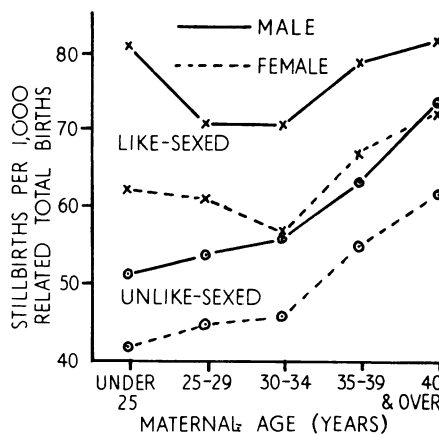


FIG. 3.—Sex specific stillbirth rates of like- and unlike-sex twins.

TABLE IV
SEX SPECIFIC STILLBIRTH RATES IN SINGLE, TWIN, AND TRIPLET MATERNITIES
(England and Wales, July, 1938, to December, 1948)

Type of Maternity	Male Propositus		Female Propositus	
	Associated in uterus with	Stillbirth rates of propositi	Associated in uterus with	Stillbirth rates of propositi
Single	—	30.4 ± 0.1	—	27.8 ± 0.1
Twin with One of Opposite Sex	F	56.9 ± 1.3	M	47.3 ± 1.2
Triplet with Two of Opposite Sex	FF	60.6 ± 15.7	MM	51.7 ± 16.8
Twin with One of Same Sex	M	75.1 ± 1.1	F	62.2 ± 1.0
Triplet with One of Same and One of Opposite Sex	MF	123.6 ± 17.6	MF	106.1 ± 14.3
Triplet with Two of Same Sex	MM	133.3 ± 14.8	FF	81.9 ± 12.0

As would be expected, stillbirth rates are lowest when the foetus is a single one. Its risk of stillbirth is increased by the presence in the uterus of another individual of different sex (twins) or of two other individuals of different sex (triplets). The stillbirth rate is still higher for foetuses associated with another individual of the same sex (twins) and very much higher when there are two other foetuses of which one or both are of the same sex (triplets).

Since in MF and MFF maternities the male has developed from a separate ovum, and since in MM, MMF, and MMM maternities some of the male pairs have developed from a single zygote, it seems probable that the risk to the foetus in multiple births is directly related to the incidence of monozygosity.

SINGLE AND DOUBLE STILLBIRTHS IN TWIN MATERNITIES

Yerushalmy and Sheerar (1940) have shown that in the United States Birth Registration Area the proportion of like-sex twin maternities resulting in two stillbirths is about twice as great as that of unlike-sex maternities, whereas the proportion of maternities resulting in one live and one stillbirth is about the same for both types of twinning. The data for England and Wales confirm this, if variation in maternal age is disregarded (Table V). When maternal age is taken into consideration, however, certain differences become apparent (Fig. 4). At all ages the proportion of maternities resulting in two stillbirths is more than twice as great for like-sex as for unlike-sex pairs; in the case of twin maternities resulting in one stillbirth, however, like-sex pairs run a greater risk in the younger and a smaller

TABLE V
TYPE OF BIRTH IN LIKE- AND UNLIKE-SEX TWIN MATERNITIES RELATED TO MATERNAL AGE
(England and Wales, July, 1938, to December, 1948)

Type of Birth	Maternal Age (years)										All Ages		
	Under 25		25-29		30-34		35-39		40 and over		Like (a)	Unlike (b)	Difference (a-b)
	Like	Unlike	Like	Unlike	Like	Unlike	Like	Unlike	Like	Unlike			
Two Live-born	88.8	92.1	89.7	91.5	89.9	91.1	88.6	89.9	87.9	88.4	89.28	91.00	-1.72±0.10
One Live-born, One Still-born	8.0	6.6	7.5	7.2	7.4	7.6	8.3	8.5	8.8	9.8	7.78	7.60	+0.18±0.09
Two Still-born	3.2	1.3	2.8	1.3	2.7	1.3	3.1	1.6	3.3	1.8	2.94	1.39	+1.55±0.05
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	— —
Maternities on which percentages are based	12,467	5,370	16,974	9,328	15,710	9,484	10,277	6,604	2,688	1,484	58,116	32,270	— —

risk in the older maternal age groups than do unlike-sex pairs ($\chi^2=13.0$, $n=4$, $0.01 < p < 0.02$).

If attention is confined to like-sex twins (Table VI, overleaf) it is seen that male pairs show a higher proportion with one or two stillbirths than do female pairs. The high risk of the male as compared with the female is particularly evident if the proportions resulting in two stillbirths are compared.

DISCUSSION

In single births it is well known that the risk of stillbirth is higher for the male than for the female foetus. That this is also true for twins is shown by data from the Annual Reports of the Registrar-General for England and Wales. Closer examination, however, indicates that the risk of stillbirth in the male, when compared with the risk in the female, varies both with maternal age and with type of twinning. In investigating these variations, we are unfortunately handicapped by inability to separate monozygous and dizygous pairs (except partially on the basis of like and unlike sex) or to examine

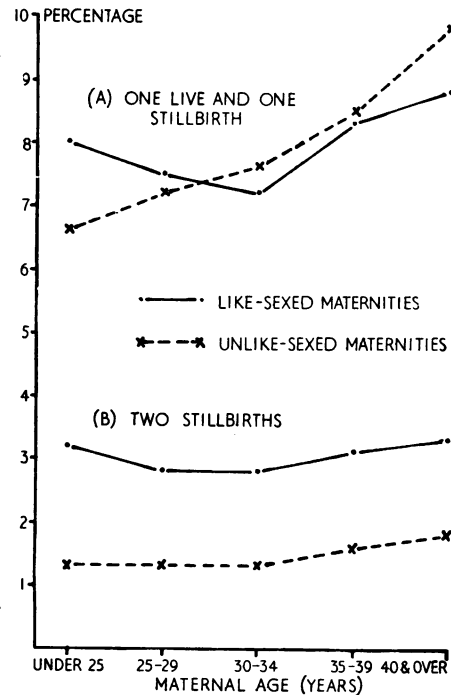


FIG. 4.—Frequency with which like- and unlike sexed twin maternities result in (A) one live and one stillbirth and (B) two stillbirths.

TABLE VI
RISK OF STILLBIRTH IN LIKE-SEX TWIN MATERNITIES

Type of Twin Maternity		Type of Birth			Total
		Two Live-born	One Live-born One Stillborn	Two Stillborn	
Both Male (MM)	%	88.48	8.16	3.36	100.0
	No.	26,411	2,435	1,004	29,850
Both Female (FF)	%	90.12	7.38	2.50	100.0
	No.	25,474	2,087	705	28,266
Total	%	89.28	7.78	2.94	100.0
	No.	51,885	4,522	1,709	58,116

the cause of death. No modest extension of national statistics is likely to provide this information, and any further progress will probably depend on careful and laborious field enquiry.

SUMMARY

Data from the Annual Reports of the Registrar-General for England and Wales (1938-1948) are used to show that:

- (1) Whereas the sex ratio of stillbirths in single pregnancies increases with maternal age, the sex ratio of twin stillbirths decreases.
- (2) At all ages stillbirth rates are higher in twins than in single births. The difference is very much greater in the younger than in the older mothers.
- (3) For twin births, male stillbirth rates are consistently higher than female rates (particularly in the case of younger mothers).
- (4) For single births there is little difference between the male and female stillbirth rates of young mothers, but as maternal age increases the risk to the male foetus becomes progressively greater than that to the female.
- (5) Stillbirth rates for like-sex pairs are consistently higher than for unlike-sex pairs.
- (6) At all maternal ages the risk to the male foetus, in both like- and unlike-sex pairs, is considerably higher than the risk to the female.
- (7) Unlike-sex twin stillbirth rates are lowest for mothers under 25 years, and, as in the case of single births, increase with maternal age. Stillbirth rates for like-sex twins have the same relation to maternal age as those for all twins, and are lowest in the middle of the reproductive period.

It is suggested that the risk to the foetus in multiple births is directly related to the frequency of monozygosity. Support for this view is provided by an analysis of sex specific stillbirth rates in single, twin, and triplet maternities.

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