

SECULAR CHANGES OF THE SEX-RATIO OF STILLBIRTHS AND EARLY DEATHS IN ITALY: EVIDENCE FOR POSTPONEMENT OF MALE SPECIFIC RISK

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Summary Analyses of Vital Statistics from various industrialized countries have shown recent reduction of both the rate and sex-ratio of stillbirths. Two alternate explanations are conceivable for the finding: 1) the improvement of environmental conditions has actually reduced the male relative risk, 2) such an improvement has merely postponed late fetal mortality into early periods of extrauterine life.

In order to discriminate between these two possibilities, both the secular trends of the sex-ratio of stillbirths and deaths in early infancy were analysed using Italian Vital Statistics. The results can be summarized as follows: 1) the sex-ratio of stillbirths continuously decreased during the examined period, from 1863 to 1979; 2) the sex-ratio of early deaths decreased until about 1920 and thereafter sharply increased. Therefore, Italian data seem to support the hypothesis of a postponement of late fetal deaths into early infant period.

INTRODUCTION

In a cross-sectional analysis performed on the different Italian regions, Cann and Cavalli-Sforza (1968) found a positive correlation between sex-ratio among stillbirths and regional stillbirth rates. Such a finding suggests that among the factors determining the decline in stillbirth rate some may be sex-selective, with a relative advantage of male sex.

Later, Teitelbaum (1971) pointed out that this result, concerning only stillbirth data, does not allow to discriminate between the two following possible explanations: 1) the improvement of environmental conditions has actually reduced the male relative risk at birth; 2) such an improvement has merely determined a postponement of late fetal mortality into early periods of extrauterine life. The longitudinal analysis performed by Teitelbaum, referring not only to stillbirths but also

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to early neonatal deaths, supports the second hypothesis. Therefore in the five European countries examined by Teitelbaum the improved living conditions seem to have determined a shift rather than a real reduction of the male relative risk. Similar results have been obtained by McMillen (1979) analysing the sex-ratio of fetal and neonatal deaths in the United States. Recently, however, Imaizumi and Murata (1981) have reported data from Japan which seem in disagreement with the postponement hypothesis.

In such a situation it is interesting to study whether the Teitelbaum's argument applies to Italian data. In the present paper the sex-ratio of all stillbirths and deaths within the first month of life has been determined over the last century, *i.e.* over a period in which this country experienced a dramatic improvement in socio-economic conditions and in sanitation (Ulizzi and Terrenato, 1982). In particular improved medical cares during pregnancy, delivery and neonatal period have determined a drastic fall of perinatal and infant mortalities, both at national and regional level; moreover, a progressive reduction of the absolute difference between male and female mortality rates was observed in the same period (Ulizzi, 1983).

A relevant question to be answered, if the postponement of late fetal male relative risk is confirmed, is which period of extrauterine life is affected by such a shift. To this purpose, the mortality within the first month of life has been subdivided in this paper into mortality within the first week and mortality from the second to the fourth week. The corresponding sex-ratios have been calculated and their trends compared in order to give a more detailed description of this crucial period of extrauterine life.

MATERIALS AND METHODS

Data referring to all Italian livebirths and stillbirths, partitioned by sex, were drawn for the period 1863–1970 from “Sommario di Statistiche Storiche dell'Italia,” published in 1976 by Istituto Centrale di Statistica (ISTAT). From the same text were also drawn data concerning male and female infants dead within the first week and from the second to the fourth week of life. In this case, however, data are available only from 1929.

Data referring to deaths within the first month of life were drawn from “Annali di Statistica-Tendenze evolutive della mortalità infantile in Italia” (ISTAT, 1976). For this kind of mortality no data are available in Italian Vital Statistics for the interval 1891–1910.

For the very recent years (1970–1979), data concerning all the categories of mortality were drawn from “Annuario di Statistiche Demografiche” of the corresponding years.

The period of about a century considered in this paper has been subdivided in decades; both the sex-ratio values and the mortality rates have been calculated for each decade using ten years figures.

The sex-ratios have been calculated as M/F.

RESULTS

The main features of the examined population are reported in Tables 1 and 2.

The secular trends of the sex-ratio both of stillbirths and deaths within the first month of life are shown in Fig. 1. It can be seen that while the sex ratio of stillbirths is almost regularly decreasing, the sex-ratio of babies dead within the first month shows a more complex pattern. In fact, this index seems to decrease until about 1920 and it sharply increases thereafter.

The subdivision of the mortality within the first month of life into within the first week and from the second to fourth week of life (Fig. 2), makes evident that the sharp increase in the sex-ratio of deaths during the first month is almost completely attributable to the increase in the sex-ratio of infants dead during the first week. In fact the sex-ratio of deaths from second to fourth week does not show relevant changes with time, with the possible exception of an interesting increase in the very recent years. It is worth noting that this increase is synchronous with the flattening shown by the sex-ratio of deaths within the first week.

As for the sex-ratio of perinatal deaths (stillbirths plus deaths within the first week) (see Fig. 2, upper part), its trend over time seems to remain more or less con-

Table 1. Mean annual number of births, stillbirths, deaths within one month and deaths within one week of life in Italy during the last century.

Decade	Total births		Stillbirths		Deaths within 1 month		Deaths within 1 week	
	Males	Females	Males	Females	Males	Females	Males	Females
1863-1870	475,233	443,520	12,342	8,713	50,064	39,963	—	—
1871-1880	537,939	502,189	17,227	12,880	51,205	41,732	—	—
1881-1890	591,493	554,232	22,398	17,116	48,989	40,216	—	—
1891-1900	588,260	552,282	25,769	20,001	—	—	—	—
1901-1910	588,981	553,697	27,328	21,521	—	—	—	—
1911-1920	522,422	491,592	23,833	18,677	25,470	21,201	—	—
1921-1930	588,556	554,970	25,713	20,096	23,889	19,409	11,609 ^a	9,426 ^a
1931-1940	535,828	506,267	18,710	15,258	21,069	16,769	11,490	9,026
1941-1950	492,839	463,539	15,852	12,991	18,978	14,902	10,905	8,371
1951-1960	461,351	435,554	13,782	11,209	13,250	10,028	9,418	6,865
1961-1970	499,313	472,275	10,227	8,696	12,161	8,944	9,421	6,691
1971-1979	420,684	396,320	5,024	4,461	7,837	5,687	6,383	4,537

^a Computed on 1929-1930 only.

Table 2. The sex-ratios of the examined population.

Decade	Total births Sex-ratio	Stillbirths Sex-ratio	Deaths within 1 month Sex-ratio	Deaths within 1 week Sex-ratio
1863-1870	1.0715	1.4165	1.2527	—
1871-1880	1.0712	1.3380	1.2270	—
1881-1890	1.0672	1.3086	1.2181	—
1891-1900	1.0651	1.2884	—	—
1901-1910	1.0637	1.2698	—	—
1911-1920	1.0627	1.2761	1.2013	—
1921-1930	1.0605	1.2795	1.2308	1.2316 ^a
1931-1940	1.0584	1.2262	1.2564	1.2730
1941-1950	1.0632	1.2202	1.2735	1.3027
1951-1960	1.0592	1.2296	1.3213	1.3719
1961-1970	1.0573	1.1761	1.3597	1.4080
1971-1979	1.0615	1.1261	1.3780	1.4067

^a Computed on 1929-1930 only.

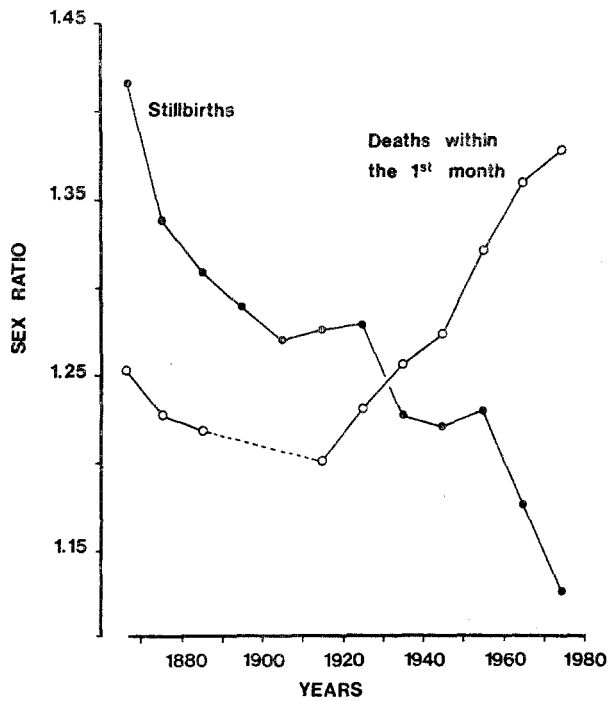


Fig. 1. Secular trends in Italy of the sex-ratio of stillbirths and deaths within the first month of life.

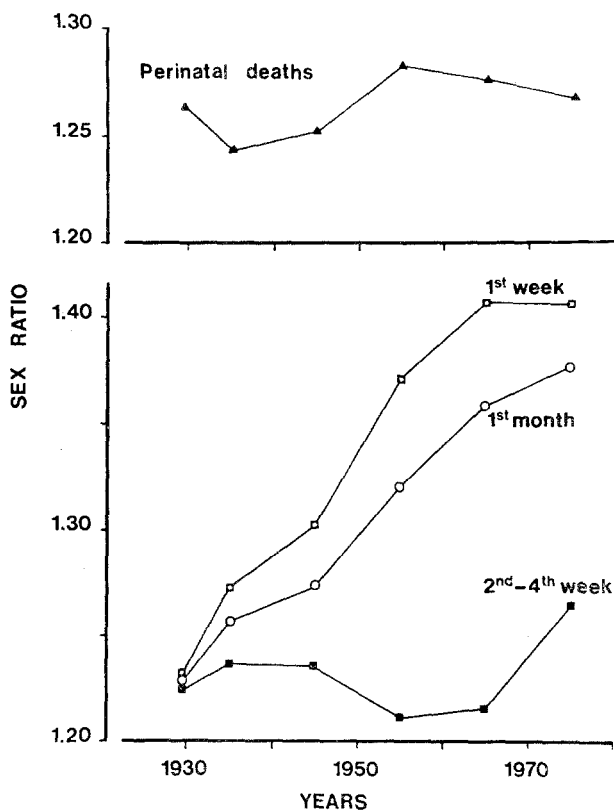


Fig. 2. (lower part) Sex-ratios after partitioning of mortality within the first month of life in mortality within the first week and from the second to the fourth week of life. (upper part) Sex ratio of perinatal deaths (stillbirths plus deaths within the first week of life).

stant, as expected considering the above described patterns of its two components (Figs. 1 and 2).

Searching for a correlation between sex-ratio and stillbirth rate has been attempted in this paper only from the beginning of the 20th century. In fact increasing stillbirth rates were observed in Italy from 1860 to about 1900. This likely resulted from a greater efficiency in the registration of stillborns. However, since the analysis of the sex-specific mortality rates along this period (Ulizzi, 1983) suggests that this under-registration was not sex-selective, this bias should affect only the corresponding mortality rates but not the M/F ratio, *i.e.* the sex-ratio.

The correlation coefficient between stillbirth rate and sex-ratio is +0.98.

The correlation coefficient between mortality within the first month and the corresponding sex-ratio turns out to be -0.66 ($p < 0.05$) if the entire study period (1863–1979) is considered, but it becomes -0.99 if one considers only the interval

1920–1979, *i.e.* the period in which the sex-ratio values show the above described sharp increase.

The very high values of the correlation coefficients found in this paper can be, at least in part, attributable to the longitudinal approach here used.

DISCUSSION

The secular trend of the sex-ratio of stillborns in this paper suggests that improved living conditions during the end of last century, together with a sharp decline in overall perinatal and infant mortality rates, caused a reduction of the male risk at birth. The parallel decline until about 1920 in the sex-ratio of the subsequent quota of mortality indicates a real and preferential saving of male fetuses from late fetal mortality. It is likely that some factor, among the factors contributing to the decline in stillbirth rate, acted in a sex-selective way. Hospital delivery, for instance, could have preferentially reduced the risk of male stillbirths whose birth weight is usually higher than that of females and therefore may undergo more difficult labours.

However, the pattern of the sex-ratio of early deaths drastically changed from the beginning of this century. The sex-ratio of stillbirths continued to decrease while that of deaths within the first month increased. This would indicate that some of the male perinatal deaths were delayed by several weeks and thus shifted from stillbirths to neonatal deaths. Therefore, like in other industrialized countries, the medical progress in Italy seems to have shifted rather than eliminated some unfavorable conditions which appear to affect preferentially the male sex.

As for the period of extrauterine life possibly affected by such postponement, subdivision of the first month of life into the first and the second-to-fourth weeks revealed that only the first week is affected. The trend relative to the sex-ratio of deaths in the second-to-fourth weeks showed no comparable variations with time.

In conclusion, the relative male risk at the perinatal level has not undergone relevant changes despite the improvements in sanitation achieved in this century. It is likely that this quota of sex-specific mortality represents mortality intrinsic to the male sex, possibly due, at least in part, to genetic factors associated with the hemizygous condition of the X-linked genes and their pseudodominant effect.

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