Factors Influencing the Stillbirth Rates in Single and Multiple Births in Sweden, 1869 to 1967

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Temporal variations in the stillbirth rate among singletons, twins and triplets in Sweden between 1869 and 1967 were studied. Both among single and multiple births there were marked secular decreasing trends in the stillbirth rates. Based on our long time series since 1869, this study confirms that among twins and triplets the stillbirth rate was higher among same-sexed than among opposite-sexed sets. Comparisons between the stillbirth rates among twin births in urban and rural regions indicate higher stillbirth rates in rural areas. In addition, the stillbirth rates among twins of unmarried mothers were higher than those of twins of married mothers. These findings also hold for both same-sexed and opposite-sexed twin pairs. Analyses of the stillbirth rates for singletons and for different types of twins indicate that up to 1950 the risk of stillbirth among males was almost constantly between 15% to 20% higher than among females. After that the difference in the risk decreased. Comparisons with other populations were performed.

We have taken advantage of the fact that Sweden has, for the whole nation, among the oldest data of multiple births with detailed information on place of birth, sex combination, live and stillbirths, and marital status of the mother (Eriksson & Fellman, 2004). The association between different factors and the stillbirth rate (SBR) in Sweden from 1869 to 1967, measured as the number of stillborn per 1000 total births in single and multiple births, was studied. Among both single and multiple births there were marked decreasing temporal trends in the SBRs. The relative declining pattern in the SBRs was almost the same for singletons, twins and triplets (Fellman & Eriksson, 2006) and for the different sex combinations of twin sets.

Based on our long time series since 1869, this study confirms that the SBR among twins and triplets is higher among same-sexed (SS) than among opposite-sexed (OS) sets. Comparisons between the SBRs among twin births in urban and rural regions indicate higher SBRs in rural areas, even if in the past the

towns in Sweden were relatively few and small and the socioeconomic differences between the urban and rural regions were small. In addition, the SBRs in twin births to unmarried mothers are higher than in twin births to married mothers. Also these findings hold for twin pairs of both SS and OS. Analyses of the SBRs for singletons and for different types of twins indicate that up to 1950 the risk of stillbirth among males was almost constantly between 15% to 20% higher than among females. After that the difference in the risk decreases.

Materials and Methods

Our series starts with birth data for the period 1869 to 1878, published by Berg (1880), where he presented the total number of singletons, the secondary sex ratio and the percentages of live and stillbirths among them. Based on this information, we estimated the number of live and stillbirths among both male and female singletons and, consequently, the SBR among males, females and all. For the multiple maternities, Berg gave exactly observed numbers of the composition of twin pairs and triplet sets with respect to live and stillbirths and to the sex combinations. Similar information published by Statistics Sweden was available for Sweden for the period 1901 to 1967. Information on the marital status of the mothers was registered for the whole period, but information on the type of living place of the mother (urban/rural) was registered only for the period up to 1964.

Since 1973, *Socialstyrelsen* (The Centre for Epidemiology at the National Board of Health and Welfare in Sweden) is responsible for the registration of stillbirths in Sweden. However, their published registers are not as informative as Berg's data and the data submitted by Statistics Sweden for the period 1901 to 1967. The distribution of

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Table 1

Stillbirth Rates per 1000 Births among Singletons, Twins and Triplets in Sweden for Males (M), Females (F) and All and For Different Periods

Period	Singletons			Twins			Triplets		
	M	F	All	M	F	All	M	F	All
1869–1878	32.7	26.1	29.5	103.0	84.6	94.0	152.8	177.9	165.9
1901–1910	25.2	20.8	23.0	88.2	73.0	80.8	126.5	130.2	128.3
1911–1920	24.0	20.2	22.2	87.0	70.1	78.8	130.7	125.8	128.2
1921–1930	25.9	21.4	23.7	81.0	71.5	76.4	139.1	114.9	126.9
1931–1940	28.0	24.1	26.1	83.1	74.7	79.0	110.2	107.4	108.7
1941–1950	22.3	19.3	20.8	63.5	54.4	59.0	68.8	70.8	69.7
1951–1960	16.9	15.1	16.0	45.1	38.1	41.7	52.0	53.7	52.8
1961–1967	10.7	10.4	10.6	34.6	33.8	34.2	44.0	54.6	49.8

Note: The average yearly number of children is approximately 116,600 singletons, 3170 twins and 47 triplets.

stillbirths according to the sex and the composition of the sets of multiple maternities were not registered for the period after 1973. Consequently, in this study we analyze the Swedish data for the period 1869 to 1967.

The Swedish data were also considered by Fellman and Eriksson (in press, 2006). However, in the former study we considered the variation in the secondary sex ratio among singletons and twins, and estimated the frequency of monozygotic and dizygotic twin maternities and how reliable Weinberg's differential rule is. In Fellman and Eriksson (2006), we considered the temporal variations in the SBR among singletons, twins and triplets. In that study we were not interested in the

influence of marital status, urbanization or the sex combination of multiple births. Therefore, we could consider the whole period 1869 to 2001.

It is a well-known fact that the SBR, after elimination of other influential factors, is higher among males than among females. Assume that our birth data contain m males and f females, that the corresponding SBRs are s_m for males and s_f for females, and that

$$\frac{s_m}{s_f} = k > 1.$$

The factor k is a measure of the higher risk of stillbirth among males. For example, if this is 20%, then $k = 1.20$. The number of stillborn females is $s_f f$
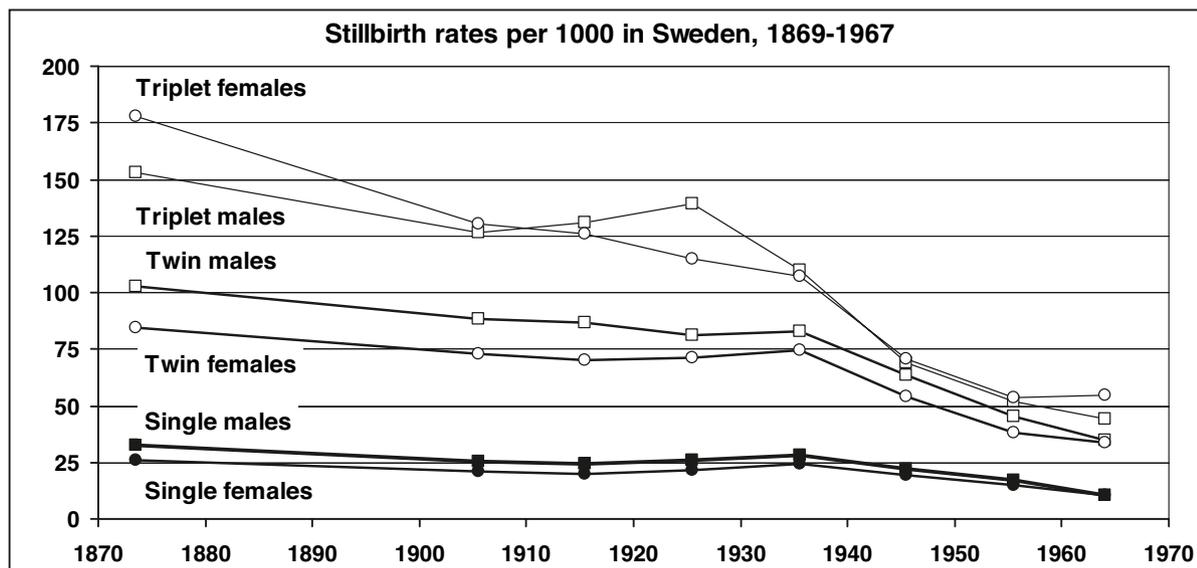
Figure 1

The stillbirth rates (SBRs) per 1000 births among singleton, twin and triplet births.

Note: In general, the SBR is higher among males than among females. Markedly decreasing trends can be observed and after the 1930s the decreases are accentuated. The relative declining pattern in the SBRs was almost the same for singletons, twins and triplets (Fellman & Eriksson, 2006). Note that, for the period 1869 to 1967, SBR is on average higher for female triplets (119.3) than male triplets (110.9).
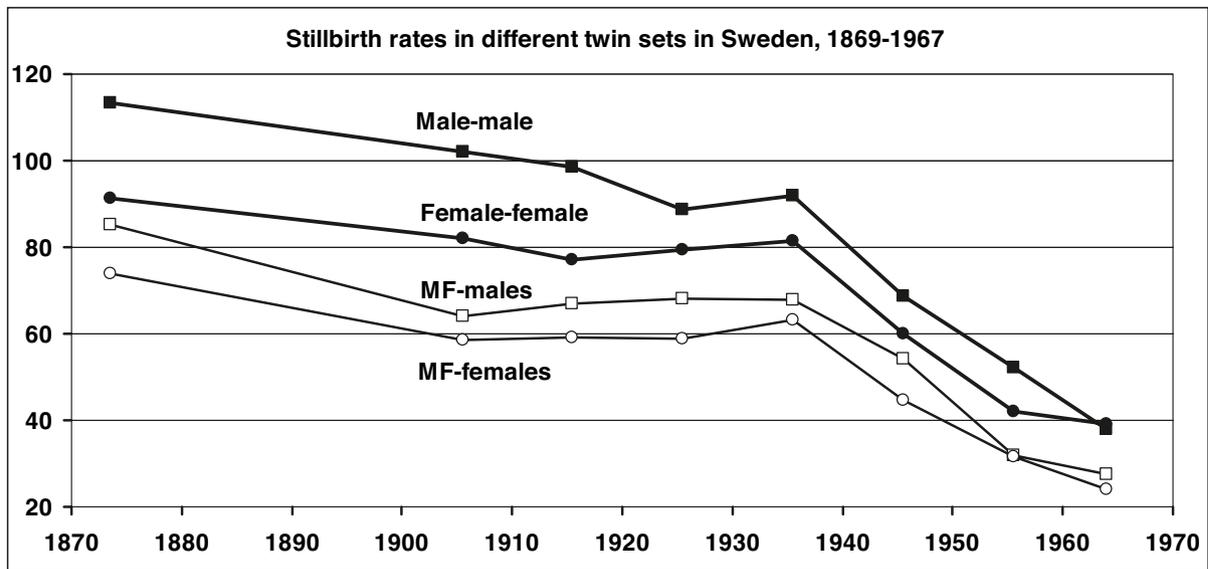
Figure 2

Stillbirth rates (SBRs) per 1000 in male–male, female–female and male–female (MF) twin pairs.

Note: In SS twin pairs the SBR is constantly higher than in OS twin pairs. The SBR is higher among males than females. The SBR for males is higher in male-male twin pairs than in male–female twin pairs. Analogously, the SBR for females is higher in female–female twin pairs than in male–female twin pairs.
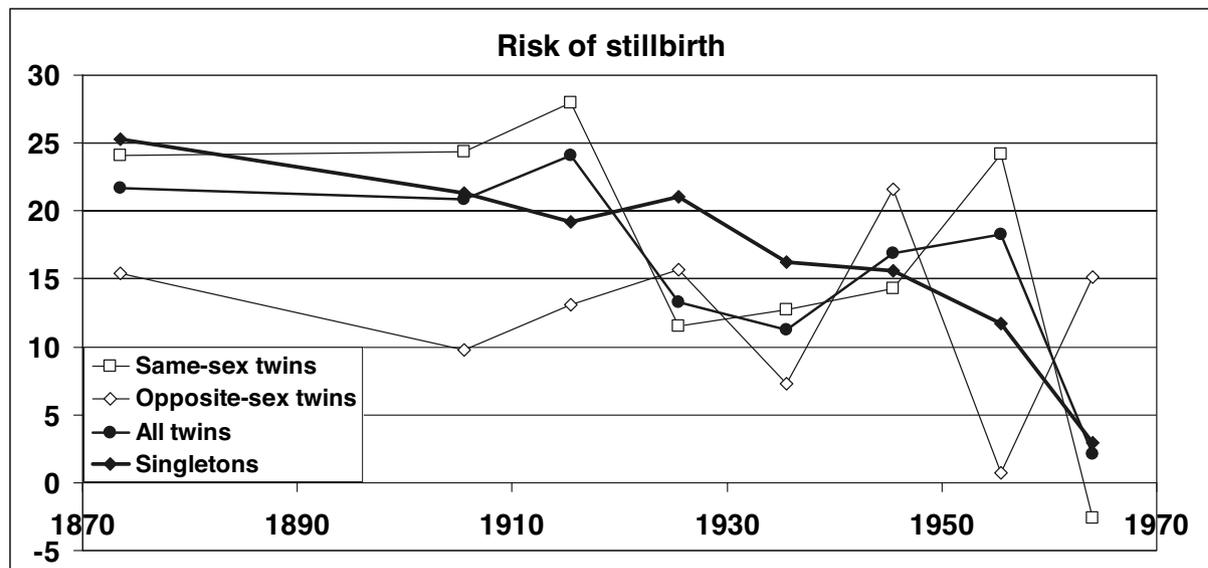
Figure 3

The higher risk of stillbirth among singleton males and among males in SS, OS and all twin pairs.

Note: The values are rather constant up to 1950 and after that a decreasing trend can be observed. For the period 1869 to 1950 the mean for singletons is 20.2. The means for the twin pairs are 20.4 among SS, 13.5 among OS and 18.8 among all twin pairs. If one considers the sex ratios among stillborn for this period, they are 127.8 for singletons, 129.3 for SS, 113.5 for OS and 124.3 for all twin pairs.

and of stillborn males is $s_m m = ks_f m$. Consequently, the sex ratio among the stillborn is

$$\frac{s_m m}{s_f f} = k\frac{m}{f}$$

and is higher than among all births. If the overall sex ratio is around 106 and $k = 1.20$, then the sex ratio among the stillborn is about 127.

Results and Discussion

Temporal Trends

The temporal trends in the SBRs among singletons, twins and triplets are presented in Table 1 and Figure 1. The SBRs decreased almost monotonically. After a local top for singletons and twins in the 1930s, this decrease was accentuated. Fellman and Eriksson (2006) noted that the relative decreasing
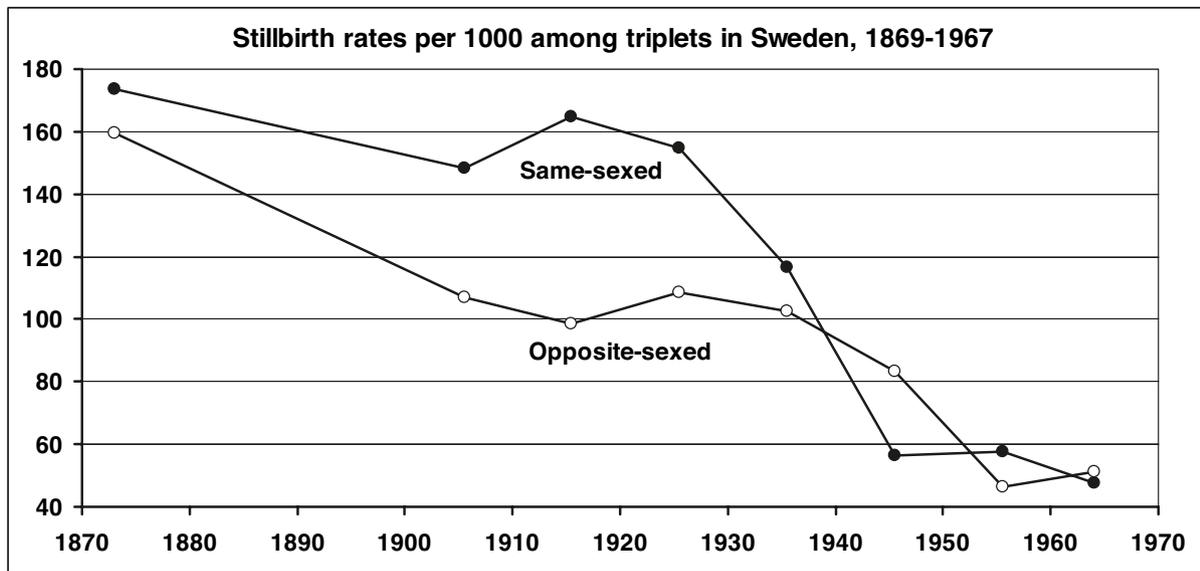
Figure 4

Stillbirth rates (SBRs) per 1000 in SS and OS triplet sets.

Note: In SS triplet sets the SBR was markedly higher than in OS triplet sets up to the 1930s. After that a leveling can be observed.
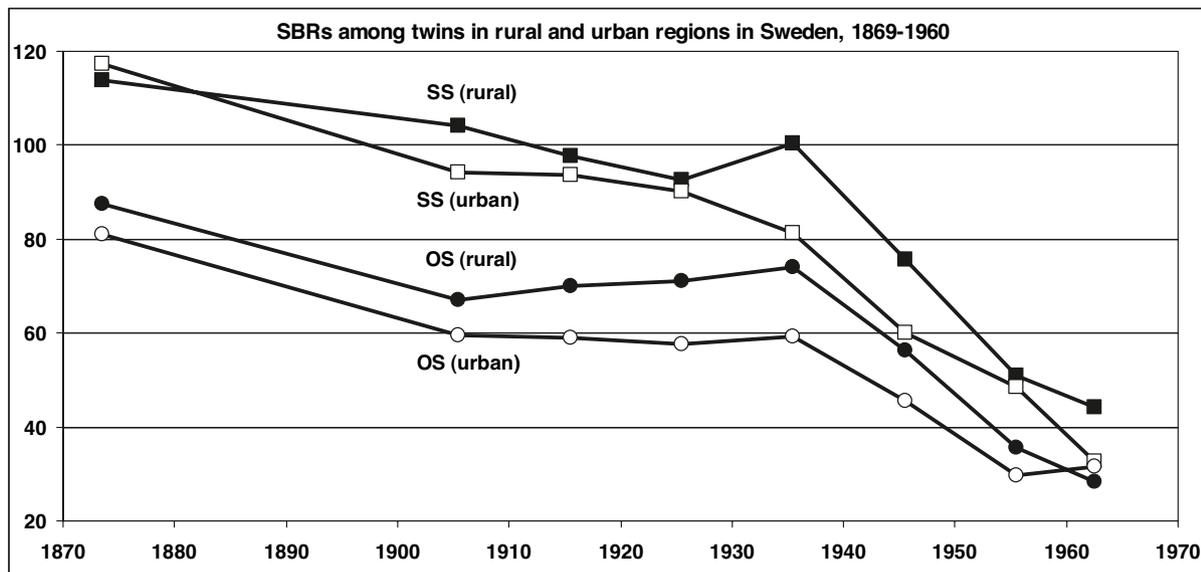

Figure 5

The influence of the type of region on the stillbirth rate (SBR) per 1000 among twins.

Note: In the rural areas the SBR is higher than in urban. This finding holds for both SS and OS twin pairs. The differences in the SBRs between towns and rural areas are small for the period 1869 to 1878, but in the past the socioeconomic differences between the towns and the rural regions in Sweden were small. Particularly, one observes that the following strict order SS (rural) > SS (urban) > OS (rural) > OS (urban) holds almost constantly.

trends in the SBR among singletons, twins and triplets were almost equally strong.

The SBR is, in general, higher among males than among females (Table 1 and Figure 1). Our opinion is that the discrepancies from this general rule among triplets are caused by random fluctuations. During the period 1869 to 1967, 20 quadruplet, two quintuplet (in 1965 and 1967) and one sextuplet set (in 1965) were registered. The quintuplet and sextuplet maternities were all born after the 1950s, when the treatment of subfertility with ovulation inducers, and so forth, started in Sweden (Gemzell & Roos, 1966). In these sets there are 46 males (36 live-born and 10 stillborn) and 50 females (44 live-born and six stillborn). Consequently, the SBR for all higher multiple births is 166.7, 217.4 for males and 120.0 for
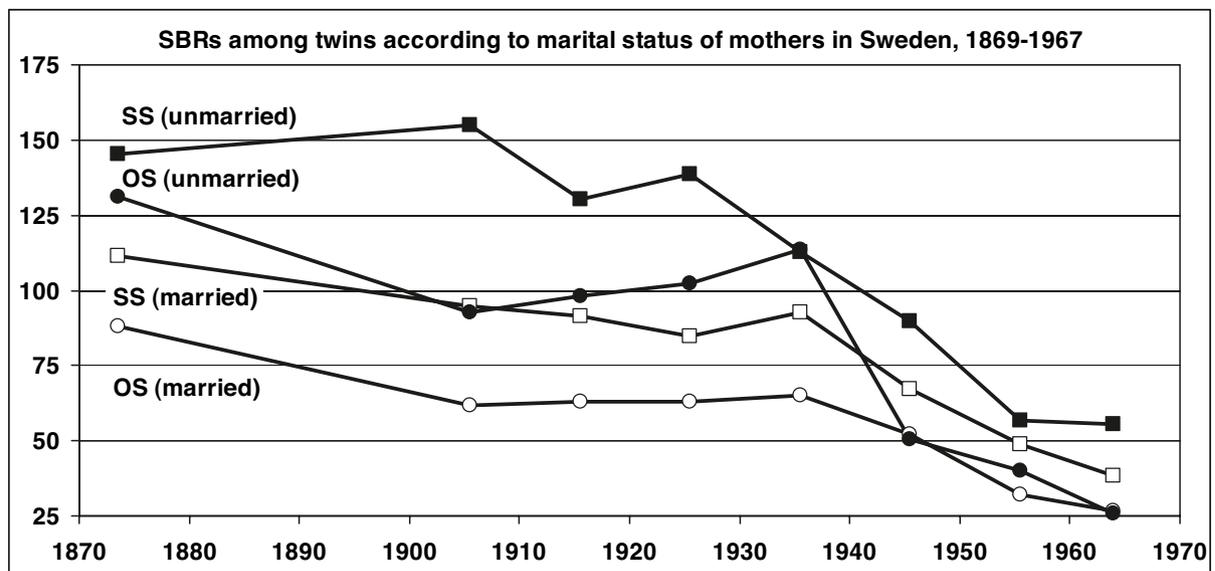
SBRs among twins according to marital status of mothers in Sweden, 1869-1967

Figure 6

The stillbirth rates (SBRs) per 1000 among twins according to the marital status of their mothers.

Note: The SBR in twin births to unmarried mothers is higher than those to married. In general, this finding holds for both SS and OS twin pairs. A strict ordering similar to the ordering in Figure 5 cannot be identified. Great differences can be noted in the SBRs between OS twins of unmarried mothers and OS twins of married ones up to the 1930s but after that the SBRs converge. SS twins born to unmarried mothers have the highest SBR during the whole period

females; the risk of stillbirth among males is 81.2% higher than among females; and the sex ratio among the stillborn is 166.7.

Sex Composition of the Set of Multiple Maternities

In Figure 2 we analyzed the SBR in twin pairs of different sex combinations. For the male–female twin pairs we distinguished between the SBR among males and females. Particularly, up to the 1930s the SBR is considerably higher among SS twin pairs than among OS pairs, and up to the 1950s the SBR is considerably higher among males than among females in OS twin pairs. Furthermore, the SBR among males is higher in male–male twin sets than in male–female twin sets. This is also the case when we compare the SBR among females in female–female and male–female twin sets. The relative decreasing trends are almost the same within all groups. Making this assumption one can estimate the higher risk of stillbirth among twin males as compared with twin females.

The higher risks of stillbirth among males in singleton births and in SS and OS twin pairs are presented in Figure 3. The values were fairly constant up to 1950 and after that a decreasing trend can be observed. For the period 1869 to 1950 the average for singletons was 20.2%. The averages for the twin pairs were 20.4 among SS, 13.5 among OS and 18.8 among all the twin pairs. If one considers the sex ratios among stillborn for this period, these are 127.8 for singletons, 129.3 among SS, 113.5 among OS, and 124.3 among all twin pairs. Among male triplets for the period 1869 to 1950 such a higher risk of stillbirth could not be identified. In fact, the

figure obtained was negative (–7.1%) and the sex ratio 90.2. However, our opinion is that the rather small number of triplets (*n* = 388) cannot give reliable results.

Previous studies have also shown that children have a better chance of survival in OS than in SS twin pairs (for review see Campbell & MacGillivray, 1988). Figures 2 and 3 show the higher risk of stillbirth in males, particularly in male–male pairs, a risk relation first noted by Lowe and Record (1951). Wedervang (1924) already noted that the probability of both twins being stillborn declined more rapidly for male–female pairs. Males had a better chance of survival if the co-twin was a female rather than a male (Potter, 1963) and the lowest death rates in females occurred in those of OS pairs (Barr & Stevenson, 1961). OS twin pairs had a better chance of survival than SS pairs (Dunn, 1965; Klein, 1964; Potter, 1963) and males were at greater risk than females (Barr & Stevenson, 1961; Potter, 1963; Spurway, 1962). SS twin males had a particularly high perinatal mortality (Butler & Alberman, 1969).

Triplet sets. In Figure 4 we compare the SBR in SS and OS triplet sets. This figure shows that the SBR is almost constantly higher, and up to the 1930s is markedly higher, among SS triplet sets than among OS triplet sets. Among the 3594 triplets for Sweden, 1869 to 1967, there are 414 stillborn.

Socioeconomic factors. Figure 5 shows that the SBRs in twin births for the period 1869 to 1964 are higher in rural regions than in urban. The socioeconomic differences between towns and rural area

were small for the period 1869 to 1878, when the differences in the SBRs were small. After the 1930s a convergence can be noted. This finding holds for both SS and OS twin pairs. Particularly, one observes that almost constantly the following strict order holds: SS (rural) > SS (urban) > OS (rural) > OS (urban).

In Figure 6 we observe that the SBRs are markedly higher in twins born to unmarried mothers than to married. In general, this finding holds for both SS and OS twin pairs. However, an equally strict ordering similar to the ordering in Figure 5 could not be identified.

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