Two Centuries of Infant, Child and Maternal Mortality in German Village Populations

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Knowledge about mortality for Germany prior to the latter part of the nineteenth century, especially for the population living outside of cities, must be based primarily on information contained in registers of deaths or burials kept by ecclesiastical authorities in local parishes. The development of the family reconstitution technique in historical demography, in connection with procedures to analyze the data it produces in ways that avoid or minimize potential inherent biases, has considerably expanded our ability to document the conditions of mortality under which German villagers lived in the past. While it is difficult to determine adult mortality with any degree of precision from family reconstitution data, relatively precise estimates of infant and child mortality are possible. In addition, estimates of the special situation of maternal mortality can also be derived without great difficulty.

The purpose of the present paper is to explore levels, trends, and differentials in mortality for a sample of 14 German village populations during the eighteenth and nineteenth centuries based on reconstituted family histories contained in village genealogies *(Ortssippenbücher)*, a source unique to Germany. The focus is on infant, child and maternal mortality, although rough estimates of life expectancy at birth are also presented. The villages are located in five different states or regions of Germany: 4 in Baden, 1 in Württemberg, 3 in Bavaria, 4 in Waldeck, and 2 in East Friesland. While the villages cannot be considered a random sample of the rural population of the period, they do cover a moderate range of demographic conditions and represent diversity in occupational distribution, inheritance systems, and religious affiliation. One interesting feature of Germany during the period of study was the sharp regional differences in the prevalence and duration of breastfeeding and this is also reflected in the sample. For example, the villages in Bavaria are located in areas where, at the turn of the nineteenth century at least, most mothers either did not breastfeed their infants at all or did so for a very short time, while in the area of the East Friesland villages, almost all mothers nursed their infants and the average duration of breastfeeding was close to a year.

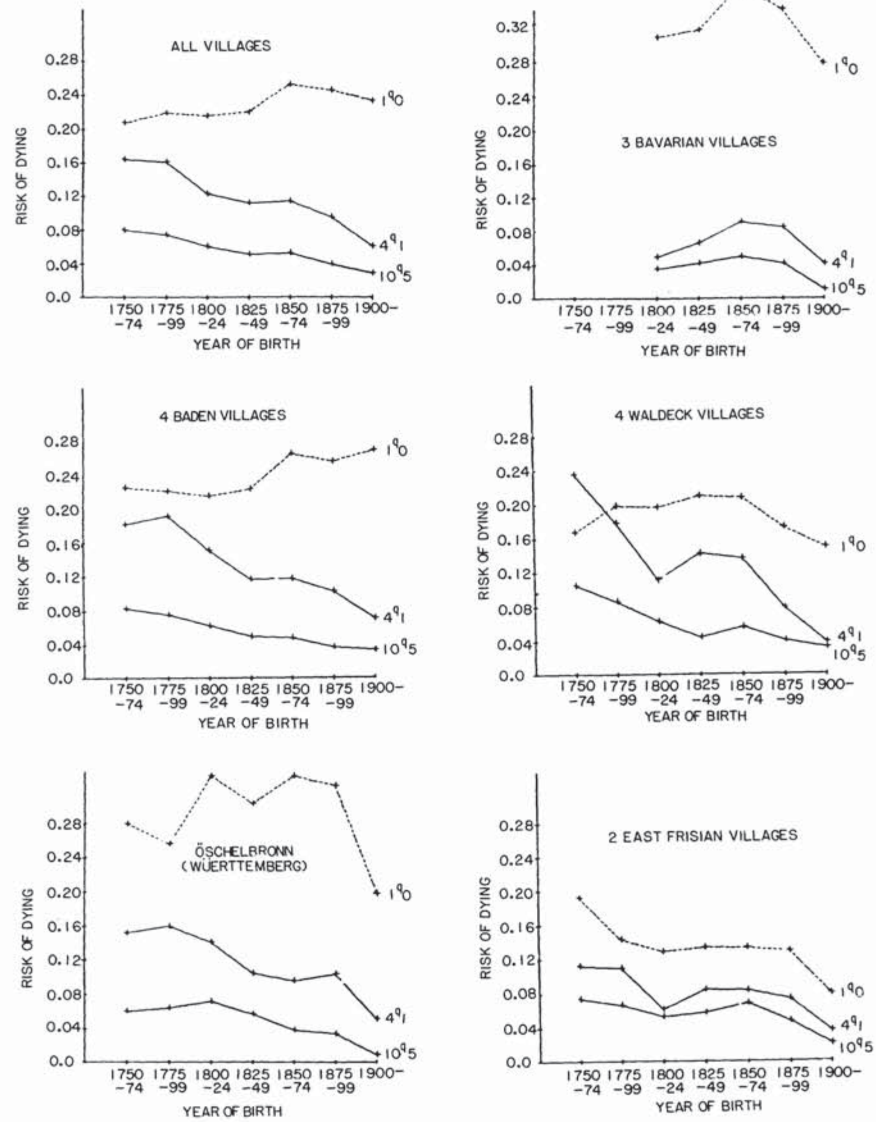
The data set on which the present study is based has been developed in connection with a broader study of demographic behavior in the past. Thus, except as noted in the discussion of maternal mortality, the analysis is limited to births to couples for whom complete reproductive histories are known, i.e. only couples that could be considered in observation until the death of the first spouse to die. In general, the data appear to be reasonably accurate with the exception of certain fairly readily identifiable periods of incomplete or imprecise registration of infant and child deaths. Data from these periods are excluded from the present study. Because of apparently variable treatment of stillbirths in the parish registers of the different villages, especially between Catholic and Protestant villages, stillbirths are included in the infant mortality rates unless specifically indicated to the contrary. Overall, the data represent more than 9,000 reproductive histories, covering some 48,000 births. The nature and quality of the genealogies, the rules of selection, and the nature of the sample are discussed at some length in a forthcoming monograph.[1]

Trends and levels of infant and child mortality

National-level life tables providing detailed information on age-specific levels of mortality are available for Germany only after 1870. Several German states produced life tables for earlier years although only exceptionally for periods prior to the mid-nineteenth century. These data indicate a steady and substantial decline in the mortality of children above age one, as well as some evidence of decline in infant mortality during the last third of the nineteenth century when the first national-level life tables were compiled.[2] There is little evidence available from official statistics, however, to determine how long these trends had been under way. Given the different implications of alternative sequences in fertility and mortality decline for understanding the demographic transition, and the real possibility that infant and child mortality trends may have differed substantially, information on long term trends prior to the period covered by official statistics takes on added importance.[3]

The probabilities of dying before age one (${}_1q_0$), between exact ages one and five (${}_4q_1$), and between exact ages five and 15 (${}_{10}q_5$) are shown in Figure 1 from the mid-eighteenth century to the early twentieth century for the combined sample as well as regional groupings of villages. While the combined sample is clearly composed of a non-random selection of German villages, results for the end of the nineteenth century correspond reasonably closely to the national levels infant and child mortality indicated by official statistics.[4] At a more local level, both the level and trend of infant mortality indicated for the four Baden villages during the last half of the nineteenth century correspond closely to the official statistics at the district level.[5]

Figure 1. Trends in infant and child mortality.



Notes: The calculations of $_1q_0$ include stillbirths.

Probably the most striking feature of the results is the indication that infant and child mortality generally follow divergent paths from the end of the eighteenth to the beginning of the twentieth century. For the sample as a whole, infant mortality reaches its highest level during the third quarter of the nineteenth century and declines only moderately by the start of the twentieth century, while in contrast the probabilities of dying between ages one and five and between ages five and 15 decline almost steadily from the mid-eighteenth century. The pronounced rise in infant mortality during the third quarter of the nineteenth century, largely evident for the sample as a whole, is absent in the Waldeck and East Frisian villages. The modest fall in infant mortality for births from 1900 onward for the combined sample is the result of a slight increase in infant mortality in the Baden villages combined with a sharp drop everywhere else. The general pattern of an earlier decline in child mortality than in infant mortality, however, holds for most of the regional groupings with the main exception being the Bavarian villages for which equivalent indices are shown only from 1800 on because of the lack of exact death dates for many infant and child deaths prior to that time. For the East Frisian villages, the trends in infant and child mortality are somewhat closer to being parallel than elsewhere. Given that infant mortality is at a higher level than child mortality, even parallel declines would reflect greater proportionate reductions in child than in infant mortality.

The tardiness in the decline in infant mortality relative to improvements in mortality at childhood ages above one appears not to be unique to Germany but rather a common feature of the demographic transition in much of Europe.[6] One possible contributing factor to the decline of child mortality, particularly at ages immediately following infancy, was the introduction of smallpox inoculation which became compulsory in a number of German states very early in the nineteenth century.[7]

A realistic assessment of the linkages between changes in mortality and fertility associated with the demographic transition clearly needs to incorporate measures of mortality which go beyond just the first year of life. In the case of Germany, judging from the results for the combined sample of all villages, improvements in child mortality were to some extent cancelled out by rising infant mortality during parts of the eighteenth and nineteenth centuries. The result is that the probability of surviving to age 15 fluctuated within a relatively narrow range until the beginning of the twentieth century.

Substantial differences in the levels of infant and child mortality for the various regional groupings of villages are also apparent. One important determinant of these differences, especially in infant mortality, was undoubtedly the variation in the prevailing infant feeding practices. The highest infant mortality rates are found for the Bavarian villages which are located in areas where breastfeeding was known to be relatively rare during the nineteenth century, while the lowest infant mortality was found for the East Frisian villages where breastfeeding was probably most extensive.

Interestingly, the risk of dying in the first four years following infancy is relatively low in the Bavarian villages perhaps reflecting a selection process in which only the hardier infants survived the high mortality before age one. One possible mechanism accounting for the relatively low early child mortality in the Bavarian villages might be the absence of weanling diarrhea since many children in the Bavarian villages were either not breastfed at all or weaned long before the end of the first year of life. In other villages, where a substantial proportion of children might have been breastfed longer than a year, the increased risk of mortality following weanling might contribute significantly to the early child mortality rate.

As mentioned above, the estimation of adult mortality from family reconstitution data is considerably more problematic than the calculation of infant and child mortality. Without information on mortality risks at all ages, it is not possible to calculate a complete life table and thus not possible to calculate directly an estimate of life expectancy at birth. One alternative is to indirectly estimate life expectancy through the application of model life tables (i.e., generalized hypothetical life tables embodying typical age patterns of mortality risks at different overall levels of mortality). All that is required is to determine which model life table embodies mortality risks in infancy and childhood that match most closely those of the observed population. The life expectancy at birth indicated in that model life table is then taken as the life expectancy corresponding to the observed data. While the procedure is relatively simple, the validity of the results is uncertain and thus can be considered only as rough estimates, especially when they refer to periods or regions other than those on which the construction of the model life tables are based. Indeed, the use of model life tables within historical demography has not been without criticism.[8]

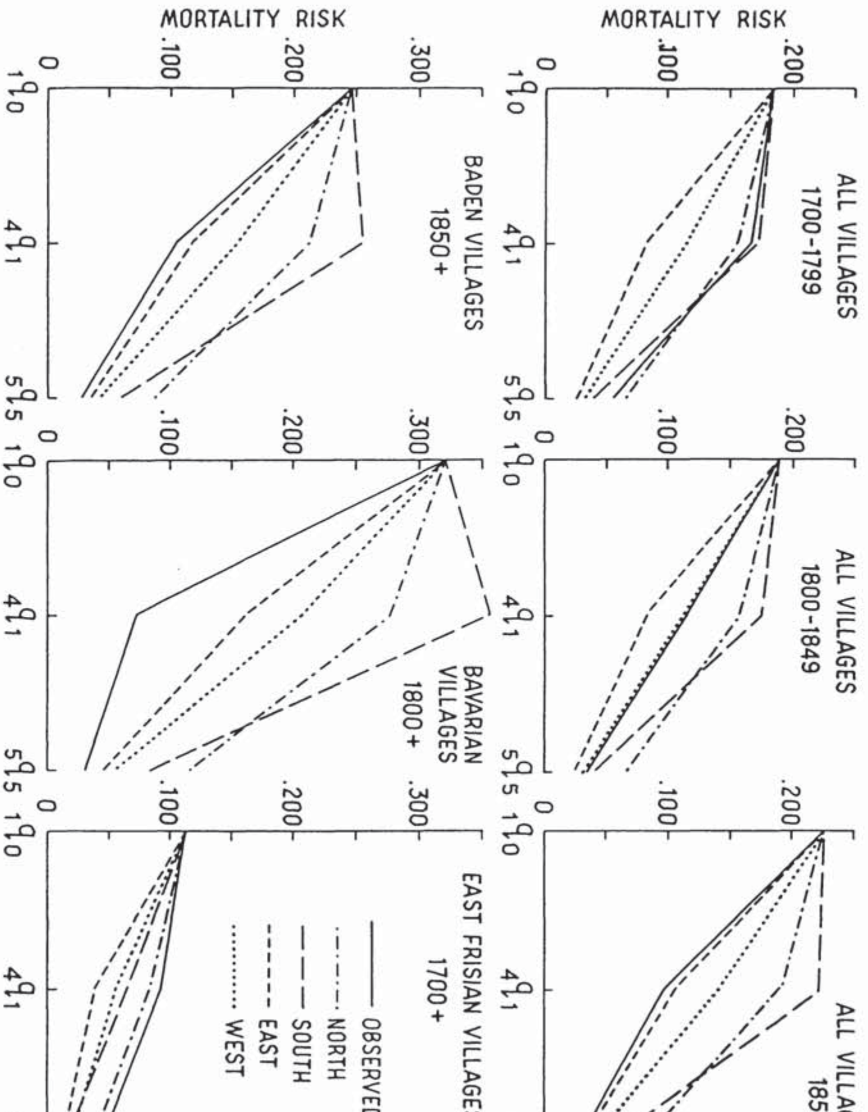
Probably the best known and most widely used model life tables are the regional model life tables developed at Princeton University by Coale and Demeny.[9] They are based on over 300 actual life tables thought to be of reasonable accuracy. Most refer to European populations or populations settled by Europeans overseas and date from the last third of the nineteenth century through the post-World War II period. Four different regional "families" of model life tables were created: The West Tables cover much of Western Europe as well as overseas European settlements and other non-European populations; the East tables cover mainly Central European countries and draw heavily on German life tables; the North and South tables are derived mainly from life tables from Scandinavian and Southern European countries respectively. The East, North, and South groups are separated out because they revealed age patterns with substantial and significant deviations from the world average while the West pattern is in a sense a residual one thought to have most general applicability.

The four regional model life table families differ substantially from one another with respect to the age structure of mortality within infancy and childhood as well as with respect to the relationship of infant and child mortality to adult mortality. Since German life tables including a number from the late nineteenth century were an important component of those determining the East model, we might expect the East model to fit the experience of the sample villages most closely. In actuality, the situation is more complicated both because there were substantial variations regionally within the sample in the age pattern of mortality during the first years of life and because trends in infant and child mortality diverged during the period under observation. The result is that the model life table family which best fits the age pattern of mortality in infancy and childhood differs both over time and across regional clusters of villages.

The values of ${}_1q_0$, ${}_4q_1$, and ${}_5q_5$ as observed in the entire sample over time and in several regional clusters of villages for selected periods are compared in Figure 2 with the equivalent model life table values from each of the four model families. The model life table values for ${}_4q_1$ and ${}_5q_5$ are equivalent in the sense that in each case they are associated with a value of ${}_1q_0$ that is identical to the observed value (after excluding stillbirths).[10] Thus the observed and model values of ${}_1q_0$ are necessarily the same but the observed and model values at older ages agree only if actual and model age patterns are identical. The comparison is extended only to age 10 rather than to age 15 in order to minimize possible biases that might affect the observed values of older childhood mortality due to the selection of cases to be included in the analysis.[11] The purpose of this comparison is to show how the age patterns of mortality in infancy and childhood varied over time and among regional groupings of villages.

One distinctive feature of the East pattern of mortality, to which Germany is generally assumed to conform, is the relatively low childhood mortality compared to a given level of infant mortality. This same pattern is evident for the combined sample of all villages for the years 1850 onward and the fit between the East model values and the observed values is quite close. This pattern, however, is a result of the declining trend in early childhood mortality during the nineteenth century in the face of persistent, even slightly rising, infant mortality. Thus for the first half of the nineteenth century, the age structure of infant and child mortality differs from that in the second half and, for the combined sample of all villages, no longer resembles the East pattern. Rather it is much closer to that embodied in the West pattern. Moreover, for the eighteenth century, prior to the decline in child mortality, results for the combined sample resemble most closely the North pattern. Thus in the case of the combined sample of villages, the divergent trends in infant and child mortality over the eighteenth and nineteenth centuries resulted in shifts in the age pattern of mortality under age ten sufficient to alter the fit with respect to the model life table family to which the observed experience conformed most closely. Schofield and Wrigley in studying infant and child mortality in England also found that a sufficient change in the age pattern occurred to af-

Figure 2. Observed values of ${}_4q_1$ and ${}_5q_5$ and corresponding regional model life table values matched on ${}_1q_0$.



Notes: Values of ${}_1q_0$ exclude stillbirths.

fect the extent to which the observed data best fit particular model life table families.[12] These results caution against assuming that mortality patterns as observed in the late nineteenth century or during the twentieth century on which the different families of model life tables have been determined, will necessarily apply for earlier periods. In the case of Germany, it appears that as far as mortality under age ten is concerned, the distinctive East pattern only emerged toward the end of the nineteenth century and may not have applied during earlier years.

Also shown in Figure 2 are equivalent comparisons for several regional groupings of villages between the observed age pattern of mortality under age ten and the model life table values corresponding to the observed mortality risk under age one. For the four Baden villages during the period from 1850 onward, the age pattern of mortality appears to most closely fit the East model. Although the degree of conformity is fairly close, the observed drop-off in childhood mortality compared to infant mortality is actually slightly more extreme than embodied in the corresponding East model. A far more pronounced example of this is provided by the Bavarian villages from 1800 onward. While the East pattern comes closest of the four model life table families to that observed in the Bavarian villages, the fit is still poor. Mortality risks between exact ages one and five and between exact ages five and ten as observed are much lower relative to infant mortality risks than embodied even in the East pattern. In both the cases of the Baden and the Bavarian villages, the possible transference of some stillbirths to the early infant death category may contribute to the exaggerated East pattern but, especially in the latter case, could hardly account for all of it. An opposite situation characterizes the East Frisian villages from 1700 onward where childhood mortality is relatively high compared to the observed level of infant mortality. The pattern conforms most closely to the North model with values of ${}_4q_1$ and ${}_5q_5$ being even higher relative to ${}_1q_0$ than implied by the North model.

Quite possibly, differences in the infant feeding practices account at least in part for the different age patterns of infant and child mortality observed for the regional clusters of villages as well as the deviations from the model life table patterns. The Bavarian villages represent the extreme case of little or no breastfeeding and thus the minimal amount of protection from mortality risks during infancy. At the same time there should be an absence of problems associated with weaning later in childhood in these villages. The Frisian villages probably represent the opposite situation or at least a marked contrast in this respect to the Bavarian villages. For Germany as a whole, at least during the latter part of the nineteenth century, the overall East pattern to which it conforms appears to result from a combination of patterns far more extreme than the East such as in the areas of Bavaria and elsewhere, where little breastfeeding occurs, and the opposite pattern in areas such as East Friesland, where breastfeeding was extensive. Thus caution must be used when choosing a model life table family to apply to particular regional groupings of villages given the substantial differences in the age pattern of mortality that characterize them.

In order to estimate life expectancy at birth (e_0) from the Coale Demeny life tables, the corresponding life table from each of the four regional families was determined by matching the observed probability of dying before age ten (excluding stillbirths) with the model life table characterized by that probability.[13] Results are shown in Table 1 for the regional groupings of villages by year of birth of children and for each of the four families of regional life tables. In order to determine which of the four model families fit best with the observed data, the sum of the absolute deviations from the observed values of ${}_1q_0$, ${}_4q_1$, and ${}_5q_5$ and those embodied in the chosen model life tables was calculated. The model for which the sum of the absolute deviations was a minimum was judged to be the best fitting and the life expectancy for that particular model is underlined in the results.

These results should only be considered as rough estimates given the uncertainties about the applicability of model life tables to historical data and particularly the possibility that the model which best fits the age pattern of infant and child mortality may not necessarily be the one that best fits the age structure of mortality over a wider age range. If we are willing to accept that for the combined sample as a whole the appropriate model shifts from North to West to East, a moderate but steady increase in life expectancy of about five years is indicated over the span covered by the present study. If, on the other hand, we were to assume that the East model, or for that matter any of the other three models, was the most appropriate throughout the period, a more modest increase in life expectancy would be indicated as well as, with the exception of the West model, a slight reduction in life expectancy between the first and second halves of the nineteenth century. Regardless of the trend in life expectancy indicated, the results are fairly consistent in indicating that during most of the period under study life expectancy at birth was in the range of 35 to 40 years.

Substantial variation according to the regional grouping of the villages is suggested by the results. If we accept the estimate corresponding to the best fitting model for each time period the following results are indicated: there appears to be little improvement in life expectancy in Oeschelbronn; a worsening of life expectancy in the Bavarian villages; some improvement in the Baden villages between the eighteenth and early nineteenth centuries but not during the nineteenth century; and substantial improvement of almost twelve years of life expectancy in the Waldeck villages and over eight years in the East Frisian villages. In the latter case, however, all the improvement occurred between the eighteenth and early nineteenth centuries and none between the first and second halves of the nineteenth century. Thus while the results cannot be taken as precise estimates of life expectancy at birth, the contrasts between the regional clusters of villages are pronounced enough to suggest strongly that mortality conditions and improvements were substantially better in some than in others.

Table 1. The observed probability of dying before age 10 (excluding stillbirths) and corresponding life expectancy at birth (e_0) according to Coale-Demeny regional model life tables by year of birth and regional clusters of villages.

	Observed $_{10}q_0$	e_0 According to model North	South	East	West
4 Baden Villages					
pre 1800	.404	32.3	*34.0*	34.0	31.1
1800-49	.330	38.4	40.3	40.0	*40.0*
1850+	.345	37.1	39.0	*38.8*	39.6
Öschelbronn (Württemberg)					
pre 1800	.378	34.4	*36.2*	36.1	33.1
1800-49	.384	33.8	35.6	*35.5*	32.6
1850+	.359	35.9	37.8	*37.6*	36.3
3 Bavarian Villages					
1800-49	.357	36.1	38.0	*37.8*	36.8
1850+	.410	31.8	33.5	*33.5*	30.6
4 Waldeck Villages					
pre 1800	.366	*35.3*	37.2	37.0	34.6
1800-49	.294	41.6	*43.6*	43.0	40.3
1850+	.259	45.0	*47.0*	46.1	43.6
2 East Frisian Villages					
pre 1800	.277	*43.1*	45.1	44.5	41.8
1800-49	.190	*51.6*	54.2	52.5	50.4
1850+	.189	*51.7*	54.3	52.6	50.5
All Villages					
pre 1800	.364	*35.5*	37.3	37.2	35.1
1800-49	.311	40.1	42.0	41.6	*38.7*
1850+	.323	39.0	41.0	*40.6*	39.4

Notes: The corresponding regional model life table was determined by matching the observed value of $_{10}q_0$. Values in italics of e_0 are from the regional model judged to best fit the observed values of $_1q_0$, $_4q_1$, and $_5q_{10}$ determined by the minimum sum of the absolute differences between the observed and model life table values.

Occupational and status differentials

The probability of dying before age five is presented in Table 2 according to the occupation of the child's father. As the results show, differentials in child mortality among these broad occupational groups were rather modest and indeed far less pronounced than differences among regional clusters of villages. In the East Frisian villages, where child mortality is generally low, this is the case for all major occupational groupings while in Oeschelbronn and the Bavarian villages, where child mortality is generally high, it is high for all occupational groupings. There is a slight tendency for children with fathers in proletarian occupations to experience risks of dying slightly above average, although this is neither pronounced nor very consistent across regional clusters or over time within clusters. There are also no clear differentials in the trend of infant mortality according to the broad occupational groups or any evidence for any of substantial improvement in infant mortality during the last half of the nineteenth century compared to earlier years.

Table 2. The probability of dying before age 5 ($_5q_0$) by occupational group, year of birth and regional clusters of villages.

	Occupational group				
	Farmers	Prole-tarians	Artisans and Skilled	Mixed, Other, Unknown	Total
4 Baden Villages					
Pre 1800	.364	.411	.367	.378	.376
1800-49	.317	.332	.328	.297	.322
1850+	.320	.369	.337	.333	.337
Total	.328	.361	.339	.331	.340
Öschelbronn (Württemberg)					
Pre 1800	.385	.391	.363	.420	.389
1800-49	.357	.436	.439	.386	.402
1850+	.417	.362	.369	.358	.382
Total	.390	.393	.389	.391	.390
3 Bavarian Villages					
Pre 1800	(.517)	.449	.334	.352	.381
1800-49	(.403)	.350	.371	.316	.351
1850+	.351	.424	.389	.408	.400
Total	.390	.400	.371	.355	.379
4 Waldeck Villages					
Pre 1800	.306	.389	.295	.357	.337
1800-49	.311	.282	.320	.303	.304
1850+	.264	.298	.254	.263	.271
Total	.291	.310	.284	.324	.303
2 East Frisian Villages					
Pre 1800	.258	.267	.335	.272	.274
1800-49	.143	.223	.198	.157	.195
1850+	.183	.189	.230	.177	.189
Total	.209	.230	.267	.208	.226
All Villages					
Pre 1800	.329	.350	.350	.361	.346
1800-49	.300	.320	.332	.295	.309
1850+	.308	.331	.329	.316	.321
Total	.311	.324	.335	.326	.324

Notes: Results in parentheses are based on less than 100 cases.

In brief, the results suggest that socioeconomic position, at least as indicated by occupation, made little difference in terms of the mortality risks experienced by the children in the families. The relatively homogeneous levels of mortality across different socioeconomic groupings within each regional grouping of villages may reflect the pervasive poverty that characterized German villagers in general, even those that were relatively better off. The fact that the major social groupings within the village appear to have shared a more or less common risk of child loss suggests that child mortality was largely determined by exogenous forces beyond their control, at least to the extent their behavior was bound to local regional customs such as infant feeding practices or other infant care practices that could exert important influences on infant and child mortality.

Sex differentials

Sex differentials in infant and child mortality are of particular interest because of their potential to reflect preferential treatment of one sex over the other although interpretation of mortality results in this connection is not without substantial difficulties[14]. In the past, traditional child care practices in parts of Europe probably contributed to infant and child mortality and may have served as a way of limiting family size. Thus in the absence of birth control, selective neglect could potentially serve not only as an effective substitute but also as a way to adjust the sex composition of the family. Even if traditional child care practices were unrelated to such motivations, provided there were strong preferences for children of one sex over the other, those of the preferred sex might receive better treatment, such as receiving more and better food or better quality care, and as a result experience lower mortality rates than children of the less preferred sex.

Without having to make a judgment regarding the motivations behind traditional child care practices, it seems reasonable to argue that if there were strong preferences for one sex over the other, children of the less favored sex would suffer relatively more "neglect", if only in the sense of receiving less or poorer quality food or care. As a result, they would experience higher mortality rates. This apparently is the case today in much of South Asia where there seems to be little doubt that the main factors behind the excessive female mortality at young ages are worse malnutrition and generally preferential treatment of sons.[15] Favored treatment of sons is also thought to account for excess mortality among daughters in nineteenth-century Ireland.[16]

In his recent study of mortality in modern populations, Preston finds females to have a greater mortality advantage in low mortality populations than in high mortality populations.[17] In a substantial number of the latter, females actually experience higher death rates than males. The relationship between sex differentials and mortality level is probably due in part to a positive association between level of mortality and the extent of preferential treatment given males. But there is undoubtedly an important biological aspect to the relationship as well. For example, the importance of relatively sex-neutral infectious diseases increases at higher levels of mortality. Other factors beyond this compositional effect also appear to be at work.[18] There is reason to expect, then, that independent of sex discriminatory practices, females would not experience as great a relative advantage in high mortality situations, such as our German villages, as would be found in low mortality situations, such as in modern day Germany. If innate biological factors alone were operative, however, female children still should experience at least some modest advantage.

Even in high mortality populations where unequal treatment of sons and daughters is known to exist, it is often only after infancy that females experience a clear mortality disadvantage. This is apparent from relatively recent data from Ceylon, Pakistan, and Bangladesh and historically in Ireland.[19] Apparently the innate biological advantage plays a more important role in determining sex differentials during the first year of life than in subsequent childhood years. Boys may be particularly disadvantaged with respect to neonatal mortality, an important component of overall infant mortality.[20] Moreover, mortality differences due to discriminatory feeding might be evident only after a child is weaned, since breast milk has the same content whether being fed to a boy or a girl.

A detailed age breakdown of infant and child mortality is presented in Table 3. Focusing on the results for the villages collectively, there appears to be a pronounced female advantage under age one, followed by a slight advantage between ages one and two and a disadvantage between ages two and five. The combination of a small advantage for girls during the second year of life and a small disadvantage during the next three years results in essentially equal probabilities of dying between exact ages one and five (${}_4q_1$) for both sexes. Furthermore, the risk of dying between exact ages five and fifteen (${}_{10}q_5$) is also close to equal for males and females. In infancy, girls show the greatest advantage during the first month of life and the least advantage toward the end of the first year. While the decreasing advantage of girls probably reflects in part the increasing importance of the relatively sex-neutral infectious diseases, the lack of any advantage at all after the second year of life and indeed even a small disadvantage between ages two and five suggests the possible existence of discriminatory child care practices favoring sons, although to only a modest extent.

Results for the separate villages or village groups are generally similar. The Bavarian villages appear most exceptional with a substantial female advantage persisting through age five but reversing between five and fifteen when in any event mortality appears to be unusually low.[21] In all villages or village groups, female infant mortality is lower than male although in each of the four Baden villages (Grafenhausen, Herbolzheim, Kappel, and Rust) the female advantage disappears during the later months of infancy. In addition,

Table 3. Infant and early childhood mortality by sex of child and ratio of female to male mortality by village.

	$_1q_0$	$_4q_1$	$_{10}q_5$	Probability of dying between exact ages: 0 & 1 month	1 & 3 months	3 & 6 months	6 & 9 months	9 & 12 months	1 & 2 years	2 & 5 years
Grafenhausen										
boys	.266	.120	.057	.126	.064	.050	.035	.023	.056	.068
girls	.240	.126	.049	.113	.050	.041	.036	.024	.058	.072
ratio	0.90	1.05	0.86	0.90	0.79	0.82	1.04	1.03	1.04	1.07
Herbolzheim										
boys	.252	.160	.057	.109	.053	.057	.032	.029	.075	.092
girls	.220	.166	.061	.088	.049	.042	.033	.029	.071	.102
ratio	0.87	1.04	1.07	0.81	0.92	0.75	1.02	1.01	0.95	1.11
Kappel										
boys	.214	.103	.057	.103	.047	.041	.023	.019	.047	.058
girls	.194	.102	.046	.089	.035	.032	.032	.020	.044	.061
ratio	0.91	0.99	0.82	0.86	0.76	0.78	1.44	1.06	0.93	1.04
Rust										
boys	.257	.115	.048	.125	.052	.048	.037	.023	.086	.062
girls	.225	.125	.049	.092	.044	.052	.034	.026	.058	.071
ratio	0.87	1.09	1.00	0.73	0.85	1.08	0.90	1.12	1.04	1.14
Öschelbronn										
boys	.309	.127	.056	.170	0.53	.036	.055	.035	.059	.072
girls	.271	.134	.047	.132	.057	.049	.036	.029	.061	.076
ratio	0.88	1.06	0.84	0.78	1.08	1.34	0.66	0.83	1.03	1.06
3 Bavarian villages										
boys	.359	.082	.035	.176	.092	.085	.042	.022	.037	.047
girls	.270	.059	.043	.125	.058	.068	.034	.017	.034	.026
ratio	0.75	0.72	1.24	0.71	0.62	0.80	0.81	0.78	0.93	0.55
4 Waldeck villages										
boys	.196	.140	.067	.098	.029	.027	.029	.028	.065	.080
girls	.169	.143	.067	.085	.026	.025	.020	.024	.062	.086
ratio	0.86	1.02	1.01	0.86	0.90	0.95	0.69	0.86	0.96	1.07
Middels										
boys	.138	.067	.047	.075	.024	.018	.014	.015	.030	.038
girls	.104	.067	.051	.055	.014	.010	.018	.011	.024	.043
ratio	0.75	1.00	1.09	0.74	0.56	0.55	1.30	0.73	0.81	1.14
Werdum										
boys	.166	.117	.076	.095	.031	.022	.014	.014	.045	.076
girls	.154	.099	.075	.083	.031	.019	.012	.017	.044	.057
ratio	0.93	.084	0.99	0.87	1.01	.087	.085	1.24	0.98	0.75
All villages										
boys	.239	.124	.057	.117	.048	.042	.031	.024	.057	.071
girls	.207	.125	.056	.095	.041	.037	.028	.023	.056	.073
ratio	0.87	1.01	0.98	0.81	0.85	0.89	0.90	0.97	0.97	1.04

Notes: Calculations of $_1q_0$ and the probability of dying between exact ages 0 and 1 month include stillbirths. The ratio of female to male mortality was calculated before rounding mortality rates as shown.

with only the exceptions of the Bavarian villages just noted and Middels, mortality between ages two and five was higher for girls.

In a recent article, Wall has suggested that if there were neglect of female children during the period prior to deliberate family limitation, this should show up more strongly in, or perhaps be entirely limited to, children of higher birth ranks.[22] He argues that the first few children will undoubtedly be wanted, regardless of sex, since families want heirs, even if there is no real property to transmit and that, at least in the European case, when there are no sons, daughters will suffice. He therefore suggests examining sex differentials in infant and child mortality according to birth rank. His own evidence in several English parishes points to excess female mortality in infancy being more common among higher-order births although his findings are not conclusive.

To examine the possibility of such a relationship in the German villages, Table 4 shows the ratio of female to male mortality in infancy and in childhood. There appears to be little systematic relationship between sex differentials in mortality and birth rank and, clearly, no consistent pattern of excess female mortality among higher birth ranks. Based on these findings, it seems reasonably safe to conclude that any neglect of female infants that might have existed was as likely to manifest itself among earlier births as it was among later births.

Maternal mortality

Calculation of adult mortality from family reconstitution data is problematic because of the difficulty of determining with any precision the period during which individuals can be considered under observation and hence at risk of dying for those individuals for whom a death date is unknown. In the special

Table 4. The ratio of female to male mortality in infancy and childhood according to birth rank and regional clusters of villages.

	Birth rank				
	1—2	3—4	5—6	7+	Total
4 Baden villages					
${}_{1}q_{0}$	.86	.85	.88	.92	.88
${}_{4}q_{1}$	1.03	1.14	1.09	.90	1.04
${}_{10}q_{5}$	.98	1.07	.92	.86	.97
Öschelbronn					
${}_{1}q_{0}$	.93	.74	.90	.92	.88
${}_{4}q_{1}$	.97	1.07	.98	1.17	1.06
${}_{10}q_{5}$	1.05	.79	.64	.80	.84
3 Bavarian villages					
${}_{1}q_{0}$	.67	.70	.79	.85	.75
${}_{4}q_{1}$	.65	.97	.85	.49	.72
${}_{10}q_{5}$	1.99	1.97	.51	1.19	1.24
4 Waldeck villages					
${}_{1}q_{0}$	.88	.85	.94	.80	.87
${}_{4}q_{1}$	1.12	.82	1.05	1.21	1.02
${}_{10}q_{5}$	.91	.88	1.70	.88	1.02
2 East Frisian villages					
${}_{1}q_{0}$	.94	.80	.75	.91	.86
${}_{4}q_{1}$	.82	.96	.81	1.07	.88
${}_{10}q_{5}$	1.04	1.17	.71	1.06	1.01
All villages					
${}_{1}q_{0}$	.87	.83	.87	.91	.87
${}_{4}q_{1}$	1.00	1.04	1.02	.97	1.01
${}_{10}q_{5}$	.99	1.04	.96	.90	.98

case of maternal mortality, provided it is defined as the risk of dying during or shortly after confinement and expressed as a rate relative to the number of confinements, this problem is essentially absent. The beginning of the period of risk is clearly defined by the birth of a child and ends, according to different definitions, within a few weeks or months following confinement. Since it is unlikely that many women migrate out of a village shortly after giving birth and, among those few who do, that they died in some other village within the specified period, women for whom no death date is known can be safely assumed to have survived the critical period after confinement.

There are special problems in measuring maternal mortality from reconstituted family histories that are essentially inherent to the parish register sources on which they are typically based.[23] The most important one is the fact that maternal mortality may be associated with miscarriages or stillbirths, events that are at best only poorly recorded in the registers. In such cases, the woman's death does not appear to follow a reproductive event in the reconstituted family history and thus is not classified as maternal mortality. To the extent this occurs, maternal mortality is underestimated.

Unlike the previous analyses, the examination of maternal mortality must be based on only six of the fourteen villages in the sample. The reason for this is that the data set used for the broader study of demographic behavior and on which the previous analyses have been based is restricted to couples for which the death date of at least one spouse is known. Such a restriction will tend to bias estimates of maternal mortality upward since the wife's death date is more likely to be known in cases where the wife died at or shortly following childbirth than in cases where she survived the reproductive age span. For six of the fourteen villages included in this study, however, all couples in the village genealogy were coded and thus are available for the calculation of maternal mortality based on women free from this restriction, thereby avoiding the biases that would otherwise result. Hence the following analysis of maternal mortality is based on all women in the six fully-coded villages rather than the usual restricted sample of women in all 14 villages used in the previous analyses. Consideration is limited to mortality following local confinements (i.e. those occurring in the village) and for which an exact date of confinement is known.

Both in historical and contemporary studies, a variety of definitions of maternal mortality appear to be used in practice. Some studies provide statistics on maternal mortality which are based on causes of death rather than simply on time since confinement. While a definition based on cause of death would be more precise, it is obviously impractical for most historical studies where such information is lacking. It is also impractical for use in many developing countries today where cause-of-death information is incomplete or faulty. Thus a number of other studies simply classify deaths to women within some period following the birth of the last child as constituting a maternal death. This risks misclassifying some deaths occurring shortly after but unrelated to childbirth as maternal mortality and missing others which in fact result from childbirth but which occur past the time span used for determining maternity-related deaths.

Even when the definition is based on the length of time following childbirth, the period chosen is not uniform in all studies and may involve deaths up to three months following confinements. Based on the six fully-coded villages, maternal mortality rates, expressed as maternal deaths per 1000 confinements, are presented in Table 5 according to different durations of periods following confinement. Probably the most common definition involves deaths within the first six weeks following childbirth. This is apparently the definition recommended by the World Health Organization as well as the American College of Obstetrics and Gynecology.[24] The latter also recommends distinguishing between maternal deaths occurring within the first seven days and those occurring later since the first week following confinement is the most dangerous period of time. As indicated by our results, such deaths involve roughly half or more of all maternal mortality during most time periods covered.

Since all couples including those married 1900 were processed in the fully-coded villages, trends through the first half of the twentieth century can be examined. Moreover, since an examination of individual villages did not reveal

Table 5. Maternal deaths per 1000 confinements according to different definitions of maternal death, and percent of deaths in first 42 days following confinement that occur in first 7 days, by year of confinement, combined sample of 6 villages.

Year of confinement	Maternal deaths per 1000 confinements, in first days following confinement				Of deaths in first 42 days	Number of confinements
	7 Days	42 Days	60 Days	90 Days	% in First 7 Days	
1700-49	5.4	9.5	10.3	10.8	57	3888
1750-99	4.3	7.6	8.3	9.1	57	6048
1800-24	4.2	7.8	8.2	9.4	55	4257
1825-49	6.9	11.3	11.7	11.7	61	5389
1850-74	5.6	10.8	11.0	12.3	52	5381
1875-99	4.0	9.7	10.2	10.8	42	5476
1900-24	1.9	4.1	4.9	5.1	47	4679
1925-49	0.3	0.9	0.9	0.9	—[a]	1699

Notes: This table is limited to the six fully-coded villages (Kappel, Rust, Öschelbronn, Braunsen, Massenhausen, and Middels). Results are based on local confinements for which an exact date of confinement is given. Women with unknown death dates are assumed to have survived past stated reference periods.

[a] Fewer than 10 deaths in first 42 days.

lower maternal mortality during periods when registration of infant and child deaths was deficient, periods when death registration for infant and child deaths were poor are not excluded. The results suggest that little improvement in maternal mortality occurred prior to the turn of the twentieth century and indeed that conditions during the mid-nineteenth century may have been somewhat worse than during previous periods. It is difficult to know how general the trends based on our sample of six villages are.

One possible explanation for a rise in maternal mortality during the middle of the nineteenth century, if indeed such an increase is genuine, could be in the initial increase in total demand for labor necessitated by agricultural reforms and which is thought to have been met in part by an extended workload for peasant women. Apparently there was generally little period of rest either during pregnancy or immediately after childbirth for women in rural society in Germany at the time.[25] However, in an extensive review of maternal mortality statistics from a variety of sources including a number referring to German populations, Shorter discerns no consistent evidence of an increase in maternal mortality during the mid-nineteenth century.[26] Data he presents for Prussia covering the years 1816 through 1894 indicate fairly steady maternal mortality ranging from 7.6 to 9.5 maternal deaths per 1000 deliveries until the end of the third quarter of the century and then somewhat lower rates than that for the last quarter of the century.

It is noteworthy that the general level of maternal mortality indicated for Prussia was similar to that indicated by our sample of six villages, at least until the end of the nineteenth century. Moreover, national statistics for Germany during the first quarter of the twentieth century as presented by Shorter indicate a maternal mortality rate of between 3.5 and 5.0 maternal deaths per 1000 live births, again reasonably consistent with the rates indicated by the sample of six villages. These comparisons indicate agreement only in terms of the rough order of magnitude, however, due to a lack of strict comparability in definitions of maternal mortality.

The general picture presented by the data from the six villages and confirmed by Shorter's extensive review of maternal mortality in a number of Western countries is that childbearing throughout the eighteenth and nineteenth centuries was associated with a risk of death many times higher than in recent times and that substantial improvement occurred only during the twentieth century. In West Germany by the late 1970s, childbearing carried with it a risk of only about .2—.3 deaths per 1000 births, only a fraction of the levels found in the sample villages during the eighteenth and nineteenth centuries.[27] Given the far lower rate of childbearing today than in the past, a maternal death has become a very rare event. The 1 percent or so chance of death associated with each confinement in the sample villages during the eighteenth and nineteenth centuries, in conjunction with considerably higher fertility at that time, meant that a significant proportion of women ended their lives as the result of reproductive activity. Given the average age at which women started childbearing in combination with the average rate of childbearing, a 1 percent chance of dying at each confinement would lead roughly to a 5 percent cumulative chance of a woman dying due to childbirth before reaching the end of her reproductive span.

Table 6 indicates the maternal mortality rates for the different villages as well as for the marital status of the union, the sex of the child, and the multiple birth status of the confinement for confinements occurring during the eighteenth and nineteenth centuries. For the six villages combined, almost a 1 percent chance of death for the mother within six weeks was associated with each confinement. Some variation is evident across villages, although given the infrequent occurrence of a maternal death, some statistical fluctuation would be expected. Data presented by Shorter for East Friesland, based apparently on a large number of cases, indicate a maternal mortality rate more than twice as high as the rate characterizing the East Frisian village of Middels.[28] In addition, when maternal mortality is calculated based on the restricted sample of women selected for the present study in Werdum, the other East Friesland village in the sample, and compared to the same rates calculated for Middels based on the restricted sample of women, far higher rates are indicated for Werdum. Thus is does not appear that the low rate for Middels is typical for East Friesland generally.[29]

Higher maternal mortality is associated for non-marital unions than for marital unions. Part of this difference is due to confinement order. A substantially higher proportion of confinements associated with non-marital compared to marital unions are first confinements and, as indicated below, maternal mortality associated with first confinements (11.7 deaths per 1000 confinements) is above average. Nevertheless, since non-marital maternal mortality is higher than that associated with all first confinements, this appears to be only part of the explanation. The small number of cases on which the non-marital maternal mortality is based must also be kept in mind. Indeed, the differences between non-marital and marital maternal mortality are not statistically significant at the .05 level even without taking into account differences in confinement order.

Maternal mortality associated with the birth of a boy is higher than that associated with the birth of a girl. Whereas the difference is small and not statistically significant at the .05 level, it is in the expected direction. Given the larger average size of newborn males, an increased risk is expected to be associated with the birth of boys. Far more dangerous are confinements associated with multiple births. Despite the small number of such cases in our sample, the difference in maternal mortality associated with single and multiple births is statistically significant at the .05 level.

Among the most often studied aspects of maternal mortality is its relationship to mother's age and order of confinement.[30] There is general agreement that biological causes at least partly underlie age and confinement order differences in maternal mortality while differences in overall levels of maternal

Table 6. Maternal deaths within six weeks of confinement per 1000 confinements, by village, by marital status of union, by sex of child, and by multiple birth status of confinements, for confinements occurring 1700-1899.

	Maternal deaths per 1000 confinements	Number of confinements
Village		
Kappel	7.4	6487
Rust	10.3	9976
Öschelbronn	11.9	5033
Braunsen	11.0	1722
Massenhausen	10.3	2899
Middels	6.5	4322
All 6 villages	9.5	30439
Marital status of union[a]		
Marital	9.2	28771
Non-marital	13.2	1667
Sex of child[b]		
Boy	9.4	15603
Girl	8.7	14700
Multiple birth status		
Single	9.2	29960
Multiple	25.1	479

Notes: This table is limited to the six fully-coded villages (Kappel, Rust, Öschelbronn, Braunsen, Massenhausen, and Middels). Results are based on local confinements for which an exact date of confinement is given. Women with unknown death dates are assumed to have survived past the end of the six-week reference period.

[a] Premarital confinements to women who later marry the father are included under marital unions; one confinement of a woman in a union of unknown marital status is excluded.

[b] In cases of a multiple birth, the confinement is included under the sex of the first-born child; a small number of confinements for which the sex of the birth is unknown are excluded.

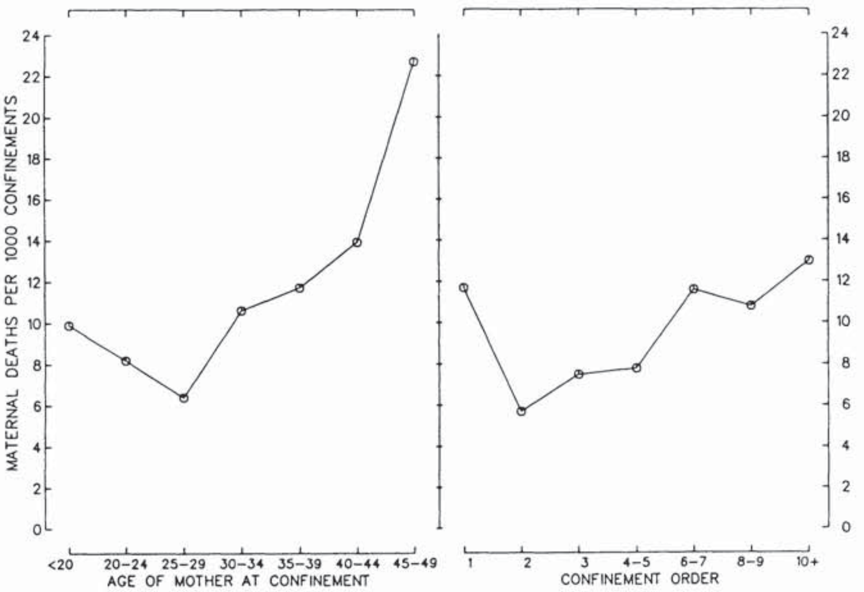
mortality are largely a result of non-biological causes such as socioeconomic levels, cultural practices, and the state of and accessibility to medical technology. To the extent that age at confinement and number of children ever born are associated with socioeconomic status (or the other relevant characteristics), the association between maternal mortality and age of mother and confinement order can also reflect non-biological influences. For example, if women of lower socioeconomic status are more likely than women of higher socioeconomic status to start childbearing earlier and to continue longer, and if they are also disadvantaged with respect to their health and access to health facilities, we would expect maternal mortality at the extreme childbearing ages to be higher than at other ages even in the absence of any biological effects. The same can be said for maternal mortality associated with confinements of higher orders if lower socioeconomic status women are disproportionately represented among those who have above average numbers of births. One advantage of examining the association of maternal mortality with age of mother and confinement order for earlier periods, when deliberate fertility control within marriage was less common, is that the non-biological influences should be less important.

Maternal deaths per 1000 confinements are shown in Figure 3 according to the age of mother at confinement and according to confinement order based on confinements in the eighteenth and nineteenth centuries for the six fully-coded villages combined. The J-shaped relationship between maternal mortality and age which typifies most populations is clearly evident. The extent to which maternal mortality is higher at the later childbearing ages, however, is somewhat less pronounced than is typical in most contemporary populations including those in high mortality developing countries for which reliable data are available. Nortman points out that the age differentials typically widen as the level of mortality is reduced.[31] According to her estimates for high mortality populations (defined as those with more than 1.0 maternal deaths per 1000 confinements), maternal mortality in the age group 40-44 is typically twice as high as that for the unweighted average of all age groups through 40-44. In the results for the six German villages, the same calculation indicates that the 40-44 age group of women experienced maternal mortality rates only about 40 percent higher than the unweighted average up to that age group. Given the fact that the overall level of maternal mortality in the German villages during the eighteenth and nineteenth centuries was about four times as high as the average of Nortman's high mortality populations, the more attenuated relationship with age observed for the German villages may simply represent a more extreme case of less pronounced differentials as the overall level increases across populations. However, it may also reflect less self-selection at higher ages of women in low socioeconomic categories than occurs in more modern populations.

The relationship of maternal mortality with confinement order is less pronounced than the association with maternal age but again a J-shaped curve, although considerably flattened, roughly describes the relationship. Particularly sharp is the drop between maternal mortality rates associated with first and second confinements. While maternal death rates increase generally with rising confinement order, not until confinements of the sixth order and above is the level characterizing first order confinements reached again.

Given the inevitable association between age and confinement order, it is of some interest to examine maternal mortality controlling for both simultaneously. The results of such a comparison are indicated in Table 7.

Figure 3. Maternal mortality within six weeks of confinement by age of mother and confinement order, 1700-1899.



Notes: Results are limited to the six fully-coded villages only and are restricted to local confinements for which an exact confinement date is known and to first marriages of women with no previous union resulting in an illegitimate birth.

Table 7. Maternal deaths within six weeks of confinement per 1000 confinements, by age and confinement order, for confinements occurring 1700—1899.

Age at Confinement	Confinement order 1	2—5	6+
Under 20	(11.7)	—	—
20—24	10.5	3.2	—
25—29	8.0	4.9	(6.2)
30—34	(22.0)	8.5	12.3
35—39	(23.3)	10.1	11.0
40—44	—	(18.5)	13.2
45—49	—	—	(20.2)

Notes: This table is limited to the six fully-coded villages (Kappel, Rust, Öschelbron, Braunsen, Massenhausen, and Middels). Results are based on local confinements for which an exact date of confinement is given and are restricted to first marriages to women who had no previous unions resulting in an illegitimate birth. Women with unknown death dates are assumed to have survived past the end of the six-week reference period. Results in parentheses are based on less than 500 confinements.

Caution is required in interpreting the results because of the extent of statistical fluctuation that can be expected due to insufficient numbers of cases when examining a phenomenon with a low frequency of occurrence such as maternal mortality. In order to reduce the problem, broad groupings of confinement order have been made after separating out the first confinement order which is of particular interest given the relatively high level of maternal mortality associated with it in the absence of control for age. Even when we examine only confinements of the first order, the general J-shaped curve with age persists. Little confidence, however, can be placed in the results indicating the small difference between maternal mortality associated with ages under 20 which is based on few cases, and the lower levels for women in their twenties. Some limited data for other populations suggest that for women bearing their first child, a monotonic increase in maternal mortality with age rather than a J-shaped relationship holds.[32]

At higher confinement orders, maternal mortality also increases fairly steadily with age, at least judging from the two broad confinement order categories into which confinements after the first have been grouped. For both categories, however, there are insufficient cases of women under age 20 to determine their level of maternal mortality. Also in the group of sixth and higher order confinements there are insufficient numbers of women below age 25 to make this determination. Nevertheless, the results suggest that the higher mortality of women under 20 compared to those in their twenties when confinement order is not controlled is to a large extent an artifact of the concentration of first order confinements at younger ages. The results also reveal that first order confinements consistently have a higher maternal mortality associated with them than higher birth orders even when age is controlled. Indeed, without exception, for the broad confinement order groups shown, the highest maternal mortality is found for women at their first confinement.

Summary and conclusions

One of the most striking findings to emerge from the present study is the divergent path followed by infant and child mortality from the mid-eighteenth to the beginning of the twentieth century. The results show fairly clearly that reductions in child mortality above age 1 preceded improvements in infant mortality. The combination of somewhat worsening infant mortality and improving early child mortality resulted in a situation in which the probability of dying between birth and age 5 showed little consistent trend, fluctuating around a level of 30 percent during most of the eighteenth and nineteenth centuries. The divergent paths of infant and child mortality underscore the difficulty of applying model life tables, which assume a fixed pattern of relations among mortality rates at different ages, to historical populations over long periods of time.

Pronounced regional differences in the levels of infant and child mortality are evident and appear to be related to differences in the prevailing infant feeding practices. In contrast socioeconomic status, at least as indicated by occupation of the father, shows little association with mortality risks experienced by the children. This lack of socio-economic differences emphasizes the probable role of local or regional infant feeding customs, common to all classes, as a key determinant of infant mortality.

Differences in mortality risks during infancy and childhood were evident between the sexes. Females tend to experience lower infant mortality rates but lose their advantage by the early childhood ages. It is difficult to draw any firm conclusions from the mortality data about the extent to which male children were given preferential treatment. If this was the case, the evidence suggests it bore no relationship to birth order as has sometimes been hypothesized.

Maternal deaths are the one aspect of adult mortality that can be investigated easily with family reconstitution data. In German village populations during the eighteenth and nineteenth centuries, there was roughly a 1 percent chance of death for women associated with each confinement. In combination with relatively high fertility, this meant that a woman had approximately a 5 percent cumulative chance of dying due to childbirth before reaching the end of her childbearing span. Thus, not an insignificant proportion of women died as a result of their reproductive efforts.

Notes

1. J. Knodel, *Demographic Behavior in the Past: German Village Populations in the 18th and 19th Centuries* (Forthcoming, Cambridge University Press).

2. J. Knodel, *The Decline of Fertility in Germany, 1871-1939* (Princeton 1974).

3. P. Matthiessen and J. McCann, 'The Role of Mortality in the European Fertility Transition: Aggregate-Level Relations', S. Preston (Ed.), *The Effects of Infant and Child Mortality on Fertility* (New York 1977), pp. 47-68.

4. For the period 1875-1899, our combined sample yields the following values: ${}_1q_0$ (excluding stillbirths) = .226; ${}_4q_1$ = .095; and ${}_{10}q_5$ = .039. This compares to an unweighted average of the three decade estimates at the national level for the period 1871-1900 as follows: ${}_1q_0$ = .226; ${}_4q_1$ = .117; and ${}_{10}q_5$ = .053.

5. The most appropriate comparison appears to be with the district of Ettenheim. Grafenhausen, Kappel, and Rust were all located in the district of Ettenheim during the last half of the nineteenth century. Herbolzheim also belonged to Ettenheim during the mid-part of the period but due to redistricting, was part of two other districts at other times within the 50-year span. Excluding stillbirths, ${}_1q_0$ in the four Baden villages was .246 during 1850-1874 and .243 during 1875-1899. In comparison, the infant mortality rate (infant deaths per 1000 live births in the district of Ettenheim was as follows: 248 in 1856-1863, 248 in 1864-1869, 244 in 1875-1880, 257 in 1885-1890, and 213 in 1891-1895, *Beitraege zur Statistik der inneren Verwaltung des Grossherzogtums Baden,* No. 46.

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7. W.R. Lee, 'Germany', W.R. Lee (Ed), *European Demography and Economic Growth* (London 1979), Chapter 4, pp. 144-195; W.R. Lee, 'The Mechanism of Mortality Change in Germany, 1750-1850', *Medizin-historisches Journal*, 15 (1980), pp. 244-268.

8. R.S. Schofield, 'Statistical Problems', *International Population Conference, Liege 1973,* Volume 3, pp. 45-57.

9. A.J. Coale, and P. Demeny, *Regional Model Life Tables and Stable Populations* (Princeton 1966); A.J. Coale and P. Demeny, *Regional Model Life Tables and Stable Populations,* 2nd edition (New York 1983).

10. Since the Coale-Demeny model life tables are given separately for males and females, the 1_x values have been combined based on a sex ratio of birth of 105 for the purpose of matching the observed values which are for both sexes combined.

11. Knodel (forthcoming).

12. R.S. Schofield and E.A. Wrigley, 'Infant and Child Mortality in England in the Late Tudor and Early Stuart Periods', C. Webster (Ed.), *Health, Medicine, and Mortality in the Sixteenth Century* (Cambridge 1979), pp. 61-95.

13. Model life table values of ${}_{10}q_0$ were estimated for the two sexes combined as indicated in the preceding footnote. A simple arithmetic average of male and female life expectancy was used to represent the combined sex life table at any given level.

14. R. Wall, 'Inferring Differential Neglect of Females from Mortality Data', *Annales de démographie historique* (1981), pp. 119-140.

15. R.H. Cassen, *India: Population, Economy, Society* (New York 1978); L.C. Chen, Emdadul Huq, and S. D'Souza, 'Sex Bias in the Family Allocation of Food and Health Care in Rural Bangladesh', *Population and Development Review,* 7 (1981), pp. 55-70; M.A. El Badry, 'Higher Female than Male Mortality in Some Countries of South Asia: A Digest', *Journal of the American Statistical Association,* 64 (1969).

16. R.E. Kennedy, *The Irish Emigration, Marriage, and Fertility* (Berkeley, Ca 1973); E.A. Wrigley, *Population and History* (New York 1969).

17. S.H. Preston, *Mortality Patterns in National Populations* (New York 1976).

18. Preston (1976), p. 153.

19. G. T. Curlin, L.C. Chen, and S.B. Hussain, *Demographic Crisis: The Impact of the Bangladesh Civil War (1971) on Births and Deaths in a Rural Area of Bangladesh* (Dacca 1975); El Badry (1969); Kennedy (1973), pp. 59-60.

20. R. Naeye, L.S. Burt, D.L. Wright, W.A. Blanc, and D. Tatter, 'Neonatal Mortality: The Male Disadvantage', *Pediatrics,* 48 (1971), pp. 902-906.

21. Statistics for all of Bavaria show a similar strong female advantage in infant mortality. For example, from 1835/1836-1868/1869, the infant mortality rate for the entire kingdom averaged 41.2 per 100 live births for males and 35.7 for females. W.R. Lee, *Population Growth, Economic Development and Social Change in Bavaria 1750-1850* (New York 1977), p. 6.

22. Wall (1981).

23. B.M.W. Dobbie, 'An Attempt to Estimate the True Rate of Maternal Mortality, Sixteenth to Eighteenth Centuries', *Medical History,* 26 (1982), pp. 79-90; E.A. Wrigley and R.S. Schofield, 'English Population History from Family Reconstitution: Summary Results 1600-1799', *Population Studies,* 37 (1983), pp. 157-184.

24. A.E. Imhof, 'Unterschiedliche Säuglingssterblickeit in Deutschland, 18. bis 20. Jahrhundert—Warum?', *Zeitschrift für Bevölkerungswissenschaft,* 7 (1981), p. 152; E.C. Hughes, 'Obstetric-Gynecologic Terminology with Section on Neonatal Mortality and Glossary of Congenital Abnormalities', *American College of Obstetrics and Gynecology* (Philadelphia 1972), p. 454.

25. Imhof (1981), pp. 343-382; W.R. Lee, 'Family and Modernization: The Peasant Family and Social Change in Nineteenth Century Germany', R. Evans and W.R. Lee (Eds.), *The German Family* (London 1981), pp. 148-174; D. Sabean, 'Small Peasant Agriculture in Germany at the Beginning of the Nineteenth Century: Changing Work Patterns', *Peasant Studies,* 7, 4 (1978), pp. 218-224.

26. E. Shorter, *The Evolution of Maternal Mortality, Eighteenth to Twentieth Centuries* (Unpublished manuscript).

27. According to the 1979 United Nations Demographic Yearbook, maternal mortality in West Germany was 31.1 per 100,000 live births in 1977 and 23.1 per 100,000 in 1978. Apparently a maternal death is determined by cause of death rather than time since confinement. A.E. Imhof, 'Women, Family and Death: Excess Mortality of Women in Childbearing Age in Four Communities in Nineteenth-Century Germany', Evans and Lee (1981), p. 161 indicates that, based on a definition of deaths within six weeks of pregnancy termination, the maternal mortality rate in West Germany in 1973 was 45.9 per 100,000 births. This compares to a figure of 37.9 for 1973 according to the U.N. Yearbook based on cause of death.

28. Shorter (Unpublished manuscript).

29. Based on the restricted sample of women, the maternal death rate in Werdum per 1000 confinements was 21.4 compared to 8.3 for Middels.

30. L.G. Berry, 'Age and Parity Influences on Maternal Mortality: United States 1919-1969', *Demography,* 14 (1977), pp. 297-310; J.T.P. Bonte and H.P. Verbrugge, 'Maternal Mortality: An Epidemiological Approach', *Acta Obstetricia et Gynecologica Scandinavica,* 46 (1967), pp. 445-474; D. Nortman, 'Parental Age as a Factor in Pregnancy Outcome and Child Development', *Reports on Population-Family Planning,* 16 (New York 1974).

31. Nortman (1974).

32. Nortman (1974).