Child and infant mortality in the Nordic countries prior to 1900

Bengtsson, Tommy; Lundh, Christer

1999

Document Version:
Publisher's PDF, also known as Version of record

Lund Papers in Economic History

No. 66, 1999 *Population Economics*

Child and Infant Mortality in the Nordic Countries Prior to 1900

Tommy Bengtsson & Christer Lundh

DEPARTMENT OF ECONOMIC HISTORY, LUND UNIVERSITY

Lund Papers in Economic History
ISSN 1101-346X
ISRN LUSADG-SAEH-P--99/66--SE+25P

Printed by KFS, Lund, Sweden, 1999

Orders of single back issues (no. 1-65)
Department of Economic History, Lund University
Postal address: P.O. Box 7083, S-220 07 Lund, Sweden
Telephone: +46 46 2227475
Telefax: +46 46 131585

Full-text issues (no. 61, 66-)
www.ekh.lu.se

Child and Infant Mortality in the Nordic Countries Prior to 1900[*]

Tommy Bengtsson & Christer Lundh

Introduction

The Nordic countries have detailed demographical statistics that predate other industrialized countries, which has resulted in an intense international interest in their development.[1] Sweden has been of particular interest, as it has good quality censuses dating already from the midth 18th century; this country has beeen a model for the demographic transition. This transition began with a general decline in mortality that can be identified in Sweden, Norway, and Denmark at the end of the 18th century, while Finland followed with a lag of about 60 years. (See diagram 1.)

The central problem of historical demography in this context has been the explanation of the cause or causes which led to the secular decline in mortality. Age specific mortality studies increase the possibility to understand these causes, which can explain the fact that a great number of such studies have been conducted in the Nordic countries, with an emphasis on Sweden and Finland which have better statistics than Norway and Denmark. The primary group of interest has been infant mortality, with child mortality being more seldom investigated. A major result of this research has been that the declines in infant and child mortality have been prime contributors to the general decline in mortality in particular in its initial phase, a situation that is

---

* This is a revised version of a paper that was presented at the IUSSP conference ”Child and Infant Mortality in the Past” in Montreal, Canada, 7-10 October 1992. The paper was part of the research project ”Life Events in a Peasant Society in Transition” supprted by the Swedish Council for Research in the Humanities and Social Sciences. The present version of the paper was published in French in Annales De Démographie Historique 1994 under the title ”La mortalité infantile et post-infantile dans les pays Nordiques avant 1900”.

1 Iceland too has detailed statistics, but its demographical development has been quite different from the other Nordic countries' (Bengtsson 1992). Therefore, Iceland is not included in "the Nordic countries" in this article.

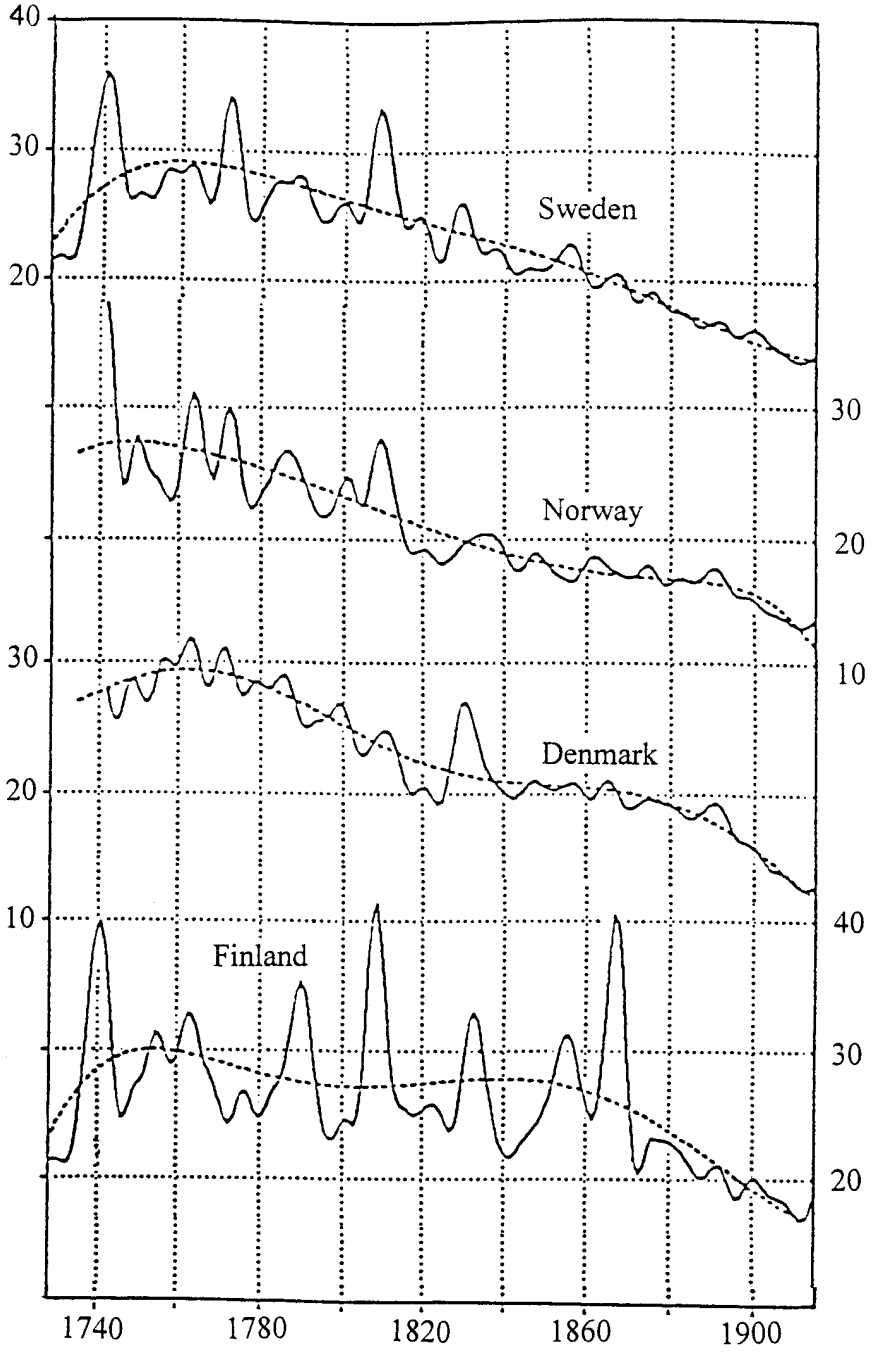

Diagram 1. Smoothed general mortality rate and mortality's polynomial trend for Sweden, Finland, Norway, and Denmark.

Source: Bengtsson 1992.

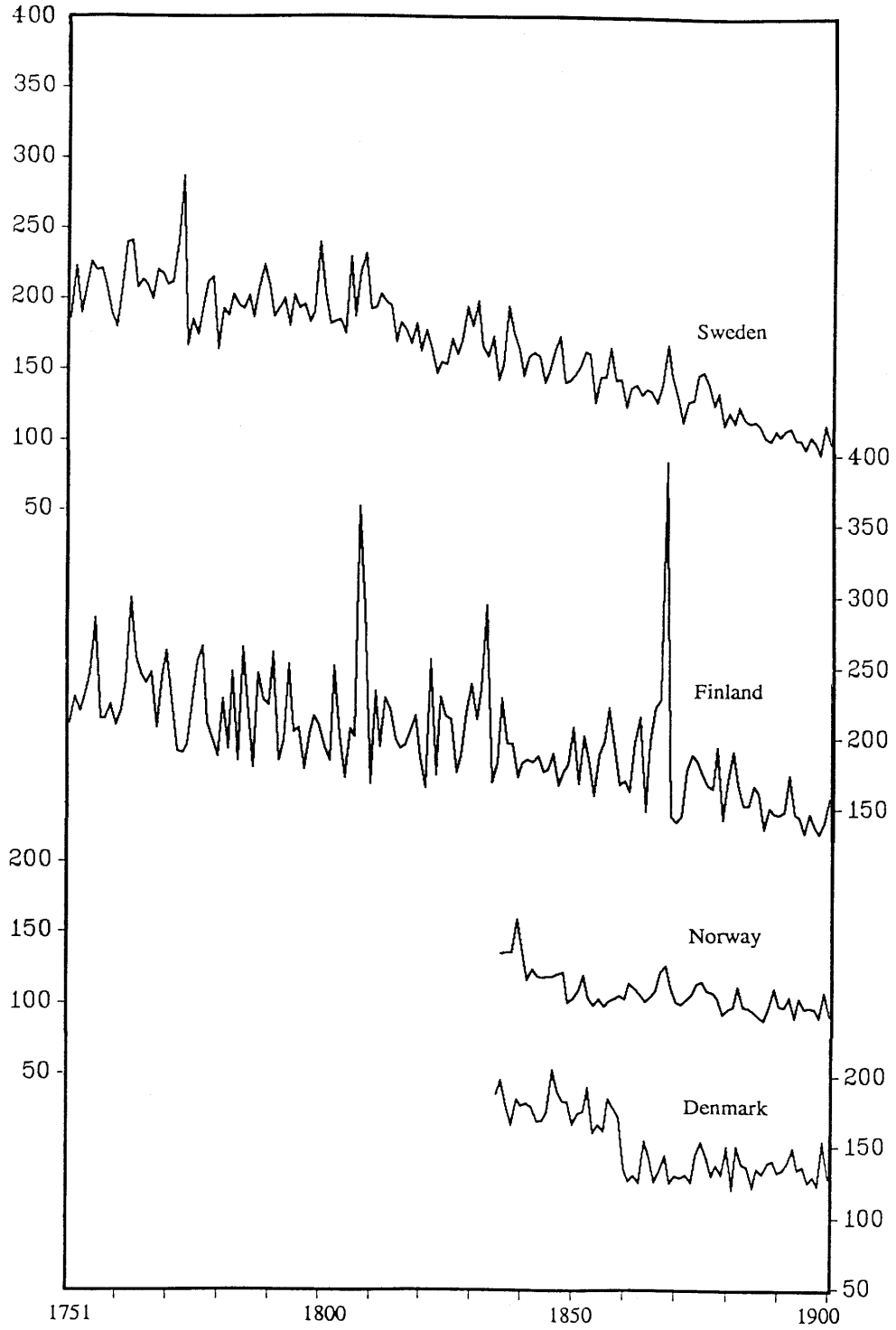

Diagram 2. Infant mortality in Sweden, Finland, Norway, and Denmark.

Source: Bengtsson 1992.

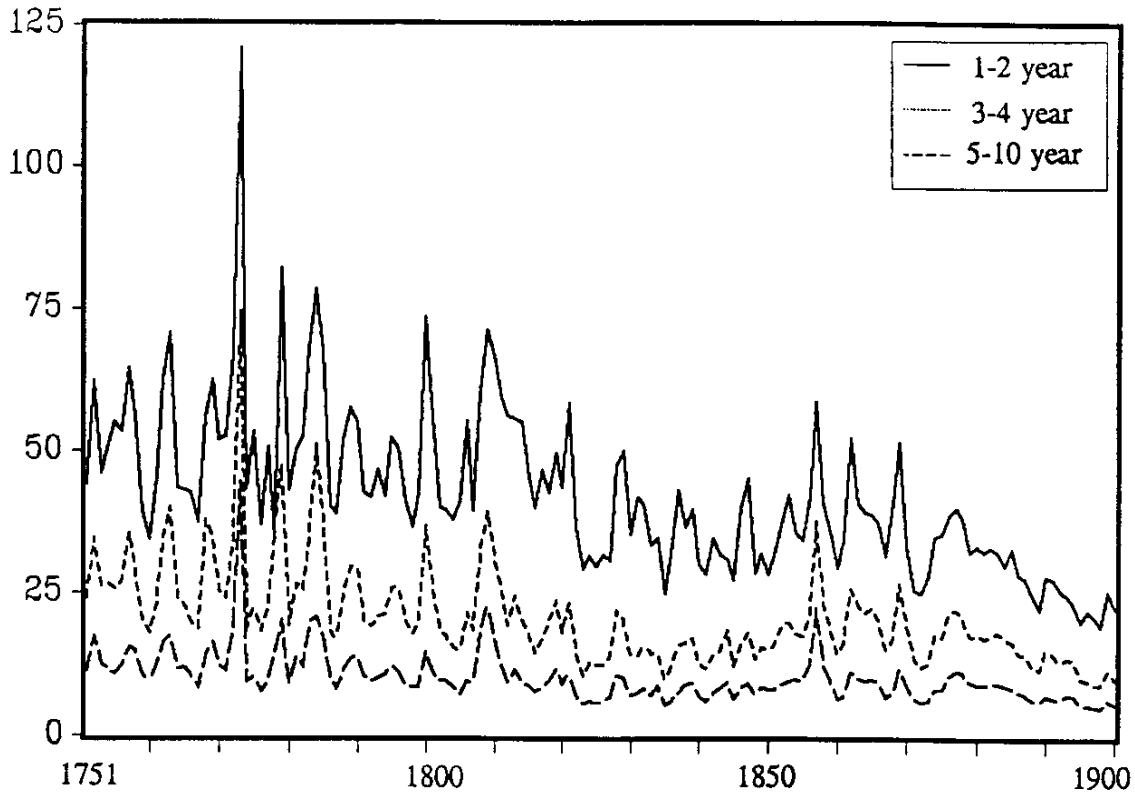

Diagram 3. Child mortality in Sweden.

Source: Historisk statistik för Sverige. Del 1. Befolkning. Andra upplagan. 1720-1967. Stockholm 1969.

not found in Germany or England. The statistics on infant and child mortality for Norway and Denmark do not reach far enough back in time to judge the impact on the initial decline that is possible for Finland and Sweden. (See diagrams 2-4.)

Two lines of inquiry have been deemed central to this research. The first is the attempt to explain the secular decline in infant and child mortality, and the second is the investigation into regional and social variations in mortality. Thus causes of the variations in child and infant mortality over time and between regions and social groups are explored.

The purpose of this paper is to give an overview of the prime results and methods used in Nordic demographic research on child and infant mortality and to present some methodological comments.

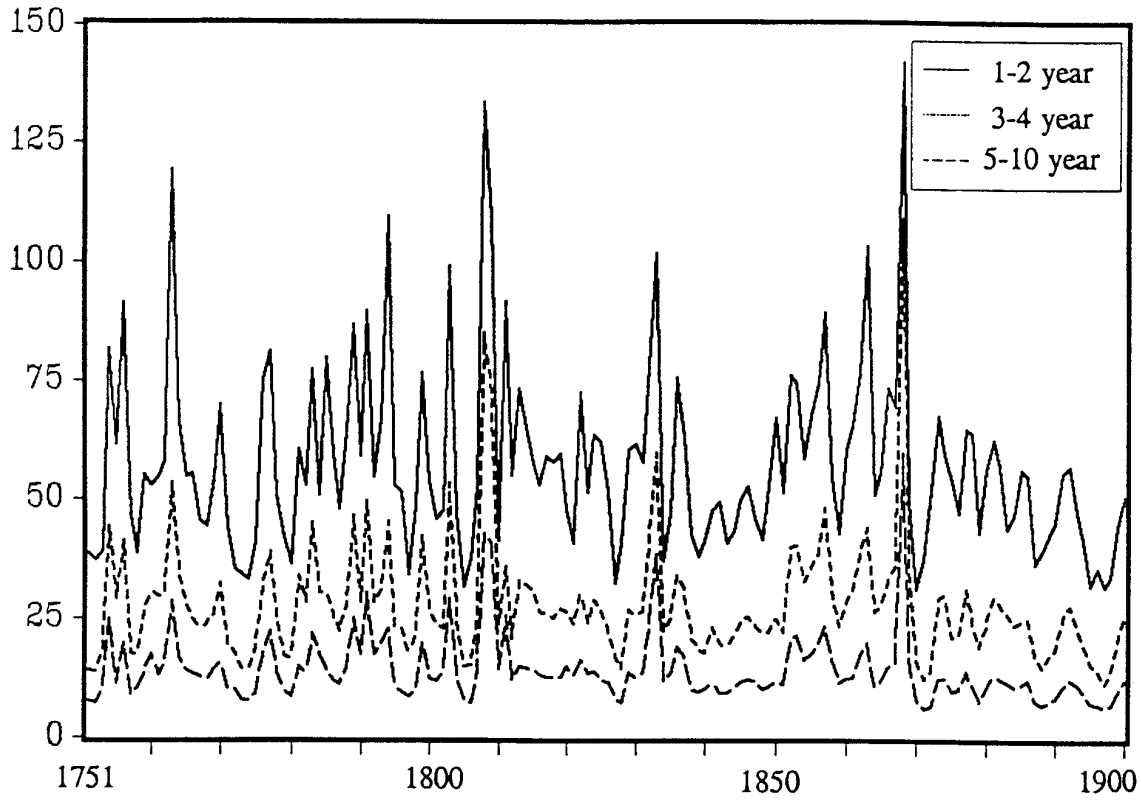

Diagram 4. Child mortality in Finland.

Source: Huvuddragen av Finlands befolkningsstatistik för åren 1750-1890. Bidrag till Finlands officielle statistik, serie VI, häfte 33. Helsingfors 1902; Turpeinen, O: "Fertility and Mortality in Finland Since 1750", Population Studies, Vol. 33, No. 1.

Explanations to the Decline in Infant and Child Mortality

It is a common perception among Nordic demographers that the factors behind the secular decline in mortality and its regional and social variations are very complex. Having made this reservation, one can find a number of more or less specific hypotheses regarding which factors have the greatest explanatory value. These hypotheses are more or less compatible to those that prevail in Western European investigations. Somewhat simplified, it can be said that the following factors are of importance in the different explanatory models: nutrition supplies, sanitary conditions and access to medicine,

relationship between humans and microorganisms, and cultural situations widely interpreted (e.g. nursing patterns).

The Malthusian view that *improved nutrient supply* was the primary factor behind decreased mortality was spread internationally through McKeown's research. McKeown questioned, in his roll as a medical historian, the great weight attributed to medical improvements as an explanation of the mortality decline. As medical and hygienic improvements were of relatively little importance during the latter half of the 19th century, McKeown argued that increased food production was the primary explanation to the decline not only during the second half but during the entire 19th century.

We should, however, keep in mind that McKeown does not take into account that the nourishment is not only determined by the food intake but also by the claims of the human body. If a person suffer from illness he needs more nutrients than if he is healthy. Thus a persons physiological development is determined not by gross nutrition, but by net nutrition, i.e. the difference between intake and claims. Most researchers in the Nordic countries in the same tradition as McKeown have, just like McKeown, been refering to the gross nutrition and not to the net nutrition.

Among Swedish economic historians, it is Heckscher who prior to McKeown has been the primary proponent of this idea.[2] Through comparisons between harvest yields and mortality, Heckscher felt that there was a causal connection where variations in production affected mortality in all age groups. On this point he received criticism from Utterström, who stated that infant mortality had its own rhythm which was largely independent of harvest yields and that mortality in other ages were not only dependent on harvests but also on other factors such as the weather.[3]

Drake has claimed that the mortality decline in Norway after 1815 was dependent upon improved nutrient supply, brought about primarily though the implementation of the potato in Norwegian agriculture.[4] Drake's explanation received support later of Lunden and Haarstad.[5]

For Sweden, Bengtsson, Fridlizius, and Ohlsson have used various statistical methods to evaluate the connection between variations in prices and real wages, used as a measure of production, and mortality.[6] Their conclusion was that a connection does exist for adults, but not for infants. Turpeinen

---

2 Heckscher 1936.

3 Utterström 1954.

4 Drake 1969.

5 Lunden 1975; Haarstad 1980.

6 Bengtsson & Ohlsson 1984, 1985; Fridlizius & Ohlsson 1984.

could find no such correlation between yields and infant mortality for Finland either.[7]

Greater correlation has been found between child mortality and economic conditions. In an examination of a parish in middle Sweden, Bengtsson has found that mortality in the ages 1 - 14 was affected by economic fluctuations.[8] Lithell, too, states that socio-economic conditions are deciding factors regarding child mortality.[9] Edvinsson found that child mortality patterns in the city of Sundsvall differed from those of adults.[10] Despite an improvement in the standard of living that decreased adult mortality, child mortality increased because children were exposed to the poor sanitary conditions that accompany urbanization.

Several investigations have studied child and infant mortality separately for wealthy regions in contrast to poor regions or for different social groups. One should expect that the poor regions and the lower social classes should have higher mortality rates than wealthy regions and the higher classes. Behind this lies the hypothesis that nutrient supply was better and more consistent for the wealthy. Several studies have supported this connection, but many results point in the opposite direction. Winberg expressed concern over this, while others look instead towards cultural explanations.[11] Bengtsson has suggested that an important share of this variance between different social groups can be the result of under-registration.[12]

Many researchers are concerned with causes of death, and have thus studied the regional and temporal variations of the deadly diseases.[13] *Medical and sanitary improvements* have, to varying degrees, been seen as contributing factors in the mortality decline. Several Swedish researchers have recently focused upon the temporal and geographic variations in the transmission of infectious diseases as important to the understanding of the mortality decline. Högberg gives a broad overview of the history of diseases and their impact on the Swedish agricultural communities.[14] Even among researchers who do not believe that medical and sanitary improvements are primary causes of the decline, increased attention is being paid to age-specific causes of death.

---

7 Turpeinen 1979b.

8 Bengtsson 1989.

9 Lithell 1981b, 1981d.

10 Edvinsson 1992.

11 Winberg 1975.

12 Bengtsson 1989.

13 Bengtsson 1988; Fridlizius 1975, 1979, 1984, 1994; Pitkänen, Mielke & Jordan 1989.

14 Högberg 1983.

Research in Finland has primarily concerned mortality crisis (see for example Jutikalla)[15] and the spread of smallpox over time. Pitkänen, Mielke, and Jorde maintain that the decline in smallpox-caused mortality began as early as the end of the 18th century, but the general decline in child mortality (1 - 4 years) did not occur until the second half of the 19th century.[16] This is explained by the fact that other diseases took the place of smallpox as the primary causes of death. Medical improvements such as vaccination, revaccination, and public health policies were important factors behind the decline of smallpox, but their impact on the general mortality decline was very limited. The authors also point to the existence of a different viral pool in Russia as an explanation to the late decline in smallpox mortality in Finland.

Fridlizius suggests that the development of Swedish mortality during the transition period occurred in three distinct steps.[17] During the first phase, from the late 18th century until about 1850, the mortality decline affected primarily infants and children. This was to a great extent caused by epidemiological factors beyond human control, i.e. variations in the *virulence of pathogens*. Fridlizius thus connects to the research represented by Chambers and Perrenoud. During the second phase, which lasted from 1850 - 1880, mortality levels were increasingly affected by a multiplicity of factors. For children, the earlier decline was dramatically reversed as a result of the appearance of new, uncontrolled waves of epidemics, partly of a pandemic character. It is only during the third period that we can speak of a sustained mortality decline determined primarily by factors connected to the emergence of an industrial society with better dissemination of medical techniques, sanitary improvements, etc. This explanatory model has been supported by studies of age specific causes of death.

The idea that the mortality decline in Norway was caused by improved nutrition supplies was criticized by Dyrvik and Sogner. Both attribute the high mortality preceding the decline to epidemical diseases. Sogner's hypothesis is that governmental action against epidemics was an important factor in the decline.[18] Dyrvik rejects both potatoes and smallpox vaccinations as primary causes of the decline in child and adult mortality, and accredits a change in the epidemiological climate instead.[19] Dyrvik is, however, uncertain of the causes of the decline in infant mortality, which he sees as being of primary importance the general decline prior to 1815.

---

15 Jutikalla 1955.

16 Pitkänen, Mielke & Jordan 1989b. Se also Pitkänen, Mielke & Jordan 1989a.

17 Fridlizius 1975, 1979, 1984, 1994.

18 Sogner 1979.

19 Dyrvik 1978, 1988. See also Dyrvik 1972, 1974.

The Malthusian view of the decline was also criticized by Engelsen.[20] He found in the 1801 census that mortality among farmers was higher than among the lower classes which suggests that access to food was not a deciding factor. More important was the exposure to epidemiological deseases since farmers lived more centrally than the poor who lived on the periphery.

Cultural differences (widely defined) between regions and social groups have been internationally regarded as deciding factors for mortality among children and especially infants. Situations such as parental attitudes towards children and childcare (see Imhof, Ariés, Ferguson) or different nursing traditions (see Knodel, Kintner) have been forwarded in different models.

Nordic research has been focused on *nursing traditions*. In her doctoral dissertation, Lithell completed a study of Swedish and Finnish parishes, and found a connection between nursing habits and infant mortality.[21] Artificial nursing led to higher mortality levels with peaks during the summer months. Nursing traditions were found to explain variations in infant mortality to a greater degree than social or economic factors. Nursing compensated for poor living conditions, while artificial nursing led to higher infant mortality in the wealthier regions. Lithell thus concluded that infant mortality rates are not a good measure of standard of living in agrarian societies.

Sundin and Tedebrand studied infant mortality in several parishes in middle and northern Sweden.[22] Surprisingly they found noticeably lower infant mortality rates in industrial areas than in agrarian ones, which they attributed to nursing patterns and the ability to get help from the factory doctor and midwife. Nursing was less common in agrarian communities, which explains the higher infant mortality. Sundin and Tedebrand also find higher infant mortality among farmers than landless labourers for certain periods, and attribute this to the fact that farmers were the most resistant to the government's nursing campaigns.

Brändström examined infant mortality in a Norrland parish in northern Sweden in his doctoral dissertation.[23] There he found a higher infant mortality among farmers than among the landless and middle class for the period from 1820 to the 1860s, and a higher mortality in the countryside than in the towns for the entire 19th century. He also saw nursing patterns as a major factor in infant mortality, with townspeople nursing more often than those in rural areas. As the governmental nursing campaign took root in the countryside, the infant mortality declined. However, he found that for a reference parish in

20 Engelsen 1983.

21 Lithell 1981b, 1981c, 1981d.

22 Sundin & Tedebrand 1981.

23 Brändström 1984.

middle Sweden other factors than nursing were of importance to the decline. In cooperation with Broström, Persson and Sundin, Brändström has studied differenses in the nursing patterns for other parishes and vaster regions.[24]

Turpeinen studied infant mortality in Finland and found large regional differences.[25] Mortality was higher in towns than in the countryside and also higher in relatively wealthy regions than in poor regions. Furthermore, differences between social groups in the countryside were relatively limited. Turpeinen's conclusion was that the nursing patterns were important in explaining these regional variations and the lack of social differences. Artificial nursing exposed infants to infection and, in the towns, to polluted water.

Explanation of the regional differences in nursing is usually given as cultural tradition, such as the use of a horn to feed the baby. Regarding social differences, such as when the farm family had higher infant mortality than poorer families, the explanation has been that farmers had greater access to cow's milk as a substitute for breast milk. Lithell has also stated that differences in women's work patterns affect their ability to nurse their children.[26]

Hansen beleives that *infanticide* was quite common in Scania, Sweden, particularly among poor people as a supplement for birth control.[27] This opinion has been criticised by several researchers. Thomson claimes that Swedish legal debate during the 18th century gives no proof of women intentionally suffocating their children during sleep.[28] To the extent that such things happened, they were mere accidents. Ahlberger and Winberg agree with Thomson that Hansen was probably wrong, but admit that it is hard to check the frequency of infanticide since the cases of children being choked by their mothers during sleep was probably often reported as 'not indicated causes of death'.[29] In some parishes where the suffocating of children was reported, family reconstitution data show that in most families where these events were taking place the choking of a child often occurred early in the family life cycle and was followed by several births. Furthermore, the suffocating of children was more common in peasant families than in landless families. Ahlberger and Winberg conclude that this indicates that the deaths

---

24 Broström, Brändström & Persson 1983; Brändström & Sundin 1981.

25 Turpeinen 1977, 1978, 1979a, 1979b, 1988.

26 Lithell 1981a. See also Brändström 1988.

27 Hansen 1952.

28 Thomson 1960

29 Ahlberger & Winberg 1987.

of these children were accidents and not a poor man's supplement to birth control.

The present state of Nordic research into infant and child mortality can be summarized in two points. The first, which is very obvious, is that age-specific studies of mortality have shown that the levels and development vary for different age groups. Regarding infant mortality, the factors that affected it varied from those affecting adult mortality that led to interest in age-specific causes of death.

The second point is that the causes behind the reduction in infant and child mortality are very complex. The awareness that different factors have differing influence in different phases of the decline lead to an understanding of the need for long, continuous series of data regarding mortality so that the entire period may be examined. The tendency now is to abandon those models which attempt to explain the *initial* decline through reliance upon nutrient supply or medical and sanitary advances, as empirical tests have shown that these models have a poor temporal correlation. As regards the importance of nutrient supply, studies of infant mortality for different social groups give such contradictory results that it is impossible to say if there is any correlation. Furthermore, research tends more and more to look to residual explanations such as changes in virulence and nursing patterns which are much more difficult to test empirically. As to the *latter phase* of the mortality decline, researchers agree that factors like nutrient supply, medical and hygienic improvements, and nursing patterns contributed to the decline.

Data and Methods

Studies of child and infant mortality in the Nordic countries have been carried out on several different levels of aggregation: national, regional, and by social group. Investigations at the national level or for large regions use data collected by governmental agencies. The advantages to such a study are obvious, large populations may be analyzed with great representativeness because much of the time-consuming work of data collection has already been done. At the same time, however, the information is limited regarding number of variables, and the source material limits the investigations to the period after 1750.

The possibility to analyze child and infant mortality at the national or the county level is the explanation to the effort which has been spent to, on the basis of tables of population, births, and deaths, construct continual age-specific series of mortality. The Swedish and Finnish series stretch back to

1749, the Norwegian and Danish to 1835. To go further back, mortality information must be gleaned manually from parish records. This naturally involves a limitation on the survey size, with single parish studies being most common, occasionally with some more parishes as references.

In addition to the ability to go further back in time, another reason to conduct research at the micro level is that information becomes more specific. There are greater possibilities to build continuous series of age specific causes of death, which gives valuable insight into those factors that contributed to the decline in mortality. Furthermore, child and infant mortality can be related to the parents occupations and thus to social position, which can cast light upon the question concerning nutrient supply. Finally, mortality can be related to marital status, allowing for regional and social-group specific analyses of mortality rates of children born out of wedlock.

The most labour intensive method of collecting data is that based upon *family reconstruction data*. The material is superior in the respect that it includes mortality statistics for individuals that are connected to families. This allows for individual-based analysis where more questions can be asked, such as what relationship exists between fertility and infant mortality.

Family reconstruction involves the connection of information regarding births, deaths and marriages from church records to families. This method was developed by Henry during the 1950s, but had predecessors in earlier studies. In Sweden Edin carried out such studies in the beginning of the century and Hyrenius in the 1940s.[30]

However, there exist for certain periods in Sweden and Finland records from the catechetical examinations, which were the yearly rounds made by the priests to check the literacy and biblical knowledge of a household's members. These records contain almost complete listings of the family's members and have been used as source material by family historians. Since they rely on the catechetical records, the Swedish studies of families and households with few exceptions refer to the 19th century. To go further back, or to examine those parishes without church catechetical examination registers, Henry's original, time-consuming method must be used. For this reason, Bengtsson and Lundh have developed a computer program that automatically links together family data, and has now been used on nine parishes in Scania in southern Sweden during the period 1660-1860.[31]

In a number of studies that examine infant and child mortality, relatively simple methods have been used. Some surveys have computed and analyzed

30 Edin 1915; Hyrenius 1942. See also Hyrenius 1958.

31 Bengtsson & Lundh 1990, 1991, 1993; Lundh & Bengtsson 1989.

changes in average life expectancy[32], while many have analyzed age-specific mortality. It is common to calculate infant mortality as the number of infants who die in their first year divided by the number of live births. Thus stillborns and miscarriages are not included. Periodic measures are almost exclusively used, and seldom is it accounted for that those who die before turning one were not necessarily born in that calender year. In general, cohort measurements are seldom used. One reason for this is that surveys often use published data, which is most often organized as period data. In his examination of the connection between child and adult mortality, Fridlizius avoided this trap though the construction of cohort data from period data.[33]

A number of improvements have been implemented in respect to research into infant mortality at the micro level. First, mortality has been analyzed at a more limited period (week, month, etc.). Second, a graphic method developed by Bourgeois-Pichat has been used. This method plots cumulative total infant deaths on a logged time scale ($\log^3(n+1)$, with n=age of death in days). The cumulative total infant deaths are often divided by number of births so that different sized populations can be compared. This method has been used internationally by Wrigley and Knodel & Kintner among others, and in the Nordic countries by Sundin & Tedebrand, Brändström, Fridlizius, and Bengtsson and others.[34]

Since the Nordic population material, and especially the Swedish, is considered so extraordinarily good less carefulness has been used in its handling than for English material (as an example).[35] One reason for this may be that the Swedish parish registers cover the entire population. Thus the problems which are encountered in England with its different religious communities do not exist in the Nordic countries. There is, however, a risk of *under-recording* due to the fact that the early parish registers covered baptisms and burials rather than births and deaths. Changes in the time interval between birth and baptism could lead to a change in the under-recording over time, making time series regarding births and infant mortality difficult to analyze. In addition, burials cost money, and this could lead to the lowest classes not being recorded as dying. However, to allow for these poor to be buried, there existed a possibility to be buried at the same time as another member of the parish was buried. This has been shown to exist through individual notes in parish records (i.e. in Norway).

---

32 Andersen 1979, 1984.

33 Fridlizius 1989.

34 Sundin & Tedebrand 1981; Brändström 1984; Fridlizius 1984; Bengtsson 1989, 1993a.

35 For Finland, see Pitkänen 1977.

One indirect way of determining the prevalence of under-registration is to calculate endogenous mortality. This method was elaborated by Wrigley for the purpose of evaluating possible under-recording, and has been used on Swedish data by Bengtsson.[36] It is based on the above-mentioned method evolved by Bourgeois-Pichat for the purpose of calculating endogenous mortality (deaths caused by delivery injuries and deformities) and exogenous mortality (other deaths) during the first year of life.

Wrigley believes that this method can be used to estimate the under-recording of deaths but after having studied endogenous mortality in a number of French and English parishes he is less convinced of the method's suitability. This is because of the great variance in endogenous mortality from parish to parish. The general conclusion is that extensive under-reporting must have existed if one is to detect it by this method.

Bengtsson's calculations of endogenous mortality in Västanfors indicate figures of only 25 per 1000 for boys, and 20 per 1000 for girls between 1751 and 1799.[37] Corresponding figures for the period 1800-1849 were 15 and 10 per 1000 respectively. Endogenous mortality in Sweden in 1954 was 12.7 per 1000. There is undoubtedly significant under-reporting of deaths during the first month of life in Västanfors.

The differences in infant mortality between different social groups which Sundin and Tedebrand find in the case of Nordingrå, and which they interpret in real terms, may very well result from under-recording.[38] The differences between the peasantry and the landless in 1840-49 emerge during the first month, after which the curves run almost parallel. (See diagram 5.) No endogenous mortality exists at all among the children of crofters and other landless persons! It is thus evident that under-recording occurred here, as in Västanfors. The question then arises as to if the cause was simply that peasants were better able to afford burials for their children than were the landless.

In summary, it can be said that under-recording of deaths among children is significant in both Nordingrå and Västanfors, and that this is not an isolated phenomenon. Our studies of Scanian parishes point to the same problem - a problem that varies between parishes and time periods.

To examine the extent to which the under-recording occurred we have analyzed additional 16 parishes for which family reconstruction was

36 Wrigley 1977; Bengtsson 1989a, 1989, 1993a.

37 Bengtsson 1989.

38 Sundin & Tedebrand 1981

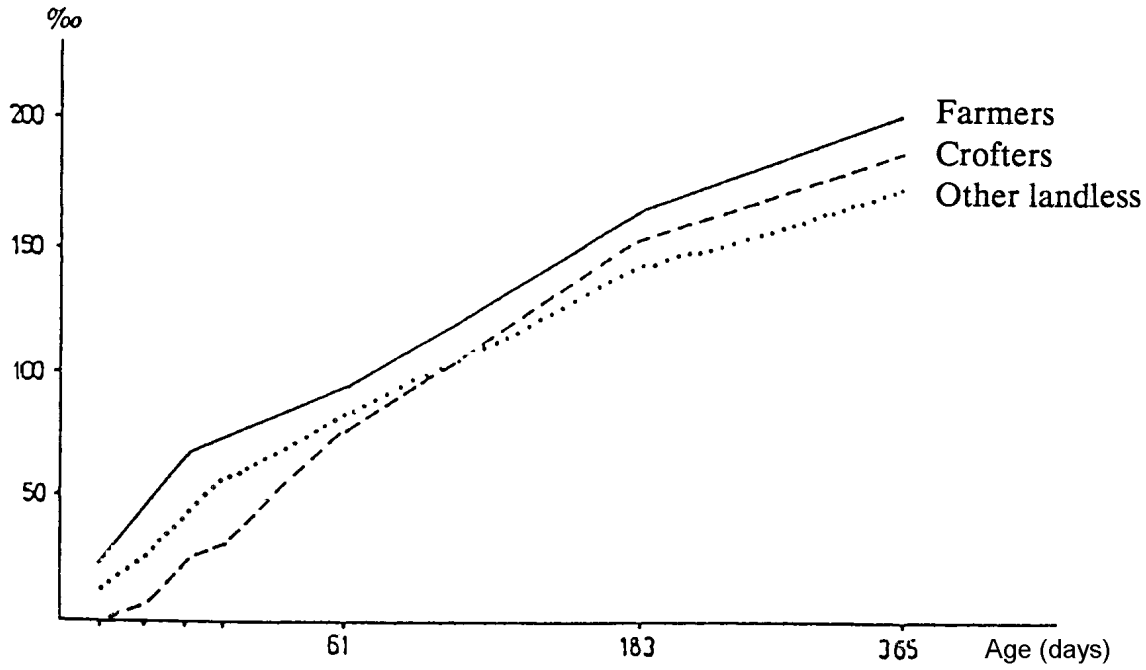

Diagram 5. Cumulative total infant mortality per 1000 live born in Nordingrå 1840-49.

Source: Sundin, J. & Tedebrand, L-G. (1981), figure 6d.

performed (see Appendix 1). For nearly all parishes, strong suspicions exist as to under-registration of mortality of children of workers and other landless persons during the first month of life, as in Nordingrå. Unlike Nordingrå, most of the 16 parishes showed a lower mortality for the landless not only the first month but during the following 11 months as well. This occurred in Trosa and Attmar among others. (See diagrams 6 & 7.) In ages 1 to 12 months, however, it is not certain that this is a sign of under-recording but of differences in the nursing patterns.

There is, theoretically, an alternative explanation to under-recording for the differences in infant mortality between different social groups. If it is true that the infant mortality was higher in peasant families than among the landless, as the figures for Trosa and Attmar suggest, this might be due to the practice of infanticide in peasant families. However, there is little evidence that infanticide was practiced in Sweden as mentioned above. Nevertheless, in the case of Nordingrå such an alternative could be excluded. Most probably this is a case of under-recording, since (as can be seen in diagram 5) there were no endogenous mortality at all for crofters and other landless.

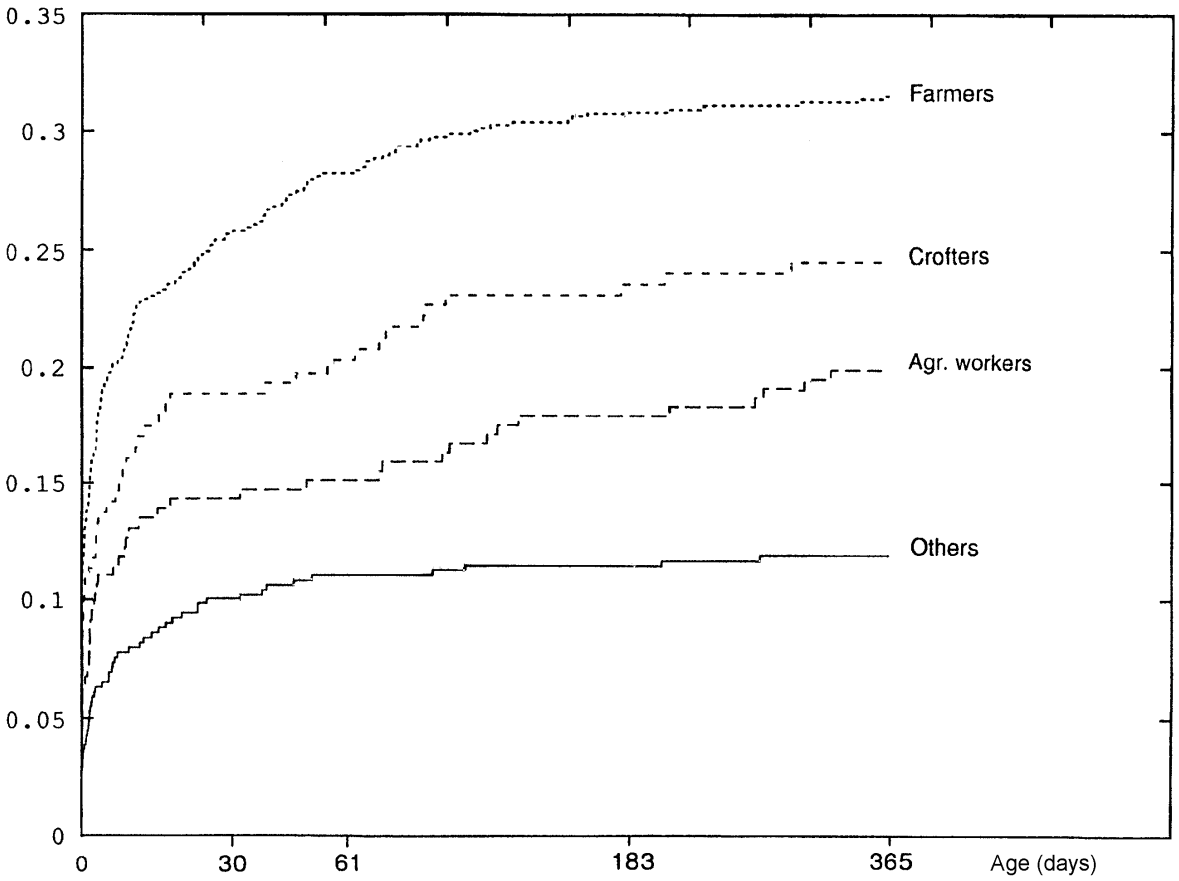

Diagram 6. Cumulative total infant mortality per 1000 live born in Trosa.

Many studies have analyzed infant and child mortality levels and changes as well as causes of the mortality decline through the use of simple tables and graphs. To determine different factors' influence on mortality development, mortality is calculated for different populations that are occasionally then divided into sub-populations. Comparisons are made between men and women, town and country, different regions, and children from different social groups. In the regional comparisons, the populations are usually so large that one can ignore random variations. On the other hand, if the population is small, a division into sub-groups increases the risk for random variation. This applies to social groups for example. The reason for this is that this type of study is based on family-reconstruction data, which is time-consuming and usually results in the use of small sample size. It is common that no formal tests are made to ascertain whether those differences in mortality that are found between the different subpopulations are significant

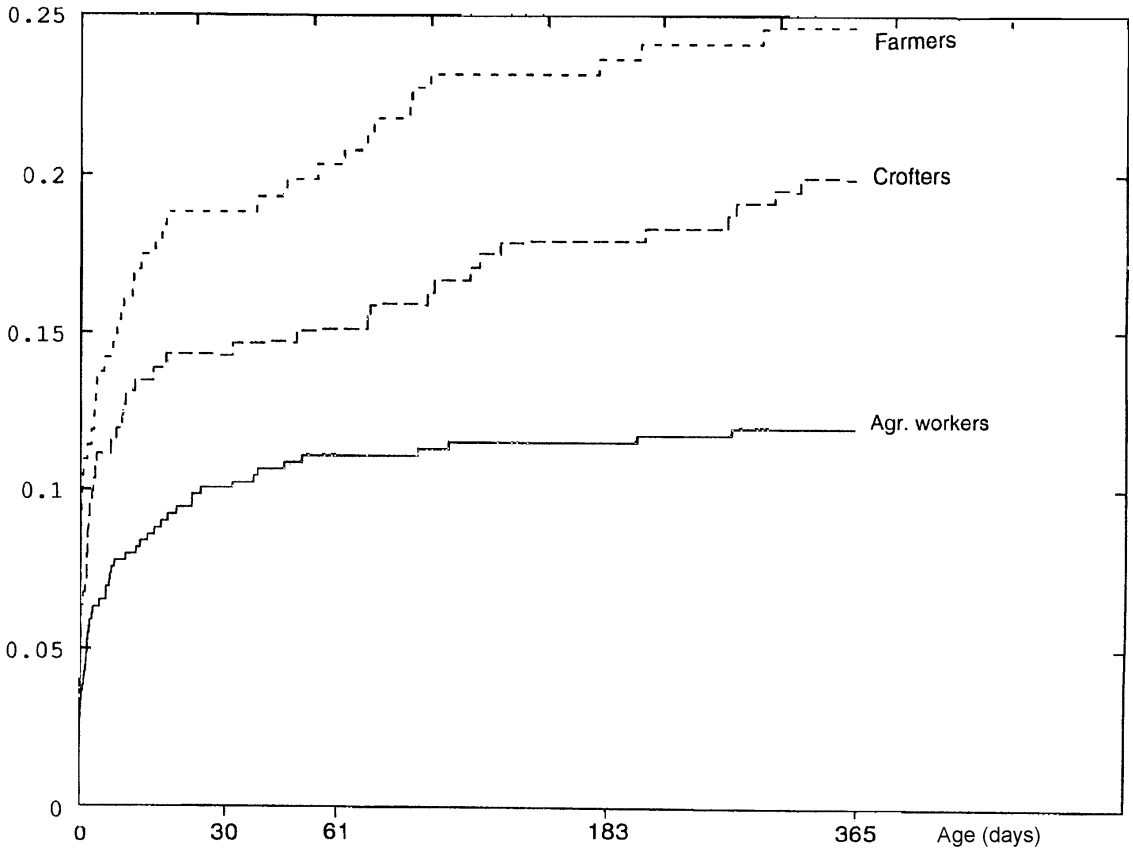

Diagram 7. Cumulative total infant mortality per 1000 live born in Attmar.

or not, despite the fact that the small sample size could be expected to lead to large random variation.

The vast majority of Nordic studies of infant and child mortality examine changes over time, primarily the long-term decline, and their causes. To pinpoint a change in the trend, graphic methods are most commonly used. Even in determining the connection between mortality decline and societal changes such as harvest yields, medicine, or nursing trends a common analytical tool has been simple graphic analysis, often in connection with tentative reasoning and little quantitative input. Statistical methods to test correlation have rarely been used within this tradition.

There is another methodological process, which builds upon formal time series analysis and is primarily advanced by Bengtsson. Several of these studies have been completed in cooperation with Ohlsson and Broström.[39] In

39 Bengtsson & Ohlsson 1985; Bengtsson & Broström 1986.

these studies it is the short-term variations which are analyzed and with the help of time series method (spectral analysis, distributed lag models, Box-Jenkins models, etc.) harvest yield and temperature's effects on mortality have been analyzed. Most of these studies encompass data for entire countries, but some have worked on lower level, most often counties. One such study is that of mortality by cause of death made by Fridlizius and Ohlsson.[40] These methods are not suitable for small populations, as the random variation then becomes too influential.

Bengtsson has also recently combined time-series with life event analysis.[41] Life event analysis is an extension of the classical life expectancy table technique. A major problem with the latter is that the number of observations when different sub-populations are to be studied becomes so small that random variations dominate. In life event analysis, therefore, use is made of a regression on quotas for the number of status changes per time unit, for example, the number of first births per 1000 months of exposure. Changes of status in several dimensions, e.g. civil status, occupational status, and number of children born, can be studied simultaneously. The dependence of the flows upon the individuals' age and background, current status, and duration in each condition are calculated. For example, the effect on fertility of age attained, occupational status, marital status, number of previous births, and time elapsed since any status was changed can be calculated.

The method also offers a considerable advantage in that it automatically takes account of the fact that an individual's life history cannot always be followed to its conclusion; observation of the individual ceases when the collection of data comes to an end. As with all other known methods, this leads to a skewness in the analysis (the censuring problem). Life event analysis has seldom been used in the Nordic countries historical demography. It has been used in some studies by Bengtsson, Brännström and by Edvinsson.[42]

Life event analysis has been combined by Bengtsson with time-series analysis to study the effects at the micro level of harvest yields and temperature on mortality. Through the use of individual data, the effects of external changes can be studied for different social groups, different parities, etc, where the influence of individual factors can be determined. Combination effects can also be analyzed. At present only one parish has been thus analyzed with the result being agreement with macro studies in certain age groups, and disparity in others. The latter is the case for child mortality which

40 Fridlizius & Ohlsson 1984

41 Bengtsson 1989, 1993a, 1993b.

42 Bengtsson 1989, 1994; Brändström 1989; Edvinsson 1992.

in this examination was as dependent upon harvest yield as adult mortality. Infant mortality seems even in this study to be relatively independent of economic fluctuations.

One can identify three characteristics that seem to summarize the state of data and method today. The first is that there is a clear desire to construct new data series to shine a light on the mortality decline. This is partially done through the construction of national and regional series of age-specific mortality tables on the basis of existing tables of population, births and deaths, and partially through studies carried out at the micro level.

The second is the suspicion of under-recording of infant mortality in certain parishes and periods so that the traditional source-critical methods used to judge the existing data must be combined with methods to judge data which may be missing.

The third is that relatively simple methods have been used to analyze changes in infant and child mortality. The trend is now toward a more advanced use of old methods such as Bourgeois-Pichat's curve describing cumulative total infant deaths and of cohort mortality in general, and the introduction and development of new advanced statistical methods (i.e. life event analysis).

Some Methodological Comments

In conclusion, we would like to make some methodological comments based on what we deem to be the state of Nordic research regarding infant and child mortality in the past. For a further analysis of the causes of the general mortality decline long, continual series of age-specific mortality is required. In the respect that such series can be constructed for the entire nation and different regions from existing tables of population, births, and deaths, it is important that it be done.

It is furthermore important that the age-specific time-series start prior to the initial phase of the decline in mortality. Only when a turning point in mortality can be identified for the different age groups will it be meaningful to discuss the causes of the initial decline. This holds true for both national and regional series constructed from official statistics and individual-based studies of family-reconstruction material. For the latter, use of Henry's method is vital so that the series stretches as far back as possible. Even though the less time consuming method to use the catechetical registers as a starting point for the family reconstitutions might be alluring, this is not to recommend if it would limit the period under study.

There are good reasons to study infant and child mortality at different levels of aggregation. Studies at the national and regional levels give an overview and are representative, while individual-based studies increase the amount and depth of information. One method that has not really been attempted and could prove worthwhile is to combine results of micro and macro studies. This can be done through a synthesis of a number of separate studies or it could be within the same project.

Many studies of changes in infant and child mortality point to a multifactoral causal connection. The analyses attempt to ascertain similarities and differences between different populations, but commonly fail to use accepted statistical methods to test for randomness. It is of great importance that this be done where this method is used. In most cases it would be better to use those methods which have been developed especially for multivariate analysis.

In the analysis of aggregated time-series one can use different types of time-series analyses. In those cases where we have a priori knowledge this can be exploited in the development of models to be tested. In those cases where our knowledge is less complete methods such as Box-Jenkins can be used. As to the analysis of individual-based data life event analysis is an important tool specially developed for small populations.

The study of how a population is affected by external factors such as harvest yields and temperature changes can be carried out through a combination of life event analysis and time-series analysis. We can thus gain insight as to how individuals with different personal characteristics (sex, age, social group, birth ranking, etc.) are affected by changes in their immediate environment, and thereby get a picture of their general living conditions. This method is new and therefore has had little application, but it is deemed to have wide applicability.[43]

It is of utmost importance that to have a basic critical view of sources. This is naturally equally important on both the aggregated and the individual level. One such problem that has aroused too little attention in Nordic research is the under-reporting of infant mortality. The problem varies between parishes and periods, and it is vital to research on infant and child mortality that those periods with acceptable data be identified.

43 Lee 1993.

Bibliography

Ahlberger, C & Winberg, C (1987): "Biologi, medvetet handlande och struktur. En studie av amning, spädbarnsdödlighet och fruktsamhet i två västsvenska samhällen", *Historisk Tidskrift*, No. 2.

Andersen, O. (1979): "The development in Danish mortality 1735-1850", *Scandinavian Population Studies*, Vol. 5. Oslo.

Andersen, O. (1984): "The decline in Danish mortality before 1850 and its economic and social background", in Bengtsson, T, Fridlizius, G. & Ohlsson, R., *Pre-Industrial Population Change: The Mortality Decline and Short-Term Population Movements*. Lund.

Bengtsson, T. (1988): "Mortality and causes of death in Västanfors parish, Sweden, 1700-1925", in Brändström, A. & Tedebrand, L.-G. (eds.), *Society, Health, and Population during the Demographic Transition*. Umeå.

Bengtsson, T. (1989): *Real wage variation and infant mortality*, Paper for the IUSSP congress in New Delhi 1989.

Bengtsson, T. (1992): *Den demografiska utvecklingen i de nordiska länderna 1720-1914*. Lund Papers in Economic History, No. 15.

Bengtsson, T (1993): *Economic, Social and Biological Determinants of Infant and Child Mortality in a Swedish Mining Parish 1757-1850. Combined Time Series and Life Event Analysis*. Paper presented at the IUSSP General Conference in Montreal 1993.

Bengtsson, T. (1993): "Combined Time Series and Life Event Analysis", in Reher, D and Schofield, R (eds): *Old and New Methods in Historical Demography.* Oxford University Press.

Bengtsson, T. & Broström, G. (1986): *A Comparison of Different Methods of Analyzing Cycles in Population Economics.* Meddelande från Ekonomisk-historiska institutionen, Lunds universitet, No. 46.

Bengtsson, T. & Lundh, C. (1990): *Life Events in a Peasant Society in Transition. Causes of Population Change in Scania, 1660-1860.* Lund Papers in Economic History, No. 1.

Bengtsson, T. & Lundh, C. (1991): *Evaluation of a Swedish Computer Program for Automatic Family Reconstitution.* Lund Papers in Economic History, No. 8.

Bengtsson, T & Lundh, C (1993): *Name-Standardisation and Automatic Family Reconstitution.* Lund Papers in Economic History, No. 29.

Bengtsson, T. & Ohlsson, R. (1984): "Population and Economic Fluctuations: Sweden 1749-1869", in Bengtsson, T., Fridlizius, G. & Ohlsson, R.

(eds.), *Pre-Industrial Population Change: The Mortality Decline and Short-Term Population Movements*. Lund.
Bengtsson, T. & Ohlsson, R., (1985): "The Standard of Living and Mortality Response in Different Ages." *European Journal of Population*, Vol. 1, No. 4.
Broström, G, Brändström, A. & Persson, L-Å. (1983): *The Impact of Breastfeeding Patterns on Infant Mortality in a 19th Century Swedish Parish*, Newsletter No. 1. Demographic Data Base, Umeå.
Brändström, A. (1984): *'De kärlekslösa mödrarna'., Spädbarnsdödligheten i Sverige under 1800-talet med särskild hänsyn till Nedertorneå*. Umeå.
Brändström, A. & Sundin, J. (1981): "Infant Mortality in a Changing Society: The Effects of Child Care in a Swedish Parish, 1829-1894", in Brändström, A. & Sundin, J (eds.), *Tradition and Transition: Studies in Microdemography and Social Change.* Umeå.
Brändström, A. (1988): "The Impact of Female Labour Conditions on Infant Mortality: A Case Study of the Parishes of Nedertorneå and Jokkmokk, 1800-96", *The Society for the Social History of Medicine*, No. 3.
Drake, M. (1969): *Population and Society in Norway 1735-1865*. Cambridge.
Dyrvik, S. (1972): Historical Demography in Norway 1660-1801. A Short Survey", *Scandinavian Economic History Review*, Vol. 20, No. 1.
Dyrvik, S. (1974): "Infant Mortality About 1800", Scandinavian Population Studies, Vol. 3. Helsinki.
Dyrvik, S. (1978): "Poteta, dœdsrata og demografien", *Norsk Historisk Tidskrift*, Vol. 57.
Dyrvik, S. (1988): "The Effects of Smallpox Vaccination on Mortality. A Norwegian Case Study 1770-1840", in Brändström, A. & Tedebrand, L-G., Society, *Health and Population During the Demographic Transition*.
Edin, K.A. (1915): "Studier i svensk fruktsamhet", *Ekonomisk Tidskrift*.
Edvinsson, S. (1992): *Den osunda staden. Sociala skillnader i dödlighet i 1800-talets Sundsvall*. Umeå.
Engelsen, R. (1983): "Mortalitetsdebatten og sosiale skilnader i mortalitet", *Norsk Historisk Tidskrift*, Vol. 62.
Fridlizius, G. & Ohlsson, R. (1984): "Mortality Patterns in Sweden 1751-1802. A Regional Analysis", in Bengtsson, T., Fridlizius, G. & Ohlsson, R., *Pre-industrial Population Change: The Mortality Decline and Short-Term Population Movements*. Lund.
Fridlizius, G. (1975): "Some New Aspects on Swedish Population Growth". *Economy and History*, Vol. XVIII, No. 2.
Fridlizius, G. (1979): "Sweden", in Lee, W.R.: *European Demography and Economic Growth*. London.

Fridlizius, G. (1984): "The Mortality Decline in the First Phase of the Demographic Transition: Swedish Experiences", in Bengtsson, T., Fridlizius, G. & Ohlsson, R., *Pre-industrial Population Change: The Mortality Decline and Short-Term Population Movements*. Lund.

Fridlizius, G. (1989): The Deformation of Cohorts: Nineteenth Century Mortality Decline in a Generational Perspective. *Scandinavian Economic History Review*, Vol. 37, No. 3.

Fridlizius, G. (1994): "The Mortality Development of a Port-town in a National Perspective. The Experience of Malmö, Sweden 1820-1911", in Lee, W.R. (ed.), *The Population Dynamics and Development of Western European Port Cities 1720-1939*. London.

Haarstad, K. (1980): "Sult, sygdom, dœd", *Norsk Historisk Tidskrift*, Vol. 59.

Hansen, B. (1952): Österlen. Stockholm.

Heckscher, E. (1936): *Sveriges ekonomiska historia från Gustav Vasa*. Stockholm.

Hyrenius, H. (1942): *Estlandssvenskarna. Demografiska studier*. Lund.

Hyrenius, H. (1958): "Fertility and reproduction in a Swedish population group without family limitation", *Population Studies*, Vol. 12.

Högberg, U. (1983): *Svagårens barn. Ur folkhälsans historia*. Stockholm.

Jutikkala, E (1955): The Great Finnish Famine in 1696-97, *Scandinavian Economic History Review*, Vol. 3.

Lee, R., (1993): *Methods and Models in Macro-Demographic History: An Update and Assessment*, Paper for the IUSSP conference on Old and New Methods in Historical Demography, Balears, Spain 1991.

Lithell, U-B. (1981a): "Childcare - A Mirror of Women's Living Conditions. A Community Study Representing 18th and 19th Century Ostrobothnia in Finland", in Brändström, A. & Sundin, J (eds.), *Tradition and Transition: Studies in Microdemography and Social Change*. Umeå.

Lithell, U-B. (1981b): *Breast feeding and Reproduction. Studies in Marital Fertility and Infant Mortality in 19th Century Finland and Sweden*. Uppsala.

Lithell, U-B. (1981c): "Breastfeeding Habits and Their Relation to Infant Mortality and Marital Fertility", *Journal of Family History*, Vol. 6, No. 2.

Lithell, U-B.(1981d): "Infant Mortality Rate and its Relation to Living Conditions in the past", *The Scandinavian Journal of History*, Vol. 6, No. 4.

Lunden, K. (1975), "Poteta og den raskere folkevoksteren i Noreg", *Norsk Historisk Tidskrift*, Vol 54.

Lundh, C. & Bengtsson, T. (1989): *Familjerekonstruktion på svenskt kyrkoboksmaterial. Problem och möjligheter*. Meddelande från Ekonomisk-historiska institutionen, Lunds universitet, No. 59.
Pitkänen, K. (1977): "The Reliability of the Registration on Births and deaths in Finland in the Eighteenth and Nineteenth Centuries: Some Examples", *The Scandinavian Economic History Review*, Vol. 25, No. 1-2.
Pitkänen, K., Mielke, J.H. & Jorde, L.B. (1989): "Predicting Smallpox Epidemics: A Statistical Analysis of Two Finnish Populations", *American Journal of Human Biology*, No. 1.
Pitkänen, K., Mielke, J.H. & Jorde, L.B. (1989): "Smallpox and its Eradication in Finland: Implications for Disease Control", *Population Studies*, No. 43.
Sundin, J. & Tedebrand, L-G. (1981): "Mortality and Morbidity in Swedish iron Foundries, 1750-1875", in Brändström, A. & Sundin, J (eds.), *Tradition and Transition: Studies in Microdemography and Social Change*. Umeå.
Sogner, S. (1979): *Folkevekst og flyttning*. Oslo.
Thomson, A. (1960): *Barnkvävningen. En rättshistorisk studie*. Lund
Turpeinen, O. (1977): "Causal Relationship between Economic Factors and Mortality", in *Yearbook of Population Research in Finland*. Vol. XV.
Turpeinen, O. (1978): "Infectious Diseases and Regional Differences in Finnish Death Rates 1749-1773". *Population Studies*, Vol. 32, No. 3.
Turpeinen, O. (1979a): "Fertility and Mortality in Finland Since 1750", *Population Studies*, Vol. 33, No. 1.
Turpeinen, O. (1979b): "Infant Mortality in Finland 1749-1865", *Scandinavian Economic History Review*, Vol. 27, No. 1.
Turpeinen, O. (1988): "Infant Mortality in Finland 1865-1869", in Brändström, A. & Tedebrand, L-G., *Society, Health and Population During the Demographic Transition*. Umeå.
Utterström, G. (1954): "Some Population Problems in Pre-industrial Sweden", *Scandinavian Economic History Review*, Vol. 2.
Winberg, C. (1975): *Folkökning och proletarisering. Kring den sociala strukturomvandlingen på Sveriges landsbygd under den agrara revolutionen*. Göteborg.
Wrigley, E A (1977): "Birth and Baptisms: The use of Anglican Baptism Registers as a Source of Information about the Numbers of Births in England before the Beginning of Civil Registration", *Population Studies*, Vol 31.

APPENDIX 1. The 16 parishes analysed for this paper.

Parish	Time period age	Number of deaths with specification of age and occupation	
Trosa	1799-1895	2 827	1 743
Locknevi	1798-1899	5 981	4 447
Svinnegarn	1804-1894	2 223	1 426
Fleninge	1801-1890	2 716	1 880
Nedertorneå	1801-1898	8 575	4 868
Ljustorp	1802-1894	4 456	2 924
Attmar	1800-1897	6 936	3 765
Sättna	1796-1895	4 013	2 216
Timrå	1803-1895	5 319	2 979
Selånger	1808-1895	3 333	1 872
Njurunga	1803-1894	7 750	3 956
Indal	1835-1900	3 940	2 012
Hässjö	1802-1902	6 057	3 831
Alnö	1801-1895	5 824	3 234
Tuna	1802-1898	6 245	3 917
Skön	1803-1894	12 157	7 465

Source: The Demographic Date Base, Umeå, Sweden.

Lund Papers in Economic History

1996

50. Lars Pettersson, Läs- och skrivkunnighet och jordbruksomvandling. Om skånska bönder under skiftenas tid. */Education and the Labour Market/*
51. Lars Pettersson & Anders Nilsson, Vocational Education and the Development of Knowledge in Sweden during the Post-war Period. Presentation of a Research Programme. */Education and the Labour Market/*
52. Christer Lundh, Youth Migration in a Life Cycle Perspective. */Population Economics/*
53. Martin Klinthäll, Utvandring från Turkiet 1961-1990. En studie av selektionsprocessen. */Population Economics/*
54. Jonas Ljungberg, European Market Integration and the Behaviour of Prices, 1850-1914. */General Issues/*
55. Göran Ahlström, On the Diffusion of Technology. The Role of International Exhibitions in the 19th Century. */General Issues/*
56. Neelambar Hatti, The Rule of Law and Dharma in Early 19th Century South Indian Villages: Panchayat adjudications recorded in the Yelandur Kaditas. */General Issues/*
57. Christer Lundh, Flexible Working Hours in Agile Companies. A Discussion of Recent Trends in the Swedish Labour Market in an Economic Structural Perspective. */General Issues/*
58. Ellen Carlsson, Small Holder Dairy Farming - An Aspect of Farm Intensification. The Case of Arumeru District, Tanzania. */Development Economics/Minor Field Studies/*

1997

59. Jonas Olofsson, Arbetsmarknadens Yrkesråd. Parterna och yrkesutbildningen 1930-1970. */Education and the Labour Market/*
60. Christer Lundh, The World of Hajnal Revisited. Marriage Patterns in Sweden 1660-1990. */Population Economics/*
61. The Department of Economic History at Lund University. A Bibliography 1945-1996. */Special Issue/*
62. Martin Andersson, Albert O Hirschman observerad. */General Issues/*
63. Lars Pettersson, Den svenska modellen på central och lokal nivå - om industriell yrkesutbildning och kunskapsproduktion. */Education and the Labour Market/*
64. Karin Steen, Women and Land Rights in Zimbabwe's Agricultural Development. */Development Economics/Minor Field Studies/*

1998

65. Annika Nilsson, Economic, Environmental and Social Impacts from Shrimp Farming and Coffee Cultivation in Nicaragua. */Development Economics/Minor Field Studies/*

1999

66. Tommy Bengtsson & Christer Lundh, Child and Infant Mortality in the Nordic Countries Prior to 1900. */Population Economics/*

Lund Papers in Economic History are published by the Department of Economic History, Lund University, Sweden. This series replaces the former series under the title *Meddelande från ekonomisk-historiska institutionen, Lunds universitet*. The change of name reflects the orientation of the series towards an international readership. The series is multilingual, but the majority of the working papers appear in English.

Lund Papers in Economic History include papers in the following topic areas:

General Issues
Development Economics
Education and the Labour Market
Population Economics

Lund Papers in Economic History are published as occasion arises, not at fixed intervals. Printed issues are distributed to libraries. From 1999 and onwards, full-text issues are also available on *www.ekh.lu.se.* Those who would be interested in receiving information by email on new issues of **Lund Papers in Economic History** are requested to send an email message to *Lund.Papers@ekh.lu.se.*

LUND
UNIVERSITY