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# Social Differences in Infant Mortality in 19th Century Rostock

## A Demographic Analysis Based on Church Records

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**Abstract:** The article examines the historical development of infant mortality in the Hanseatic city of Rostock, with a special focus on the question of how socio-economic factors influenced infant mortality in the early 19th century. Compared with the rest of Germany, the city exhibited an exceedingly low infant mortality level, in particular in the first third of the century. Our analyses show that the occupation of the father had a significant influence on the survival probability of a child in the first year of life in the early 19th century. Newborn children of fathers in lower ranked occupations exhibited a greater mortality risk in the first year of life than the offspring of fathers with occupations of higher status. The analyses are based on the registries of burials and baptisms of St. James's Church *(Jakobikirche)* in Rostock, which are largely preserved and much of which has been digitalised. Based on these individual data, this is the first event history analysis model conducted in the context of infant mortality in a German city in the 19th century. This article is also the first to reveal Rostock infant mortality rates for the entire 19th century according to sex, thus closing two research gaps.

**Keywords:** Infant mortality · Rostock · Historical demography · Church records · Event history analysis

## 1 Introduction

The analysis of infant mortality is an important element of mortality research. In the late 19th century, in some German regions more than one third of all live births did not survive the first year of life (*Würzburg* 1887, 1888; *Prinzing* 1900). Thus, infant mortality substantially determined the overall mortality rate. Today, according to the Federal Statistical Office (31.12.2013), the infant mortality rate in Germany is only 3.3‰. Due to its low level and minor variation, infant mortality has largely lost its influence on the average life expectancy. The rise in life expectancy in the first half of the 20th century in Germany was mainly caused by the decline in infant mor-


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tality and was significantly responsible for the introduction of the first demographic transition.

There are many studies about the development and the determinants of infant mortality in the 19th century. Nonetheless, some German regions have not yet been sufficiently covered by research and not all influencing factors and causes for regional differences have been clarified (*Imhof* 1981; *Gehrmann* 2000, 2011; *Kloke* 1997). This is mainly due to the focus of interest in research and differing methods and definitions. While today there are internationally comparable classifications for stillbirths and live births,[1] this was not always the case in the past. A number of questions have been left unanswered. What role does the documentation of deaths and births before and after baptism play? How do different levels of education and different religions affect registration? When is a stillbirth documented? Since when have what variables been recorded in the context of infant mortality?

Mecklenburg-Schwerin is a region that was distinguished in the 19th century by particularly low infant mortality and high life expectancy compared to other regions in Germany (*Dippe* 1857). The historical demographic data for the region of Mecklenburg-Schwerin is very favourable. Historical population data have been registered going back to the 19th century as individual data in the form of household lists for a number of censuses for the entire region. Church records have also been almost completely preserved. This provides us with individual data to document demographic events. However, using this kind of data for research requires considerable effort since the existing sources must first be digitalised.[2]

Sources of information on infant mortality in the respective local context have existed since the introduction of church records. Analyses on mortality on the basis of church records were conducted, for example, by *Halley* (1693), *Kundmann* (1737), *Süßmilch* (1761), *Blayo* (1975), *Wrigley* and *Schofield* (1981), *Schultz* (1991), *Gehrmann* (2000, 2011), *Johansson* (2004, 2009) and *Breschi et al.* (2014), whereby *Gehrmann* not only uses church records as a data basis, but also all other available sources concerning population statistics.

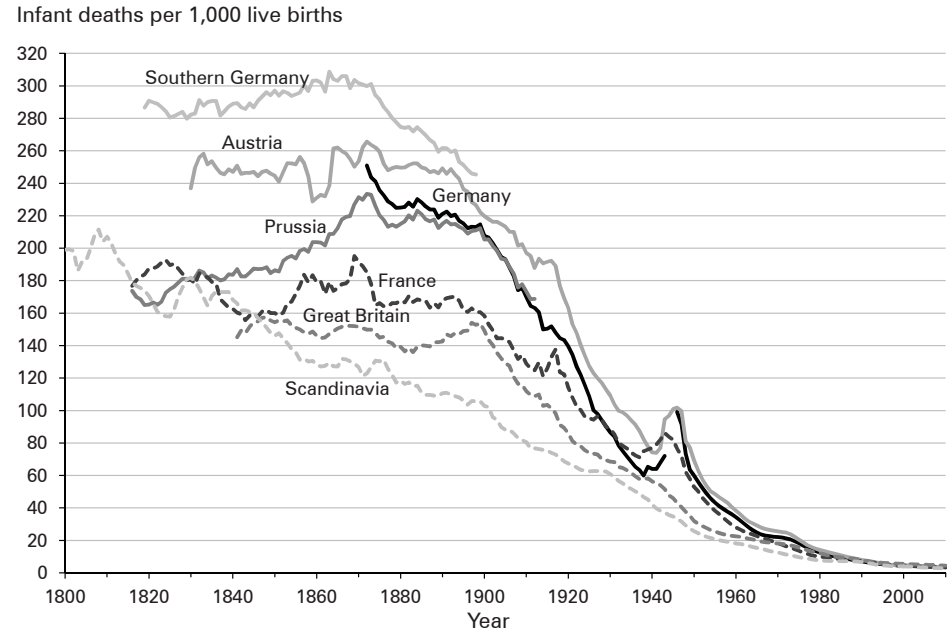
Only the introduction of official statistics makes comprehensive statistical statements possible for entire regions. The first country to begin to document demographic events at the national level was Sweden in the year 1751. The other European countries followed its lead beginning in the mid-19th century (*Westergaard* 1932; *Hollingsworth* 1969; *Rödel* 1990; *Ehling* 1996). Comparable data for Germany

1 Classifications in Germany: A live birth means that at least one of three vital signs occurs (breathing, pulsation of the umbilical cord or heartbeat). If none of these are observed, but the birth weight is at least 500 g the birth is considered a stillbirth. If none of the characteristics occurs and the birth weight is under 500 g, the birth is considered a miscarriage, which is not registered (Deutsche Verordnung zur Ausführung des Personenstandsgesetzes (Kapitel 5, § 31)).

2 Notable for Mecklenburg-Schwerin is the census of 1819, including the city of Rostock and its analysis. This is the pilot project Mecklenburg in the Demographic Transition of the 18th and 19th Centuries (title translated by CPoS). In addition, various research findings on the urban population and social history at the beginning of the 19th century were provided by Rostock historians (*Krüger/Kroll* 1998; *Krüger* 1998, 2000, 2003; *Manke* 2000, 2005a/b).

on regional infant mortality rates cannot be obtained until 1875 through the foundation of the empire and the establishment of the Imperial Statistical Office (*Westergaard* 1932: 239). The development of infant mortality rates for selected countries is shown in Figure 1. In Scandinavia, a decline in infant mortality can be observed throughout the entire period. In the other countries the decline did not begin until the late 19th century, since industrialisation and accompanying urbanisation at first caused a decline in the survival probability of infants. The 20th century brings a strong decline and levelling off at a very low level. Figure 1 also shows the rise in infant mortality during the two World Wars and the post-war period.

**Fig. 1:** Infant mortality in selected European countries, 1800-2010 (moving 5-year average)



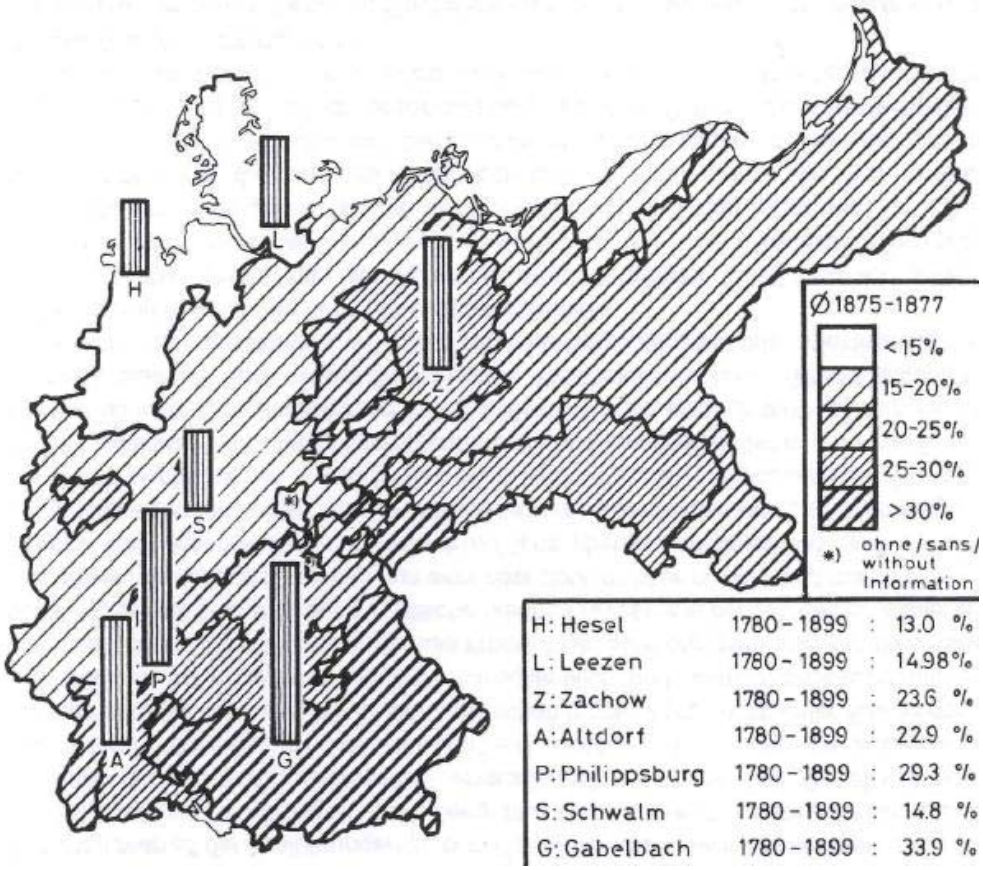

Notes: Scandinavia consists of the countries of Sweden (from 1800), Denmark (from 1835) and Norway (from 1846); Great Britain consists of England and Wales (from 1841) and Scotland (from 1855); Southern Germany consists of Bavaria (from 1819), Saxony (from 1831), Baden (from 1852), Württemberg (from 1859 as well as 1819-1822 and 1847-1856) and the Grand Duchy of Hesse (from 1863); Prussia (from 1816) in its 1866 borders.

Source: Human Mortality Database (for Austria from 1947, France, Scandinavia and Great Britain), Federal Statistical Office (for Germany), *Gehrmann* 2002 and 2011 (for Prussia), *Gehrmann* 2011 (for Southern Germany) and *Mitchell* 2007 (for Austria until 1946); own calculations using the calendar year method.

The difference in infant mortality rates between Prussia and the south of Germany also indicates the considerable north-south divide that existed in the 19th century in Germany. Generally, the Baltic Sea region had a comparatively low infant

mortality rate. This applies not only to countries like Sweden and Denmark, but also to the German Baltic regions of Schleswig, Holstein, Mecklenburg and Pomerania. The survival rates of small children in the 19th century were not only better in the north than in the south, but also tended to be better in the west than in the east. Infant mortality was lowest in the northwest and highest in the southeast. The primary cause is assumed to be the frequency and duration of breastfeeding which was differently distributed across the regions, both between northern and southern Germany as well as between the urban and rural areas (*Gehrmann* 2000, 2011; *Imhof* 1981; *Kintner* 1985; *Knodel* 1968, 1988; *Prinzing* 1900). The first regional studies by the Imperial Statistical Office on infant mortality (Fig. 2) in Germany in the period of 1875 until 1877 reveal an infant mortality rate of over 30 percent in Bavaria and Swabia, while it was below 15 percent in East Frisia and Schleswig-Holstein.

**Fig. 2:** Regional infant mortality rates in Germany 1875-1877 including selected places: Hesel, Leezen, Zachow, Altdorf, Philippsburg, Schwalm and Gabelbach 1780-1899 (micro study)




Source: Official regional data: *Würzburg* (1887), micro study: *Imhof* (1981); diagram: *Imhof* (1981)

One factor often mentioned in the literature with regard to regional infant mortality differences is confessional affiliation and the related differences in value orientation. The north of Germany was largely Protestant whereas the south is predominantely Catholic. It is interesting that infant mortality in mostly Protestant Franconia was considerably lower than in neighbouring Catholic Bavaria (*Imhof* 1981; *Prinzing* 1900). Seasonal weather events were also different from region to region and thus had different impacts on infant mortality, particularly with regard to non-breastfed children (*Prinzing* 1899; *Stöckel* 1986).

Moreover, in many parts of Germany infant mortality was higher in the cities than in rural regions (*Spree* 1988; *Gehrmann* 2002; *Prinzing* 1900). While infant mortality in rural areas was significantly correlated with living and working conditions there, the higher level in the cities was caused by the arising processes of urbanisation and industrialisation. These differences declined, however, towards the end of the 19th century and at the beginning of the 20th century shifted in favour of the cities, which can be ascribed to the improvements to nutritional, hygienic and housing conditions that began in the cities (*Gehrmann* 2011; *Imhof* 1981; *Prinzing* 1899, 1900; *Stöckel* 1986).

The Rostock paediatrician Hermann Brüning rendered outstanding services to the analysis of infant mortality rates in Rostock and Mecklenburg. He ascertained an infant mortality rate of 15.1 percent for legitimate and 24.2 percent for illegitimate live births in the city of Rostock between 1901 and 1905 (*Brüning* 1908: 375). He also discovered a correlation between social class and infant mortality, with a higher mortality in low social classes.

Our study examines the extent to which social differences are revealed in infant mortality rates in Rostock's St. James's church congregation at the beginning of the 19th century. A systematic investigation of the historic demographic sources of births and deaths in the church records in the 19th century enables us to conduct analyses that were not possible until now[3] due to the lack of digitalised sources.[4]

We specifically focus on the influence of a birth's legitimacy and that of the father's occupation. We assume that the infant mortality rate of children born within marriage is lower than those born illegitimately and that those infants whose fathers have a low occupational status exhibit an increased mortality risk compared to newborns with occupationally better situated fathers.

The influencing factors of mortality change over the first year of life (*Brüning* 1928; *Brüning/Mahlo* 1929; *Imhof* 1981). While mortality in the first thirty days after birth is still greatly determined by the development of the foetus during the mother's pregnancy and problems during childbirth, environmental influences be-

3 *Mühlichen* (2011), Master's thesis, University of Rostock.

4 For two years, the state of Mecklenburg-Western Pomerania funded the Rostocker Forschungsverbund Historische Demografie, a cooperation of the University of Rostock and the Max Planck Institute for Demographic Research. The project digitalised the original handwritten sources of the Mecklenburg-Schwerin censuses of the years 1867 and 1900 as well as selected demographic events (births, deaths, marriages) from Rostock church records in the period between 1800 and 1900.

come increasingly important in the following eleven months. Therefore, all analyses are conducted separately for the first thirty days of life and for the ensuing eleven months.

## 2 Historical findings on the influence of socio-economic differences on infant mortality rates

The influencing factors on infant mortality in the 19th century are manifold and difficult to distinguish from one another since they are sometimes mutually dependent. Regional differences in infant mortality were far greater in the 18th and especially in the 19th century in Germany than they are today; however a comprehensive explanation of these differences has not yet been satisfactory because of the difficulties regarding the source material and the complexity of the causes which reach far beyond the field of historical demography (*Ehmer* 2004: 92-94).

In an article based on his own extensive research as well as studies by *Bluhm* (1912), *Krieg* (1890), *Prinzing* (1899, 1900, 1931), *Würzburg* (1887, 1888) and others as well as official data, *Imhof* (1981) cites the primary influencing factors. These are the season of birth, region of birth, frequency and duration of breastfeeding, times of crisis, birth legitimacy, birth weight, birth order, family size, child spacing, sex, age of the mother, social class, working, housing, nutritional and hygienic conditions as well as the parents' confession and value orientation.

In the following, we will specifically highlight socio-economic factors, although the behavioural patterns responsible for differences in infant mortality cannot be solely explained by social factors (*Spree* 1980). *Imhof* (1981) and *Gehrmann* (2011), for example, provide a more comprehensive overview of the state of research on other influencing factors in Germany in the 19th century. Our socio-economic factors include birth legitimacy, social class and working conditions.

Birth legitimacy differentiates between whether an infant was born within or outside of marriage. This factor is highly significant since a far higher mortality rate in infancy among children born out of wedlock is proven by the contemporary population statistics and medical literature (e.g. *Prinzing* 1900; 1911; *Saul* 1909) than among legitimate children. Although some of the unmarried women later legitimized the birth through marriage, they are, however, not the majority (*Prinzing* 1902: 44). The main cause for higher mortality among illegitimate infants was a lack of care caused by the comparatively unfavourable financial situation that forced mothers to go to work and leave the child in the care of confidants or an institution (*Vögele* 1994: 411; *Preston/Haines* 1991: 30). Nevertheless, the influence of legitimacy on infant mortality was rather low compared to the influence of nutritional, working and hygienic conditions (*Kintner* 1994; *Spree* 1998).

The national and international findings differ regarding the influence of the working conditions of fathers and mothers – their occupational class, income and workload – on the mortality of their children in the first year of life. *Bengtsson* and *Lundh* (1994) were unable to find evidence of an effect of real wages on infant mortality in Scandinavia, while for Sweden, *Sundin* (1995) specifically sees the upper class as

profiting at least in times of a particularly rapid decline in infant mortality. By contrast, *Woods et al.* (1988, 1989) and *Haines* (1995) ascertain an influence of social class and income for England and Wales, at least on the rate of infant mortality but less on the time and extent of infant mortality decline in the late 19th and early 20th century. Compared with France, *Woods* (1994) however sees the reasons for the lesser infant mortality rates in England specifically in the more pronounced breastfeeding habits, lower fertility and illegitimacy rates as well as the extensive absence of times of crisis. German contemporaries such as *Prinzing* (1899) and *Hanssen* (1912) also see greater explanatory power in breastfeeding practices than in socio-economic factors, although *Prinzing* (1899: 588) considers the better economic and structural conditions in western provinces the cause at least for the west-east differences in Prussia. *Hanssen* (1912: 8) writes that for Schleswig-Holstein an influence of social class is only measureable for non-breastfed infants. However, observing the neighbouring region of Mecklenburg-Schwerin, *Saul* (1909: 38) finds that infant mortality was higher for children of workers with lower economic status such as day labourers, factory workers and servants compared to financially better situated workers. Women's workloads are also significant. Specifically, infants whose mothers worked in factories showed a lower survival probability, however in 19th century Mecklenburg this was hardly ever the case compared to Germany's industrialised regions. Nonetheless, a mother's involvement in farm work also had negative effects (*Gehrmann* 2011; *Heller/Imhof* 1983; *Prinzing* 1899). Socio-economic factors thus have an indirect effect on infant mortality rates by influencing the breastfeeding behaviour and the quality of nutrition as well as care and welfare (*Imhof* 1981: 359; *Kloke* 1997: 76).

Value orientation is another influencing factor manifested in "regionally, denominationally, socially divergent attitudes of the population towards fertility, towards sexuality, towards health and disease, towards dying and death" (*Imhof* 1981: 366; translated by CPoS). Wars and times of crisis, for example, presumably had a rather negative influence on the appreciation of life and hence infant mortality was relatively high in particular in regions with a high frequency of crises and war (*Imhof* 1981: 367). *Imhof* (1981: 375) identifies two contrary dispositions: the "system of conservation of human life" and the "system of wastage". The former is distinguished by a general appreciation of life, expressed, for example, in lengthy breastfeeding of an infant, while the latter – marked by trauma and times of crisis – meets life with a certain indifference and was more characteristic of the south of Germany than the north. "This indifference was a direct and inevitable consequence of the demography of the period." (*Ariés* 1975: 99; translated by CPoS)

Looking at religious denomination, Protestant regions in southern Germany often feature far lower infant mortality rates than Catholic ones. A good example in this context is the Kingdom of Bavaria (*Prinzing* 1900: 620). As an attempted explanation, *Imhof* (1981: 378-379) cites the notion widespread among Catholics at that time, expressed in the imagination of the so-called *"Himmeln"*: in order to safeguard the survival of at least the older siblings, poor families with many children sometimes neglected the youngest child and even resigned themselves to its death in order to spare it from suffering under the humble circumstances and give it, as

offspring without sin, a place in heaven where it could in turn safeguard a place for its family. Then again, in regions of mixed religions no significant differences could be found in infant mortality rates between the two Christian denominations (*Kloke* 1997: 266). The differences found in Bavaria ought to be seen in the light of the German north-south divide that dominated at that time. In addition, the Protestant town of Laichingen in Württemberg exhibited particularly high rates of infant mortality at a level of at times 40 to 50 percent (*Medick* 1997: 359-365). In the late 19th century there was a similar north-south divide in the Netherlands as well, to the disadvantage of the largely Catholic regions in the south, which can be explained with a considerably lower propensity to breastfeed and greater scepticism towards new ideas for fighting disease and hygienic improvements compared to the Protestant-dominated north (*Wolleswinkel-van den Bosch et al.* 2000).

Therefore, the literature ascribes far greater influence to the regionally different nutritional and breastfeeding habits. For example, *Imhof* (1981: 347-349, 353-354), *Kloke* (1997: 54, 157, 266) and *Gehrmann* (2002: 546) highlight that the survival probability of infants was distinctly better in regions where they were breastfed frequently and for a long time than in regions where this was not the case. "In the northern German villages with low infant mortality rates it appears that almost all mothers breastfed their infants, and did so for a relatively long time; at least for the entire first year. In southern German communities with a high infant mortality, by contrast, the contemporaries already complained that many mothers did not breastfeed their children or only very briefly." (*Ehmer* 2004: 94; translated by CPoS) Especially in the summers, infant mortality increased considerably due to gastro-intestinal diseases caused by the poor supplemental foods that spoiled more quickly in warm weather (*Kloke* 1997). *Lee* and *Marschalck* (2002) ascertained a rise in the mortality of newborns in the city of Bremen between 1861 and 1863 and between 1870 and 1872 in the third, sixth, ninth and twelfth months of life, which they explain by the fact that infants were often weaned at exactly these ages. According to *Imhof* (1981: 373), mothers at that time were often quite aware that breast milk was the healthiest food for infants. The fact that many nonetheless did not breastfeed their babies in many regions could have something to do with a lack of time to care for the child, specifically if the mother was single and working or involved in her husband's work, for example on the farm. The above-mentioned "system of wastage" could also be an explanatory approach, according to Imhof.

At the end of the 19th century, nutritional, as well as hygienic and housing conditions began to improve, leading to a rise in the survival probability of infants, particularly due to the accompanying decline in gastro-intestinal diseases (*Gehrmann* 2011; *Imhof* 1981).

## 3 Data and Methods[5]

This study is based on the newly digitalised registries of burials and baptisms from St. James's church records, which provide the necessary data on births and deaths. St. James's Church was by far the largest of the four Rostock parishes at the time alongside St. Mary's, St. Nicholas's and St. Peter's (*Szołtysek et al.* 2010: 10).[6] In 1905 more than half of Rostock's inhabitants were members of St. James's Church, which led in that same year to the division of the congregation due to the insufficient ability to care for them all, and finally the 1908 completion of the Church of the Holy Spirit in the Kröpeliner-Tor district (*Schulz* 2008: 24). The study is based on a complete survey of all births and deaths in St. James parish in Rostock.

Both the baptism and the burial registry contain full names making individuals identifiable and enabling us to merge the baptism and burial data set to one complete data set. This data merging was conducted for the period between 1815 and 1829 and serves as the data basis for the following analyses. The example in Figure 3 shows the baptism registry entry for Emma Krüger on the left in the second line. She was born in 28 January 1815 and baptised the same year on 5 February. On the right, the burial registry contains an entry in the second line showing that she died on 31 December 1815 and was buried on 5 January 1816. The baptism registry contains further information: the occupation and name of the father and the name of the mother as well as the godparents present at the baptism. In addition to the name and occupation of the father, the burial registry also contains the age upon death and the cause of death. The birthplace is also sometimes cited but only if it was not Rostock. Information about any employment pursued by the mother is not included in the registries.

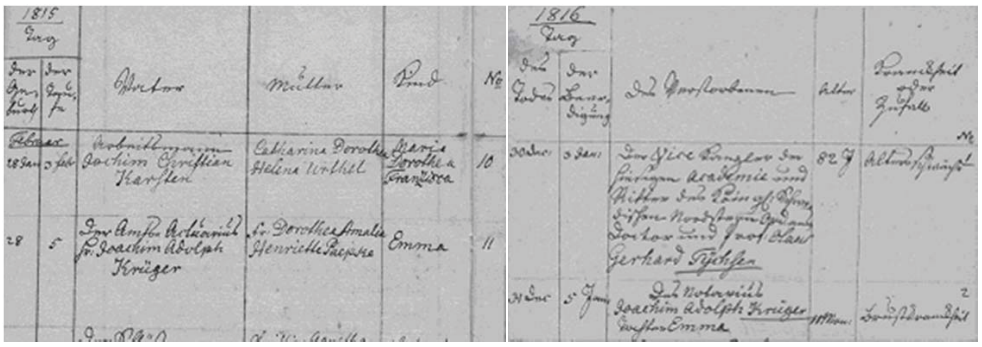
The population at risk for the mortality analyses includes all births registered in Rostock for St. James parish as live births in the studied periods. In-migrating infants who are not included in the baptismal registry of St. James parish, but are listed in the burial registry, are excluded from the analyses (20 cases; 6 percent). We cannot ascertain whether and how many newborns left the city or changed parishes and died in the first year of life. This makes an under-recording of infant mortality possible. Moreover, since there were no uniform procedures in the 19th century how to classify live births and stillbirths we can also not exclude biases based on this.

The mortality intensity in the first year of life is analysed using event history analysis (*Allison* 1984; *Diekmann/Mitter* 1984; *Blossfeld et al.* 1986), whereby the analysis time is measured by the age in days. It begins at the time of birth at the age of 0 days and ends with the death in the first year of life or – in the case of censored

5 See *Mühlichen/Scholz* (2015) for detailed descriptions of the sources and data.

6 As most of northern Germany, the city of Rostock was largely Protestant in the 19th century. Not until 1909 was a Catholic church re-established. St James's, Rostock's largest church at the time, no longer exists. Most of the church was destroyed in 1942 by a British air raid. The remaining structure was razed in 1960 (*Köppe* 2010; *Kuzia* 2004).

**Fig. 3:** Excerpts from the registries of baptisms and burials of St. James parish, Rostock



Source: Baptismal register 1815 and burial register 1816 of the church records of St. James parish, Rostock.

data – with the first birthday and thus exclusion from the population at risk. The age of newborns who survive the first year of life is set at the censored time of 365 days.

Cox proportional hazards models of the form $h(t \mid X)=h_0(t)\cdot e^{\beta x}$ are calculated to ascertain the influence of the newborns' characteristics on their mortality risk. In the calculation, $h_0(t)$ is the semi-parametric baseline hazard, $\beta$ is the parameter to be estimated and $x$ the covariates. The power $e^{\beta}$ is the hazard ratio calculated from the ratio of two compared hazard rates and is considered the relative risk in the interpretation.

The covariates are sex, season of the birth, birth legitimacy and occupation of the father. When the data processing is complete, the data set contains 2,768 live births in the period 1815 to 1829, of which 331, or 12.0 percent, died in the first year of life. There are also 124 stillbirths. The share of stillbirths among all births between 1815 and 1829 is 4.3 percent. Stillbirths are, however, excluded from all analyses and tables.

Sex is categorised as male or female, the seasons of birth are distinguished into spring, summer, autumn and winter. The meteorological categorisation of seasons is used here with spring lasting from March until May, summer from June until August, autumn from September until November and winter from December until February.

The legitimacy of birth is either classified as legitimate or illegitimate. Legitimacy does not have its own column in the registries, but an illegitimate birth can be recognized from notes such as "illegitimate" or "allegedly […] is the father."

In order to operationalise the occupations, we established a new classification based on those of the *North Atlantic Population Project* (NAPP 2013) as well as studies on historical occupational and social structures in the German Baltic Sea region (*Brandenburg et al.* 1991; *Brandenburg/Kroll* 1998, *Lorenzen-Schmidt* 1996; *Manke* 2000). Our classification allows us to both count the frequencies of various types of occupations and to categorise them by employment groups or by social classes (*Mühlichen/Scholz* 2015). Broken down by social class, we have the following main

**Tab. 1:** Deaths, censors, person-years and mortality rate according to the independent variables in the event data set for infant mortality in Rostock in the period 1815-1829

| Variable | Deaths | | | Censors | Person-years | Mortality rate |
|---|---|---|---|---|---|---|
| | Total | 1st month | 2nd to 12th month | | | |
| *Sex* | | | | | | |
| Male | 175 | 67 | 108 | 1292 | 1339 | 0.1307 |
| Female | 156 | 53 | 103 | 1145 | 1191 | 0.1310 |
| Total | 331 | 120 | 211 | 2437 | 2530 | 0.1308 |
| *Season of birth* | | | | | | |
| Spring | 84 | 23 | 61 | 602 | 626 | 0.1341 |
| Summer | 80 | 35 | 45 | 591 | 612 | 0.1307 |
| Autumn | 85 | 33 | 52 | 599 | 621 | 0.1368 |
| Winter | 82 | 29 | 53 | 645 | 670 | 0.1224 |
| Total | 331 | 120 | 211 | 2437 | 2530 | 0.1308 |
| *Father's occupation* | | | | | | |
| High status | 51 | 16 | 35 | 455 | 469 | 0.1087 |
| Medium status | 113 | 43 | 70 | 738 | 768 | 0.1472 |
| Low status | 81 | 32 | 49 | 452 | 474 | 0.1707 |
| Other, unknown | 86 | 29 | 57 | 792 | 819 | 0.1051 |
| Total | 331 | 120 | 211 | 2437 | 2530 | 0.1308 |
| *Legitimacy* | | | | | | |
| Legitimate | 290 | 107 | 183 | 2063 | 2144 | 0.1353 |
| Illegitimate | 41 | 13 | 28 | 374 | 386 | 0.1063 |
| Total | 331 | 120 | 211 | 2437 | 2530 | 0.1308 |

Source: Burial and baptismal registers of the church records of St. James parish, Rostock (own calculations)

groups for the fathers' occupations: 1) high status occupations, 2) medium status occupations, 3) low status occupations and 4) other occupations or unknown. The first category includes merchants, traders, jurists, upper grade civil servants, nobility, physicians, teachers, professors, clergymen, pensioners, brewers and master craftsmen. The second category contains craftsmen, bailiffs, innkeepers and mariners. The third group consists of apprentice craftsmen, servants, porters, field workers, gardeners, fishermen, musicians, sailors, seamen, steersmen, soldiers and the unemployed. The fourth group mostly includes labourers – who are a very heterogeneous group with regard to type of work and financial situation – and fathers of whom nothing is known. Fathers who died prior to the birth as well as "illegitimate" or "alleged" fathers are also included in this category. Almost half of this fourth group therefore coincides with the category "illegitimate" of the legitimacy variable. Illegitimate fathers who married the mother of the child within the observation period are exceptions to this and are recognizable from other mutual birth

entries in the data set. These men are to be found in the class allocated to their occupation (12 cases in total).

Table 1 contains an overview of the covariates and their respective distribution, the number of deaths, censors, risk times and mortality rates. We differentiate between mortality in the first thirty days and between the second and twelfth month. The mortality rate is calculated from the number of deaths in the first year of life divided by the person-years.

All data entries, error corrections and the merging of the baptism and burial data were conducted using Microsoft Excel. We used the statistical programme package SPSS 20 to process the data for the survival analysis. The event history analysis was done using STATA 11.

## 4 Results

Figure 4 shows the development of infant mortality in Rostock's congregation of St. James in the 19th century. The study period of the event history analysis model (1815-1829) is highlighted.[7] Until 1840 the mortality of newborns remains at a roughly constant to slightly declining level. It fluctuates in the studied period of 1815 until 1829 between 104 and 143 deaths per 1,000 live births and is 127.7 for boys and 127.9 for girls, a total of 127.8 for both sexes. Notable sex differences can only be identified from 1830 onwards to the disadvantage of boys. In addition, the level of infant mortality rises considerably from 1840, reaching 219 deaths per 1,000 live births in the year 1858. The causes for this are possibly related to the growth of the population and its consequences on the living, working, nutritional and hygienic situation. After 1858, the infant mortality rate drops again somewhat and fluctuates between 1880 and 1902, stagnating at about 170 deaths.

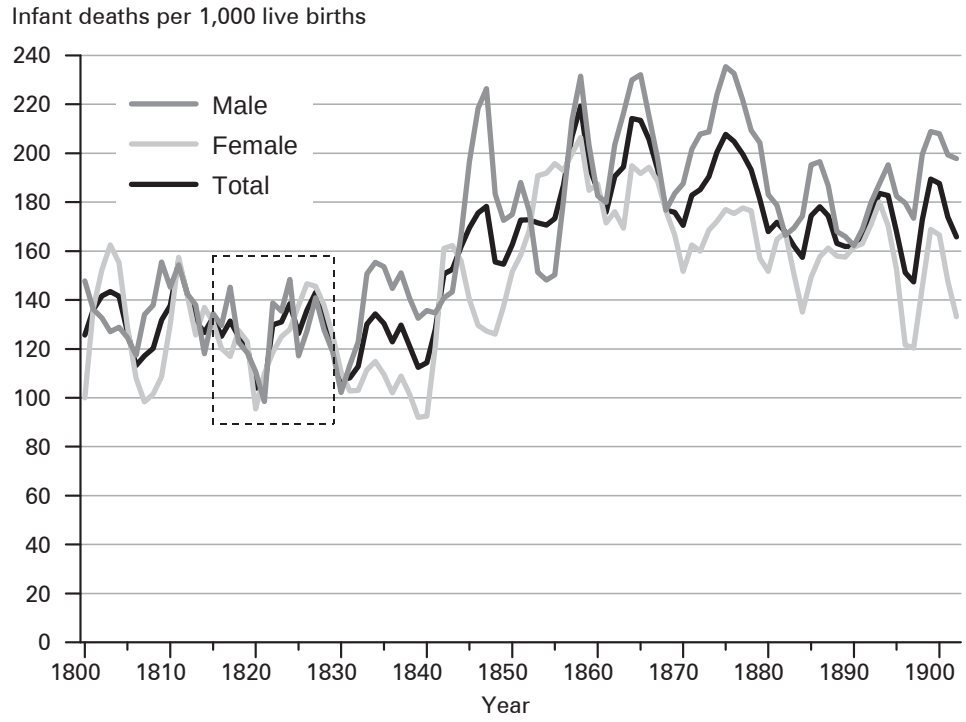
Figure 5 illustrates the Kaplan-Meier survival curves for the two independent variables legitimacy and father's occupation.

Illegitimate births exhibit a better survival curve than legitimate births. 90 percent of the illegitimate-born and 88 percent of the legitimate-born survive their first year of life. We will discuss the causes of this finding in the next chapter.

There are more distinct differences for the fathers' employment groups. In the first year of life, the survival curve for children whose fathers pursue a low-status occupation is clearly poorer compared to the other employment groups (85 percent). The share of survival for children of fathers with a medium-status occupation is 87 percent and for children of fathers with a high-class occupation is 90 percent. The category of infants for whom the father's occupation is unknown or unassignable or the father himself is unknown is also 90 percent. Almost half of the members

7 The 20 in-migrating deaths in the period of 1815 until 1829 are included in this figure in order to portray a continuous time series (no similar data processing was yet done for the years from 1830 onwards, which might allow for the exclusion of further in-migration). These cases are excluded in the ensuing analyses.

**Fig. 4:** Infant mortality* in St. James parish Rostock by sex, 1800-1902 (moving 3-year average)




* For the analysed period 1815-1829, we were able to calculate the infant mortality rate according to the birth year method used by *Becker* (1874) and *Zeuner* (1869). The calendar year method by Böckh (*Esenwein-Rothe* 1982: 241-248) was employed for the remaining years. The deaths in a year t were, however, not assigned to 100 percent, but to 70 percent of the births of the year t and to 30 percent of the births of the year t+1. This weighting appears more realistic after a corresponding evaluation of the years 1815 to 1829. The at times quite sizeable sex differences (e.g. in 1847) may partly be a result of the less precise calendar year method. Because of its cohort approach, the birth year method is more precise, in particular for smaller case numbers.

Source: Burial and baptismal registers from the church records of St. James parish, Rostock (own calculations)

of this group coincide with the "illegitimate" category of the legitimacy variable. Because of this multi-collinearity, we examined the two variables in separate models.

Low case numbers are to blame for the irregularity of the survival curves. Since the curves of the employment groups intersect a number of times, we also assume they do not fulfil the proportionality assumption of the Cox proportional hazards model. The log-log survival plot (Fig. 6) confirms this assumption since the curves do not run parallel to each other. For the sake of comparability, the first step is to ascertain the influence of the covariates on mortality in the entire first year of life (Table 2).

**Fig. 5:** Kaplan-Meier survival curve for the first year of life of infants born in Rostock to the St. James congregation between 1815 and 1829 according to legitimacy (left) and father's occupation (right)

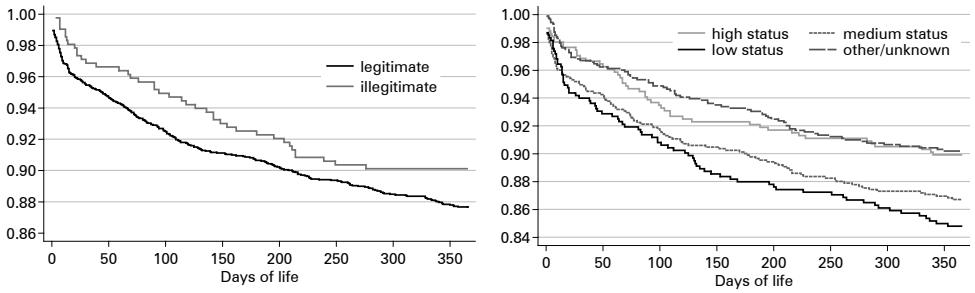
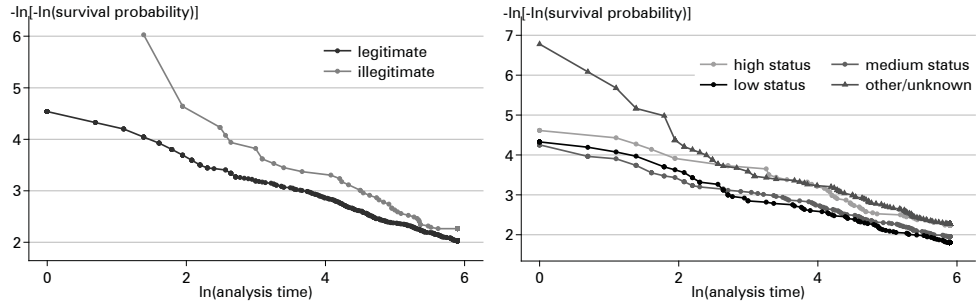



**Fig. 6:** Test of the assumption of proportionality (log-log survival plot) for the independent variables legitimacy (left) and father's occupation (right)




Source: Burial and baptismal registers from the church records of St. James parish, Rostock (own calculations)

The comparison of the four models for the first year of life reveals that gradually adding new independent variables does not alter the relative risks. Legitimacy and the father's occupation are integrated in separate models since half of the category of illegitimate births is identical with the category "other/unknown" occupation of the father.

The employment groups confirm the impression gained from the Kaplan-Meier survival curves (Fig. 6). Compared to the reference group consisting of children of fathers with a high-status occupation, the relative risk of not surviving the first year of life is 34 percent higher for the children of fathers in the medium employment class and 55 percent higher for the children of fathers with a low-status occupation. These differences are significant. The residual category does not differ significantly from the reference group. Going beyond these main groups, the risk among the employment groups of bailiffs, musicians, fishermen, innkeepers, sailors and seamen and field workers is the highest, while it is lowest among the higher ranked civil servants and academics, merchants, labourers and porters. The large group of craftsmen, both master craftsmen and apprentices, can be found in the middle.

**Tab. 2:** Relative mortality risks for live births in St. James parish, Rostock 1815-1829 (population at risk); event: death in the 1st year of life; analysis time: age in days

| Variables and distribution | Model 1: Occupation | | Model 2: Legitimacy | |
|---|---|---|---|---|
| | Only father's occupation | With control variables | Only legitimacy | With control variables |
| *Father's occupation* | | | | |
| High status (RG) | 1 | 1 | | |
| Medium status | 1.35* | 1.34* | *** | *** |
| Low status | 1.55** | 1.55** | | |
| Other, unknown | 0.97 | 0.97 | | |
| *Legitimacy* | | | | |
| Legitimate (RG) | | | 1 | 1 |
| Illegitimate | | | 0.79 | 0.79 |
| *Sex* | | | | |
| Female (RG) | | 1 | | 1 |
| Male | | 1.00 | | 1.00 |
| *Season of birth* | | | | |
| Spring (RG) | | 1 | | 1 |
| Summer | | 0.97 | | 0.98 |
| Autumn | | 1.01 | | 1.02 |
| Winter | | 0.92 | | 0.92 |
| Number of cases (N) | 2768 | 2768 | 2768 | 2768 |
| Events (E) | 331 | 331 | 331 | 331 |
| Risk time (t) in days | 923404 | 923404 | 923404 | 923404 |

* $p \leq 0.1$; ** $p \leq 0.05$; *** $p \leq 0.01$.

RG = reference group

Source: Burial and baptismal registers of St. James parish, Rostock (own calculations)

The relative risk of not surviving the first year of life is 21 percent lower for illegitimate live births than the reference group of the legitimately born. This difference is, however, not significant. For the control variables sex and season of birth the differences between the characteristics are small and not significant.

In the following, we again illustrate the Cox model separately for the first 30 days of life and for the remaining second to twelfth months of life (Tables 3 and 4).

Both tables show increased risks for the medium and low employment classes. However, this finding is far more distinct and significant during the first month (Table 3). The hazard ratio is 62 percent higher for the medium class and 92 percent higher for the lower class compared to the reference group. The residual category does not differ significantly from the reference group in the two periods.

With regard to birth legitimacy, the hazard ratio for the illegitimate-born infants in the first 30 days of life is 31 percent lower than that of the legitimate-born and 15 percent lower in the following period. This difference is, however, not significant.

**Tab. 3:** Relative mortality risks for live births in St. James parish, Rostock 1815-1829 (population at risk); event: death in the 1st month of life; analysis time: age in days

| Variables and distribution | Model 1: Occupation | | Model 2: Legitimacy | |
|---|---|---|---|---|
| | Only father's occupation | With control variables | Only legitimacy | With control variables |
| *Father's occupation* | | | | |
| High status (RG) | 1 | 1 | | |
| Medium status | 1.62* | 1.65* | *** | *** |
| Low status | 1.92** | 1.89** | | |
| Other, unknown | 1.04 | 1.06 | | |
| *Legitimacy* | | | | |
| Legitimate (RG) | | | 1 | 1 |
| Illegitimate | | | 0.68 | 0.69 |
| *Sex* | | | | |
| Female (RG) | | 1 | | 1 |
| Male | | 1.13 | | 1.12 |
| *Season of birth* | | | | |
| Spring (RG) | | 1 | | 1 |
| Summer | | 1.56* | | 1.56* |
| Autumn | | 1.43 | | 1.44 |
| Winter | | 1.21 | | 1.20 |
| Number of cases (N) | 2768 | 2768 | 2768 | 2768 |
| Events (E) | 120 | 120 | 120 | 120 |
| Risk time (t) in days | 923404 | 923404 | 923404 | 923404 |

* $p \leq 0.1$; ** $p \leq 0.05$; *** $p \leq 0.01$.
RG = reference group

Source: Burial and baptismal registers of St. James parish, Rostock (own calculations)

The sex differences are also not significant, but it can be seen that the hazard ratio slightly favours girls in the first and boys in the second period. The seasonal differences are more pronounced in the two chosen periods than in the entire first year of life. For example, the relative risk is significantly increased by 56 percent for the first 30 days for infants born in the summer (Table 3, Model 2) compared to those born in the spring, while the summer births exhibit the lowest risk in the ensuing period.

**Tab. 4:** Relative mortality risks for live births in St. James parish, Rostock 1815-1829 (population at risk); event: death in the 2nd to 12th month of life; analysis time: age in days

| Variables and distribution | Model 1: Occupation | | Model 2: Legitimacy | |
|---|---|---|---|---|
| | Only father's occupation | With control variables | Only legitimacy | With control variables |
| *Father's occupation* | | | | |
| High status (RG) | 1 | 1 | | |
| Medium status | 1.22 | 1.20 | | |
| Low status | 1.38 | 1.39 | | |
| Other, unknown | 0.93 | 0.92 | | |
| *Legitimacy* | | | | |
| Legitimate (RG) | | | 1 | 1 |
| Illegitimate | | | 0.85 | 0.85 |
| *Sex* | | | | |
| Female (RG) | | 1 | | 1 |
| Male | | 0.93 | | 0.93 |
| *Season of birth* | | | | |
| Spring (RG) | | 1 | | 1 |
| Summer | | 0.75 | | 0.76 |
| Autumn | | 0.85 | | 0.86 |
| Winter | | 0.82 | | 0.82 |
| Number of cases (N) | 2768 | 2768 | 2768 | 2768 |
| Events (E) | 211 | 211 | 211 | 211 |
| Risk time (t) in days | 923404 | 923404 | 923404 | 923404 |

* $p \leq 0.1$; ** $p \leq 0.05$; *** $p \leq 0.01$.
RG = reference group

Source: Burial and baptismal registers of St. James parish, Rostock (own calculations)

## 5 Discussion

In St. James, one of the four parishes of the city of Rostock, infant mortality at the beginning of the 19th century was significantly linked to the occupation of the father. The correlation is particularly strong during the first thirty days of life, but tends to remain detectable in the following eleven months. Children of fathers with lower ranked occupations such as lower administrative employees, seamen, fishermen and field workers have the highest risk of dying during their first year of life, while those from the group of higher ranked civil servants, merchants and lawyers, who formed Rostock's elite (*Manke* 2000: 369-370), have the lowest mortality risk. According to the literature cited in the second section, these differences may be linked to the family's economic situation, the mother's nutrition during pregnancy as well as that of the newborns during their first months. In addition, mothers were also

more involved in work on farms and thus had less time to devote to their offspring. The children of seafaring workers also exhibit a comparatively high risk, which can be explained by low incomes and long and frequent absence of the fathers.

Our results with regard to legitimacy are unusual. The literature always provides evidence of increased infant mortality rates among illegitimate births both for Rostock as well as for Germany as a whole, at least in the late 19th and early 20th centuries (e.g. *Brüning/Balck* 1906 and *Brüning/Josephy* 1928 for Rostock as well as *Prinzing* 1902 and 1911 for the German Empire). We could not, however, identify this effect for St. James parish; illegitimate births even tend to have a higher survival probability, even though the effect is not statistically significant. It is possible that some of the unmarried mothers are domestic servants who handed their children over to grandmothers living in the countryside or other intimates or an institution after the baptism or perhaps even returned to the country themselves. *Vögele* (1994) as well as *Preston* and *Haines* (1991) explain this phenomenon with the unfavourable financial situation that forced single mothers to return to work and surrender their child to relatives or institutions. This would mean that respective infant deaths would not have been recorded in St. James. The high numbers of domestic servants among the female population of Rostock would also substantiate this speculation. In the year 1800, at least 30 percent of the age group between 21 and 30 (*Manke* 2000: 336) fit this description. If we further calculate the Cox model only for stillbirths, illegitimate births exhibit a 28 percent higher mortality risk than legitimate births. Although this difference is also not significant, this would be another indication for an underreporting of illegitimate infant deaths caused by out-migration.

The season of birth has a significant influence on survival in the first thirty days, whereby infants born in June, July and August exhibit the highest mortality risk. *Breschi/Bacci* (1997) were able to show for five countries that in the 19th century mortality in the first two years is linked to the month of birth and that this pattern differs between the countries. In Italy, for example, children born in the summer and infants born in the winter in Switzerland had a lower mortality rate. A comparable pattern to that of Switzerland and St. James parish can also be seen in the first year of life in Denmark of the 19th century (*Doblhammer/Vaupel* 2001; *Doblhammer* 2004). Since the effect of the birth month in St. James parish is highly significant in the first thirty days of life, this indicates endogenous factors for infant mortality, which have more to do with the development of the foetus during pregnancy than with exogenous factors such as infectious diseases. Since breastfeeding was more widespread in northern Germany than in the south, the newborns in St. James parish were better protected by the defensive substances in breast milk from seasonal gastro-intestinal and respiratory infections.

We found no significant differences with regard to sex, although the boys have an increased mortality risk in the first 30 days of life, a circumstance in which endogenous factors – specifically the birth weight and the general physical constitution at birth – play decisive roles. This effect reverses, however, in the ensuing months.

Baptism is one of the factors that could not be taken into consideration in this study. Generally, it is one of the strengths of the data set that it contains both information about baptisms as well as dates of births. Cases of unbaptised children were

also recorded in the studied period of 1815 to 1829, but these only include stillbirths. Jews, for example, are also not included in these registries. While the time span between birth and baptism is always only a few days in the studied period, it becomes ever greater towards the end of the 19th century stretching to a few weeks or even months as later cohorts in the church records of St. James parish show. However, children who were expected to die soon after birth were baptised *in extremis*, usually by the midwife, as notes in the burial and baptismal registers illustrate – this applies to both the early as well as the late 19th century.

It is, however, questionable whether the registered stillbirths were actually correct. In the 19th century there had been no fixed definitions for live births and stillbirths. The pastor decided whether a deceased infant had shown any previous signs of life, but we do not know the criteria for such a decision. Looking at the available data set for the period 1815 to 1829 we cannot exclude a correlation with baptism. It is likely that a new-born was only considered a live birth once it has been baptised and when it died without being baptised, it was described as a stillbirth. This could be analysed using other Rostock church records from the same period. This is not, however, verifiable as conventional practice in the second half of the 19th century, at least not for St. James, since the deaths of unbaptised live births are also included in the registries during this time.

In summary, we can state that the available individual data from St. James parish offers new insights into infant mortality of a largely urban population in northern Germany in the early 19th century. This closes a research gap. For further analyses, the studied period would have to be enlarged, both to generate larger case numbers and to be able to examine the chronological development of social differences in infant mortality rates. The latter is of particular interest since infant mortality rates rise again from about 1840 onwards and it is unknown to which extent all social groups are affected by this increase.

Further promising analyses would be possible by merging the data from St. James parish with the 19th century Rostock censuses and the marriage and confirmation registries of St. James. In doing so, additional factors in infant mortality could be added to the analysis, such as those at the household level (*Scholz* 2013). We would thereby gain more information about the parents, such as the date of birth of the mother as well as the father, which was recorded in Rostock's marriage registries from 1853 onwards. There is also information about child spacing, birth order and number of siblings. This would not only make the data interesting for further mortality research, but also for fertility and social structure analyses as well as for genealogical studies.

## References

*Allison, Paul D.* 1984: Event History Analysis. Regression for Longitudinal Event Data. Beverly Hills: Sage Publications.

*Ariés, Philippe* 1975: Geschichte der Kindheit. München: Carl Hanser Verlag.

*Backhaus, Klaus; Erichson, Bernd; Plinke, Wulff; Weiber, Rolf* 2006: Multivariate Analysemethoden. Eine anwendungsorientierte Einführung. 11. Auflage. Berlin: Springer [doi: 10.1007/3-540-29932-7].

*Becker, Karl M. L.* 1874: Zur Berechnung von Sterbetafeln an die Bevölkerungsstatistik zu stellende Anforderungen. Berlin: Verlag des Königlichen Statistischen Bureaus.

*Bengtsson, Tommy; Lundh, Christer* 1994: La mortalité infantile et post-infantile dans les pays Nordiques avant 1900. In: Annales de Démographie historique 1994: 23-43.

*Blayo, Yves* 1975: La mortalité en France de 1740 à 1829. In: Population 30, special issue „Démographie historique": 123-142.

*Blossfeld, Hans-Peter; Hamerle, Alfred; Mayer, Karl-Ulrich* 1986: Ereignisanalyse. Frankfurt: Campus.

*Bluhm, Agnes* 1912: Stillhäufigkeit und Stilldauer. In: *Grotjahn, Alfred; Kaup, Ignaz* (Eds.): Handwörterbuch der Sozialen Hygiene. Vol. 2. Leipzig: F. C. W. Vogel: 570-591.

*Brandenburg, Hajo et al.* 1991: Berufe in Altona 1803. Berufssystematik für eine präindustrielle Stadtgesellschaft anhand der Volkszählung. Kleine Schriften des Arbeitskreises für Wirtschafts- und Sozialgeschichte Schleswig-Holsteins, Vol. 1. Kiel: Arbeitskreis für Wirtschafts- und Sozialgeschichte Schleswig-Holsteins.

*Brandenburg, Hajo; Kroll, Stefan* 1998: „Erwerbsstruktur" und „Beruf". Möglichkeiten und Grenzen einer Berufssystematik für präindustrielle Stadtgesellschaften. In: *Krüger, Kersten; Kroll, Stefan* (Eds.): Die Sozialstruktur der Städte Kiel und Altona um 1800. Demographie, Erwerbsstruktur und wirtschaftliche Leistungsfähigkeit. Studien zur Wirtschafts- und Sozialgeschichte Schleswig-Holsteins, Vol. 29. Neumünster: Wachholtz Verlag: 21-29.

*Breschi, Marco; Bacci, Massimo Livi* 1997: Month of Birth as a Factor in Children's Survival. In: *Bideau, Alain; Desjardins, Bertrand; Brignoli, Héctor Pérez* (Eds.): Infant and Child Mortality in the Past. Oxford: Clarendon Press: 157-173.

*Breschi, Marco et al.* 2014: Social and Economic Determinants of Reproductive Behavior before the Fertility Decline. The Case of Six Italian Communities during the Nineteenth Century. In: European Journal of Population 30,3: 291-315 [doi: 10.1007/s10680-013-9303-8].

*Brüning, Hermann* 1908: Säuglingssterblichkeit im Großherzogtum Mecklenburg-Schwerin in den Jahren 1876-1905. Nach einem Vortrag. Aus der medizinischen Kinderabteilung des Universitäts-Krankenhauses zu Rostock. In: Zeitschrift für Säuglingsfürsorge 2: 367-378.

*Brüning, Hermann* 1928: Über die Frühsterblichkeit der Säuglinge in Mecklenburg-Schwerin in der Zeit vor und nach dem Kriege 1901-1905 und 1921-1925. In: Archiv für Kinderheilkunde 86,1: 1-8.

*Brüning, Hermann; Balck, R.* 1906: Säuglingssterblichkeit in Rostock. In: Zeitschrift für Säuglingsfürsorge 1: 338-355.

*Brüning, Hermann; Josephy, Edith* 1928: Über Säuglingssterblichkeit in Rostock. In: Gesundheitsfürsorge für das Kindesalter 3,2-3: 141-152.

*Brüning, Hermann; Mahlo, Erwin* 1929: Ein weiterer Beitrag zur Frühsterblichkeit der mecklenburgischen Säuglinge vor und nach dem Kriege. In: Archiv für Kinderheilkunde 86,2: 122-140.

*Brüning, Hermann; Stein, Ernst W. M.* 1911: Die Säuglingssterblichkeit im Großherzogtum Mecklenburg-Strelitz. Nebst Bemerkungen über ihre Ursachen und Bekämpfung. In: Zeitschrift für Säuglingsschutz 3: 142-222.

*Diekmann, Andreas; Mitter, Peter* 1984: Methoden zur Analyse von Zeitverläufen. Stuttgart: Teubner.

*Dinkel, Reiner H.* 1984: Sterblichkeit in Perioden- und Kohortenbetrachtung. In: Zeitschrift für Bevölkerungswissenschaft 10,4: 477-500.

*Dippe, Martin C.* 1857: Die lange Dauer des Lebens in Mecklenburg. In: Archiv für Landeskunde in den Grossherzogtümern Mecklenburg 8: 545-562.

*Doblhammer, Gabriele; Vaupel, James W.* 2001: Life Span Depends on Month of Birth. In: Proceedings of the National Academy Sciences of the United States of America 98,5: 2934-2939 [doi: 10.1073/pnas.041431898].

*Doblhammer, Gabriele* 2004: The Late Life Legacy of Very Early Life. Demographic Research Monographs. Berlin/Heidelberg: Springer Verlag [http://www.demogr.mpg.de/books/drm/002/, 24.02.2015] [doi: 10.1007/978-3-662-10349-4].

*Ehling, Manfred* 1996: Historische Statistik. Perspektiven der internationalen Zusammenarbeit. In: Wirtschaft und Statistik 7: 413-421.

*Ehmer, Josef* 2004: Bevölkerungsgeschichte und historische Demographie 1800-2000. München: Oldenbourg.

*Esenwein-Rothe, Ingeborg* 1982: Einführung in die Demographie. Bevölkerungsstruktur und Bevölkerungsprozess aus der Sicht der Statistik. Wiesbaden: Franz Steiner Verlag.

*Gehrmann, Rolf* 2000: Bevölkerungsgeschichte Norddeutschlands zwischen Aufklärung und Vormärz. Schriftenreihe des Forschungsinstituts für die Geschichte Preußens e.V., Vol. 1. Berlin: Berlin Verlag Arno Spitz.

*Gehrmann, Rolf* 2002: Infant Mortality in Town and Countryside: Northern Germany, ca. 1750-1850. In: The History of the Family 7: 545-556.

*Gehrmann, Rolf* 2011: Säuglingssterblichkeit in Deutschland im 19. Jahrhundert. In: Comparative Population Studies – Zeitschrift für Bevölkerungswissenschaft 36,4: 807-838 [doi: 10.4232/10.CPoS-2011-22de].

*Haines, Michael R.* 1995: Socio-economic Differentials in Infant and Child Mortality during Mortality Decline: England and Wales, 1890-1911. In: Population Studies 49,2: 297-315 [doi: 10.1080/0032472031000148526].

*Halley, Edmond* 1693: An Estimate of the Degrees of the Mortality of Mankind, drawn from curious Tables of the Births and Funerals at the City of Breslaw, with an Attempt to ascertain the Price of Annuities upon Lives. In: Philosophical Transactions 196: 596-610.

*Hanssen, Peter* 1912: Die Säuglingssterblichkeit der Provinz Schleswig-Holstein und die Mittel zu ihrer Abhilfe. Kiel: Handorff.

*Heller, Geneviève; Imhof, Arthur E.* 1983: Körperliche Überlastung der Frauen im 19. Jahrhundert. In: *Imhof, Arthur E.* (Ed.): Leib und Leben in der Geschichte der Neuzeit. Berlin: Duncker & Humblot.

*Höfler, Max* 1899: Deutsches Krankheitsnamen-Buch. München: Piloty & Loehle. Nachdruck: Hildesheim: Georg Olms (1970).

*Hollingsworth, Thomas H.* 1969: Historical Demography. Ithaca/New York: Cornell University Press.

*Hosmer, David W.; Lemeshow, Stanley* 2000: Applied Logistic Regression. Second Edition. New York: John Wiley & Sons.

*Imhof, Arthur E.* 1977: Einführung in die historische Demographie. München: C. H. Beck.

*Imhof, Arthur E.* 1981: Unterschiedliche Säuglingssterblichkeit in Deutschland, 18. bis 20. Jahrhundert – Warum? In: Zeitschrift für Bevölkerungswissenschaft 7,3: 343-382.

*Johansson, Kent* 2004: Child Mortality during the Demographic Transition. A Longitudinal Analysis of a Rural Population in Southern Sweden, 1766-1894. Stockholm: Almquist & Wiksell International.

*Johansson, Kent* 2009: Interaction Effects of Infection and Malnutrition on Child Mortality in Scania, Sweden 1766-1894. Conference paper presented at the IUSSP meeting in Marrakech, Maroc 28 September - 2 October 2009.

*Kintner, Hallie J.* 1985: Trends and Regional Differences in Breastfeeding in Germany from 1871 to 1937. In: Journal of Family History 10: 163-182 [doi: 10.1177/036319908501000203].

*Kintner, Hallie J.* 1994: Infant Mortality Decline in Germany, 1871-1925. The Roles of Changes in Variables and Changes in the Structure of Relations. In: Genus 50,3-4: 117-132.

*Kloke, Ines E.* 1997: Säuglingssterblichkeit in Deutschland im 18. und 19. Jh. am Beispiel von sechs ländlichen Regionen. Berlin. Digitale Dissertation [https://www.phf.uni-rostock.de/tthist/kloke/iekloke.pdf, 25.11.2013].

*Knodel, John E.* 1968: Infant Mortality and Fertility in Three Bavarian Villages. An Analysis of Family Histories from the 19th Century. In: Population Studies 22: 297-318 [doi: 10.1080/00324728.1968.10404941].

*Knodel, John E.* 1988: Demographic Behaviour in the Past. A Study of Fourteen German Village Populations in the Eighteenth and Nineteenth Centuries. New York: Cambridge University Press.

*Kölbl, Stefanie* 2004: Das Kinderdefizit im frühen Mittelalter. Realität oder Hypothese? Zur Deutung demographischer Strukturen in Gräberfeldern. Tübingen. Digitale Dissertation [http://tobias-lib.uni-tuebingen.de/volltexte/2004/1152/pdf/diss_a4.pdf, 25.11.2013].

*Köppe, Tobias* 2010: Kirchensprengung und -abriss in der Deutschen Demokratischen Republik. Rostock [http://www.kirchensprengung.de/cms/kirchensprengung_rostock.html, 25.11.2013].

*Krieg, Georg* 1890: Bewegung der Bevölkerung im Königreich Bayern im Jahresdurchschnitt der Periode 1879/88. Mit einleitenden Bemerkungen und Rückblicken auf die vier Jahrzehnte 1838/78. In: *Königlich statistisches Bureau* (Ed.): Beiträge zur Statistik des Königreichs Bayern LVI. München: Lindauer.

*Krüger, Kersten; Kroll, Stefan* (Eds.) 1998: Die Sozialstruktur der Städte Kiel und Altona um 1800. Demographie, Erwerbsstruktur und wirtschaftliche Leistungsfähigkeit. Studien zur Wirtschafts- und Sozialgeschichte Schleswig-Holsteins, Vol. 29. Neumünster: Wachholtz.

*Krüger, Kersten* 1998: Norddeutsche Hafenstädte um 1800: Altona, Kiel, Rostock und Wismar. Ein sozialgeschichtlicher Vergleich. In: Historical Social Research 23,3: 90-128.

*Krüger, Kersten* 2000: Das Gewerbe in Altona und Kiel 1803, Rostock und Wismar 1819. In: *Kaufhold, Karl H.; Reininghaus, Wilfried* (Eds.): Stadt und Handwerk in Mittelalter und früher Neuzeit. Köln/Weimar/Wien: Böhlau: 159-168.

*Krüger, Kersten* 2003: Erwerbsleben in Altona, Kiel, Rostock und Wismar an der Schwelle zur Moderne um 1800. In: *Krüger, Kersten; Pápay, Gyula; Kroll, Stefan* (Eds.): Stadtgeschichte und Historische Informationssysteme. Der Ostseeraum im 17. und 18. Jahrhundert. Beiträge des wissenschaftlichen Kolloquiums in Rostock vom 21. und 22. März 2002. Münster: Lit Verlag: 247-271.

*Kundmann, Johann C.* 1737: Reflexiones über die Kranckheits- und Todten-Listen, mit Medicinischen Anmerckungen begleitet. In: *Kundmann, Johann C.* (Ed.): Rariora Naturæ & Artis item in Re Medica, oder Seltenheiten der Natur und Kunst des Kundmannischen Naturalien-Cabinets, wie auch in der Artzeney-Wissenschaft. Breslau/Leipzig: Ben Michael Hubert: 1248-1312.

*Kuzia, Detlef* 2004: Historische Rostocker Bauwerke. Rostocker Jakobi-Kirche. Reich und doch nicht erste Adresse [http://www.mv-terra-incognita.de/beitraege/denkmale/verlorene/jakobi/jakobi1.htm, 25.11.2013].

*Lee, Robert; Marschalck, Peter* 2002: Infant Mortality in Bremen in the 19th Century. In: The History of the Family 7: 557-583 [doi: 10.1016/S1081-602X(02)00127-6].

*Lorenzen-Schmidt, Klaus-Joachim* 1996: Lexikon historischer Berufe in Schleswig-Holstein und Hamburg. Kleine Schriften des Arbeitskreises für Wirtschafts- und Sozialgeschichte Schleswig-Holsteins, Vol. 2. Kiel: Arbeitskreis für Wirtschafts- und Sozialgeschichte Schleswig-Holsteins.

*Manke, Matthias* 2000: Rostock zwischen Revolution und Biedermeier. Alltag und Sozialstruktur. Rostocker Studien zur Regionalgeschichte, Vol. 1. Rostock: Ingo Koch Verlag.

*Manke, Matthias* 2005a: Einleitung. Die mecklenburgische Volkszählung von 1819. In: *Manke, Matthias* (Ed.): „... dass alle Welt geschätzt würde." Die Einwohner der Stadt Rostock nach der Volkszählung von 1819. Rostock: Ingo Koch Verlag: 7-26.

*Manke, Matthias* 2005b: Die Volkszählungen des Großherzogtums Mecklenburg-Schwerin in den Jahren 1819 und 1867 unter Berücksichtigung der Volkszählung des Jahres 1866. In: Genealogie 54,3-4: 449-468.

*Medick, Hans* 1997: Weben und Überleben in Laichingen 1650-1900. Lokalgeschichte als Allgemeine Geschichte. Veröffentlichungen des Max-Planck-Instituts für Geschichte, Vol. 126. Göttingen: Vandenhoeck & Ruprecht.

*Mitchell, Brian R.* 2007: International Historical Statistics. Europe 1750-2005. Sixth Edition. Basingstoke/New York: Palgrave Macmillan.

*Mühlichen, Michael* 2011: Säuglingssterblichkeit in Rostock im 19. Jahrhundert. Eine demografische Analyse anhand von Kirchenbuchdaten. Masterarbeit an der Wirtschafts- und Sozialwissenschaftlichen Fakultät der Universität Rostock.

*Mühlichen, Michael; Scholz, Rembrandt D.* 2015: Demographic Analyses on the Basis of Church Records: The Case of Infant Mortality in the Hanseatic City of Rostock in the 19th Century. MPIDR Technical Report. Rostock: Max Planck Institute for Demographic Research (in print).

*North Atlantic Population Project (NAPP)* 2013: OCCHISCO. Occupation, HISCO Classification [https://www.nappdata.org/napp-action/variables/OCCHISCO#codes_section, 25.11.2013].

*Paulsen, Christian* 1909: Die Säuglingssterblichkeit in den mecklenburgischen Aushebungsbezirken in den Jahren 1876-1905. Inaugural-Dissertation zur Erlangung der Doktorwürde der medizinischen Fakultät der Universität zu Rostock. Rostock: Adler.

*Preston, Samuel H.; Haines, Michael R.* 1991: Fatal Years. Child Mortality in Late Nineteenth-Century America. Princeton: Princeton University Press.

*Prinzing, Friedrich* 1899: Die Entwicklung der Kindersterblichkeit in den europäischen Staaten. In: Jahrbücher für Nationalökonomie und Statistik 72: 577-635.

*Prinzing, Friedrich* 1900: Die Kindersterblichkeit in Stadt und Land. In: Jahrbücher für Nationalökonomie und Statistik 75: 593-645.

*Prinzing, Friedrich* 1902: Die uneheliche Fruchtbarkeit in Deutschland. In: Zeitschrift für Sozialwissenschaft 5: 37-46.

*Prinzing, Friedrich* 1911: Uneheliche Geburten. In: *Conrad, Johannes* (Ed.): Handwörterbuch der Staatswissenschaften. Jena: Fischer: 34-43.

*Prinzing, Friedrich* 1931: Handbuch der medizinischen Statistik. Zweite, vollständig umgearbeitete Auflage. Jena: Fischer.

*Rödel, Walter G.* 1990: „Statistik" in vorstatistischer Zeit. Möglichkeiten und Probleme der Erforschung frühneuzeitlicher Populationen. In: *Andermann, Kurt; Ehmer, Hermann* (Eds.): Bevölkerungsstatistik an der Wende vom Mittelalter zur Neuzeit. Quellen und methodische Probleme im überregionalen Vergleich. Sigmaringen: Thorbecke: 9-25.

*Saul, Rudolf* 1909: Säuglingssterblichkeit im Großherzogtum Mecklenburg-Schwerin. Inaugural-Dissertation zur Erlangung der Doktorwürde der medizinischen Fakultät der Universität zu Rostock. Rostock: Adler.

*Scholz, Rembrandt D.* 2013: Zur demographischen Entwicklung der Hansestadt Rostock im 19. Jahrhundert. In: *Busch, Michael; Kroll, Stefan; Scholz, Rembrandt D.* (Eds.): Geschichte – Kartographie – Demographie. Historisch-Geographische Informationssysteme im methodischen Vergleich. Geschichte: Forschung und Wissenschaft, Vol. 45. Münster: LIT Verlag: 195-227.

*Schultz, Helga* 1991: Social Differences in Mortality in the Eighteenth Century. An Analysis of Berlin Church Registers. In: International Review of Social History 2: 232-248.

*Schulz, Inga-Marie* 2008: Die Säuglingssterblichkeit in Rostock im Zeitraum 1875-1910. Eine Studie auf Basis der Sterberegister der Kirchengemeinde St. Jakobi. Bachelorarbeit an der Wirtschafts- und Sozialwissenschaftlichen Fakultät der Universität Rostock.

*Spree, Reinhard* 1980: Die Entwicklung der differentiellen Säuglingssterblichkeit in Deutschland seit der Mitte des 19. Jahrhunderts. Ein Versuch zur Mentalitätsgeschichte. In: *Imhof, Arthur E.* (Ed.): Mensch und Gesundheit in der Geschichte. Husum: Matthiessen: 251-278 [doi: 10.1017/S0025727300036115].

*Spree, Reinhard* 1988: Volksgesundheit und Lebensbedingungen in Deutschland während des frühen 19. Jahrhunderts. In: Jahrbuch des Instituts für Geschichte der Medizin der Robert Bosch Stiftung 7: 75-113.

*Spree, Reinhard* 1998: Der Rückzug des Todes. Der epidemiologische Übergang in Deutschland während des 19. und 20. Jahrhunderts. In: Historical Social Research 23,1-2: 4-43.

*Stöckel, Sigrid* 1986: Säuglingssterblichkeit in Berlin von 1870 bis zum Vorabend des Ersten Weltkriegs. Eine Kurve mit hohem Maximum und starkem Gefälle. In: *Ribbe, Wolfgang* (Ed.): Berlin-Forschungen, Vol. 1. Berlin: Colloquium: 219-264.

*Sundin, Jan* 1995: Culture, Class, and Infant Mortality during the Swedish Mortality Transition, 1750-1850. In: Social Science History 19,1: 117-145.

*Süßmilch, Johann Peter* 1761: Die göttliche Ordnung in den Veränderungen des menschlichen Geschlechts, aus der Geburt, dem Tode und der Fortpflanzung desselben erwiesen. Zwote und ganz umgearbeitete Ausgabe. Berlin: Verlag des Buchladens der Realschule.

*Szołtysek, Mikołaj et al.* 2010: Living Arrangements and Household Formation in the Crucible of Social Change. Rostock 1867-1900. MPIDR Working Paper 2010-036. Rostock: Max-Planck-Institut für demografische Forschung.

*Vögele, Jörg P.* 1994: Urban Infant Mortality in Imperial Germany. In: Social History of Medicine 7,3: 401-425 [doi: 10.1093/shm/7.3.401].

*Waldron, Ingrid* 1983: Sex Differences in Human Mortality. The Role of Genetic Factors. In: Social Science and Medicine 17,6: 321-333 [doi: 10.1016/0277-9536(83)90234-4].

*Westergaard, Harald* 1932: Contributions to the History of Statistics. London: P. S. King and Son.

*Wolleswinkel-van den Bosch, Judith H. et al.* 2000: Determinants of Infant and Early Childhood Mortality Levels and Their Decline in The Netherlands in the Late Nineteenth Century. In: International Journal of Epidemiology 29,6: 1031-1040 [doi: 10.1093/ije/29.6.103].

*Woods, Robert I*. 1994: La mortalité infantile en Grand-Bretagne. Un bilan des connaissances historiques. In: Annales de Démographie historique 1994: 119-134.

*Woods, Robert I.; Watterson, Patricia A.; Woodward, John H*. 1988: The Causes of Rapid Infant Mortality Decline in England and Wales, 1861–1921 Part I. In: Population Studies 42,3: 343-366 [doi: 10.1080/0032472031000143516].

*Woods, Robert I.; Watterson, Patricia A.; Woodward, John H.* 1989: The Causes of Rapid Infant Mortality Decline in England and Wales, 1861–1921 Part II. In: Population Studies 43,1: 113-132 [doi: 10.1080/0032472031000143876].

*Wrigley, Edward A.; Schofield, Roger S.* 1981: The Population History of England 1541-1871. London: Edward Arnold.

*Würzburg, Arthur* 1887: Die Säuglingssterblichkeit im Deutschen Reiche während der Jahre 1875 bis 1877. Arbeiten aus dem Kaiserlichen Gesundheitsamte (=Beihefte zu den Veröffentlichungen aus dem Kaiserlichen Gesundheitsamte) 2: 208-222.

*Würzburg, Arthur* 1888: Die Säuglingssterblichkeit im Deutschen Reiche während der Jahre 1875 bis 1877. Arbeiten aus dem Kaiserlichen Gesundheitsamte (=Beihefte zu den Veröffentlichungen aus dem Kaiserlichen Gesundheitsamte) 4: 28-108.

*Zeuner, Gustav A.* 1869: Abhandlungen zur mathematischen Statistik. Leipzig: Arthur Felix.

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