

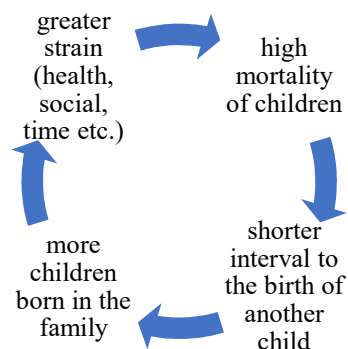
## Where the High infant mortality rate trap might begin?

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### Introduction

Recently the term High infant mortality trap was proposed in historical demographic literature (Fialová et al., 2019) as a representation of more or less known, studied, and discussed relations observed or supposed in historical reproductive processes. Specifically, the term represents a situation, where 1) the inter-birth (or “birth-birth”) intervals are on average shorter because of the death of a child of previous order (influenced by biological as well as behavioral factors), and where 2) the probability of infant death is on average higher for children born after shorter birth intervals. As a result, in families affected by the High infant mortality trap the overall number of births is on average higher in comparison to families with longer birth-birth intervals and lower relative risk of infant death. The main principle of the High infant mortality trap is illustrated in Fig. 1.

**Figure 1:** *The high infant mortality trap – a scheme of the supposed relationship between the mortality at a very early (infant) age and level of fertility (under the assumption that shorter birth-birth intervals generally lead to a higher overall level of fertility)*



**Source:** copied from Fialová et al., 2019

### Motive and aims of the paper

There could a question arise, where this “spiral” of shorter birth intervals leading to higher average number of births in a family and higher relative risk of infant death starts. This could remind us almost the “*chicken or the egg causality dilemma*”. However, the answer could be revealed by the research focused on the risk of death of the first-born children in a family. In accordance to that, the aim of the paper is to analyze the first-born children in a family and evaluate 1) potential factors standing behind the risk of infant death of those children, and 2) potential relation of survival of the first-born child in a family to the overall number of children born in the family.

The previous research (Fialová et al., 2019) was focused only on children of higher order, not the first-born children in a family. This is a common approach in historical demographic research focused on reproductive behavior in a marriage. The reason is found in significantly different approach to reproduction in marriage and factors influencing the timing of the first and later births in a family. Among the children of higher order, the higher risk of infant death was observed for the last-born ones. However, if the first-born children were included into the analysis, the results would be different.

## Theoretical background

The analysis of the first-born children is not very common in contemporary historical demographic research. Results of the analysis of infant mortality of the first-born children in relation to the survival or total number of later siblings in a family are not consistent for every epoch and place. E.g. Cohen (1975) mentions the comparison of situation in England in the 18<sup>th</sup> century (where the decrease in survival with increasing birth order was observed), situation in modern Birmingham (where the risk of infant death was more than twice as high for children of the 4<sup>th</sup> or higher birth order in comparison to the first-born ones), situation in Crulai and Tourouvre (France) in 17<sup>th</sup> and 18<sup>th</sup> century (where infant mortality rates of the first-born children are on average higher than those of later siblings) and situation in Geneva from 16<sup>th</sup> to 20<sup>th</sup> century (where mortality at age 20 was not significantly associated with birth order).

However, some of the observed differences might be biased by the used data or control variables. This was illustrated by Magaud and Henry (1968). From their example it is clear, that the completed sibship has to be taken into account in the model studying the effect of birth order on infant mortality risk. They presented a model situation, where within a family of a given final size the survival rate is identical for all birth orders, but that the larger the family, the lower it is. Then if individuals are sampled at random, there will be an apparent inverse relation between birth order and survival only because higher proportions of the later birth orders will come from larger families. Magaud and Henry (1968) cite a 1906 study of Statistique General de la France which proved this hypothetical possibility to be real: "*While they were living without either brothers or sisters, the firstborn incurred risks of death dependent on the final future size of the family.*" According to them, there is no significant influence of birth order on infant mortality. The above-mentioned selection problem was treated in the presented study by including the variables of the total number of births in a family as well as birth order both in the models. As will be shown later, the birth order showed to be less significant in the models in comparison to the total number of births in a family. The only exceptions were the first- and last-born children in a family, for which the risk of infant death was significantly higher.

Similar results for the first-born children and their higher risk of death were discovered also for the localities Crulai and Tourouvre. The results partly differ only by the risk of the last-born children in a family. In their case, however, the overall family size did not prove to be significant. In the study of Mishra (2017) the risk of infant death proved to be higher for the first-born ones as well as the last ones in a family. Different results of the risk of infant death of the first-born children observed by various authors may be explored by the influence of different factors. Dong et al. (2016) mentioned the beneficial effect of generation overlap with parents and other older kin (supporting longer survival of the first-borns) as well as the unfavorable potential effect of possible mother absence for the first-borns which cannot be replaced by the alternative care of older siblings. Moreover, for the first-born ones, Siervo et al. (2010) or Swamy et al. (2012) mention the greater risk of diseases and death because of lower average age of mothers, neither mature and experienced enough in mothering, nor economically well ensured. They also discussed the risk of premature birth and on average lower birth weight of the first-born children. The economic aspects or effect of premature births or lower birth weight cannot be studied using the available data for the studied localities. However, all the results presented below were adjusted for the different age of mother at birth of the child, so the pure effects of birth order or total number of births were estimated. On the other hand, the explanation of higher risk of infant death by lower level of experiences of the mothers of first-borns could be considered also in the studied localities. Potentially, this could be eliminated by the previous care for younger siblings before the birth of own children, but there are no data available for such a study at this moment.

Based on the mentioned studies, it could be concluded, that although the results differ in general, the risk of infant death might be expected to be different (from other siblings) for the first-born or last-born ones in a family. The on average higher risk of infant death in the studied populations was

already proved for the last-born children in a family (Fialová et al., 2019). The current study focuses above all on the first-born ones and the relation of their risk of infant death to the overall family size (total number of births observed in the family).

### **Data used in the analysis and studied localities**

The analysis uses data from two localities that are relatively well covered with reliable data for the period prior to the onset of the demographic transition (mostly the 18<sup>th</sup> century). These localities are Jablonec (Gablonz), an industrial town, and Stružinec, an agricultural-industrial village. Both localities are located in northern Bohemia. Historically they differed by their ethnic composition – the population of Jablonec was mostly German, population of Stružinec was Czech. As it was proved already (e.g. Fialová et al., 2019), both the localities differed significantly in some aspects of reproductive behavior. The data sets contain records from the parish registers and started to be completed already in 1970s (Wovková, Fialová, 1995; more description in Fialová et al., 2019). The dataset used in the analysis contained 1,954 families with at least one observed child – 1,236 in Jablonec and 718 in Stružinec.

### **Analysis and selected results**

The first step of the study was the analysis of infant mortality. In the analysis, 7,833 cases (children born in a marriage) were used, 1,655 (21.1%) of them died during the first year of life. All the birth orders were considered and only the spinster/bachelor marriages were used in the model (moreover, only cases where the age of mother at marriage as well as at birth of the child was at least 15 and lower than 50 were used, more detailed description of the data set is included in Fialová et al., 2019). The binomial logistic analysis was used (the explained variable had two values only – the child survived/not survived the infant period).

It was confirmed, that more variables are significant in a model – e.g. the risk of infant death is slightly lower if the age of mother was between 20–24 years in comparison to the age category of 30 and more years (other age categories were not statistically significant in the model)<sup>1</sup>, the risk of infant death was almost double in families where 10 or more children were born in comparison to families where only 4–5 children were born (reference category). Also, the risk of infant death was slightly higher for boys, what could be expected. According to the birth order of the studied child, the risk of infant death of the first-born child in a family was similar to the risk of the last child in the family. In other words, the risk of infant death of the first-born child in a family was on average higher in comparison to all other birth orders, except for the last child in family.

The second step of the analysis was already focused solely on the first-born children in a family. In relation to the issue of High infant mortality trap, it was proved that in families, where the first-born children died at the infant age, the overall number of births (realized after the first-born one) was on average significantly higher and also that for the children of higher birth order the risk of death was higher. This might be potentially taken as the beginning of the High infant mortality trap spiral, where already the destiny of the first child in a family foreshadows the vulnerability of the following children born to the same parents.

For this analysis 968 cases (first-born children) were available, 183 (18.9%) of them died during the infant period. As it was stated above, the relation of the infant death of the first-born child in a family was significant only to the overall number of births in the same family (and locality – in Stružinec the risk of infant death of the first-born children was on average higher in comparison to the town of Jablonec).

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<sup>1</sup> All the analyses presented here are based on the 5% level of significance.

The relation of the infant death of the first-born children to the overall number of births in the family was not straightforward neither. The only statistically significant difference was observed for the category of 10 or more children born in a family (where the risk of infant death of the first-born child was nearly double in comparison to families where only 4–5 children were born). The differences for other categories were not statistically significant in this model.

## Conclusion

For completeness of the analysis, the model was repeated only for children of higher birth order (as presented e.g. by Fialová et al., 2019). However, in the model one variable was added – the identification whether the first-born child in the family survived during the first year of life or not. Again it was proved, that the risk of infant death of the studied children was significantly related to the overall number of births in the family, it was also higher for the last child in a family and also the infant death of a child of previous order led to the increase of risk of infant death of the studied child. As it could be expected, the sex of the studied child was significant in this model too, as well as the locality. Moreover, the infant death of the first-born child in a family proved to be statistically significant. On average, the risk of infant death of any child in a family of second or higher birth order was by some 27% higher if also the first-born child in a family died.

We suppose that these issues deserve more attention in the historical demographic research and may even contribute to the knowledge of current needs and possibilities of family planning and population policy programs in developing populations.

## References

- Cohen Joel E. (1975) Childhood mortality, family size and birth order in pre-industrial Europe. *Demography* 12 (1), p. 35–55.
- Dong Hao, Manfredini Matteo, Kurosu Satomi, Yang Wenshan & James Z. Lee (2017) Kin and birth order effects on male child mortality: three East Asian populations, 1716–1945. *Evolution and Human Behavior* 38, p. 208–216.
- Ludmila Fialova, Klara Hulikova Tesarkova & Barbora Janakova Kuprova (2019) The ‘high infant mortality’ trap’: the relationship between birth intervals and infant mortality – the example of two localities in Bohemia between the 17th and 19th centuries, *The History of the Family*, DOI: [10.1080/1081602X.2019.1650792](https://doi.org/10.1080/1081602X.2019.1650792)
- Magaud Jacques and Louis Henry (1968) La Rang de Naissance dans les Phénomènes Démographiques. *Population* 23 (5), p. 879–920.
- Mishra S. K., Ram Bali, Singh Abhishek & Awdhesh Yadav (2018) Birth order, stage of infancy and infant mortality in India. *Journal of Biosocial Science* 50 (5), p. 604–625.
- Siervo Mario, Horta Bernardo, Stephen Blossom, Victoria Cesar & Jonathan Wells (2010) First-borns carry a high metabolic risk in early adulthood: evidence from a prospective cohort study. *PLoS One* 5 (11). DOI: [10.1371/journal.pone.0013907](https://doi.org/10.1371/journal.pone.0013907)
- Swamy G., Edwards S., Gelfand A, James S. A. & M. L. Miranda (2012) Maternal age, birth order, and race: differential effects on birthweight. *Journal of Epidemiology and Community Health* 66, p. 136–142.
- Wovková Walburga & Ludmila Fialová (1992) Plodnost vdaných žen v Jablonci nad Nisou do roku 1800. *Demografie* 34, s. 223–234.