

# Risk Families and the Unequal Distribution of Deaths in France and Sweden during the 19<sup>th</sup> Century

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## Abstract

In the past, high levels of infant and child mortality were the main responsible of low levels of life expectancy at birth. During the last decades, several studies have highlighted the fact that in some historical as well as in some contemporary populations, infant and child deaths are concentrated in a reduced number of families (e.g. Das Gupta 1990; Zaba and David 1996; Willführ and Gagnon 2012). This phenomenon, known as 'death clustering', implies that the risks of experiencing infant and child deaths are unequally distributed among the families in a population. This finding stresses the need of shifting the attention from single individuals to families as the appropriate units of analysis in the study of infant and child mortality (Edvinsson and Janssens 2012). In the present study, we use aggregate mortality data as well as two reliable sources of historical microdata from Sweden and France in order to calculate comparable measures of the concentration of infant and child deaths in different subpopulations, and to examine the impact of the factors affecting the unequal distribution of those deaths. The measures of death clustering in different subpopulations will be illustrated with Lorenz curves, where the observed distributions of deaths will be compared with the corresponding expected binomial distributions. The impact of several factors affecting the distribution of infant and child deaths within families will be analysed with logistic regression, with the mothers as the units of analysis. We expect to find higher levels of death clustering in populations with high mortality. Furthermore, we expect the distribution of deaths to be determined by differences in various biological as well as social characteristics of the mother, in particular the length of the birth interval, the total number of births, and the parental care.

## Extended abstract

In the past, high levels of infant and child mortality were the main responsible of low levels of life expectancy at birth. During the last decades, several studies have highlighted the fact that in some historical as well as in some contemporary populations, infant and child deaths are concentrated in a reduced number of families (e.g. Das Gupta 1990; Guo 1993; Zaba and David 1996; Edvinsson et al. 2005; Willführ and Gagnon 2012; van Poppel et al. 2012). This phenomenon, known as 'death clustering', implies that the risks of experiencing infant and child deaths are unequally distributed among the families in a population. This finding stresses the need of shifting the attention from single individuals to families as the appropriate units of analysis in the study of infant and child mortality (Edvinsson and Janssens 2012). According to Zaba and David (1996), "by bringing the health status of those at the bottom end of the distribution closer to those at the top, the overall level of health in a population can be improved and the mean distribution shifted upward" (p. 278). Hence, identifying the factors that explain the distribution of risks among families is fundamental in order to understand the differences in health and mortality within and between populations.

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Taking the previous considerations into account and in the light of the historical rise in life expectancy at birth, which started during the late-18<sup>th</sup> century in some countries (Vallin and Meslé 2009), the present study aims to explore the association between different levels and distributions of infant and child mortality in the context of increasing levels of life expectancy at birth. We will use aggregate mortality data by country (HMD) as well as by *département* (Bonneuil 2005), county or parish (SHiPS). In addition, we will use two reliable sources of historical microdata from Sweden (SEDD) and France (TRA). Based on these data, we will calculate comparable measures of the concentration of infant and child deaths in different subpopulations and we will examine the impact of several factors affecting the unequal distribution of those deaths.

Since one of the advantages of using microdata is the possibility to study the life course of individuals and given our interest in the early phases of the historical rise in life expectancy at birth, our analyses will be limited to the females born during the 19<sup>th</sup> century and their families. Another advantage of using microdata is that it allows breaking-down the analysis of several population phenomena in smaller geographical units than the country level (e.g. at the county level), as well as in smaller units of analysis (e.g. at the household, the family, or the individual level). These are important advantages, since aggregate data at the country level often hides important regional differences and it is not suitable for the study of processes at the micro level. Our choice of Swedish and French populations is based on the availability of long time-series good quality data, as well as on the possibility to compare populations in one country (France) with populations in another country (Sweden), the latter of which often occupied one of the top positions in terms of life expectancy at birth during the 19<sup>th</sup> century (Oeppen and Vaupel 2002; Shkolnikov et al.2011).

In order to perform the analyses mentioned above, we will first illustrate the measures of infant and child death clustering with Lorenz curves, by comparing the observed distribution of deaths in populations that differ in time and space with their corresponding expected binomial distributions (see for instance Willfür and Gagnon 2012). If, for a subpopulation  $x$ , the observed distribution differs significantly from its correspondent expected distribution, then we can assume that there is evidence of death clustering due to some unobserved factors, since “the difference between the two curves represents the amount of concentration that is not due to chance” (Willfür and Gagnon 2012). This first analysis will provide an idea of the magnitude of the inequalities in the distribution of infant and child death risks in the subpopulations studied. However, it will not shed light on the factors affecting and determining those inequalities.

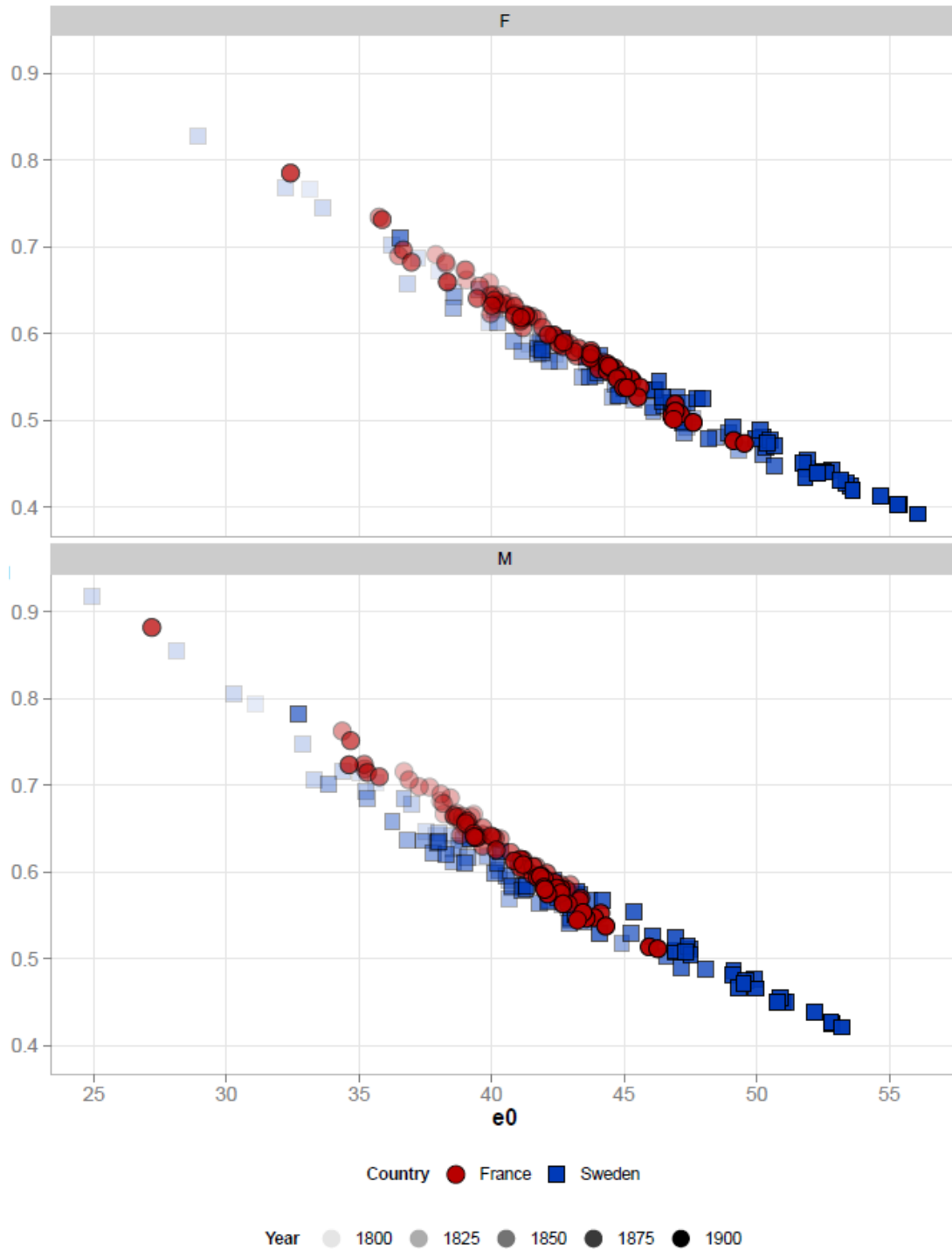
In order to overcome the previous limitation, we will perform a logistic regression analysis where we will try to examine the impact of several bio-demographic and social characteristics on the probability of being a high-risk mother. We define high-risk mothers are those women who, having completed their reproductive careers, experienced more stillbirths, infant, and child deaths than would be expected based on the binomial distribution of deaths for females of the same population and parity. Thus, based on the conclusions of previous studies, we will focus our attention on the family – particularly on the mothers – and not on individual infants and children as the units of analysis. Our dependent variable is an indicator of the fact of having experienced more infant deaths than expected, and the independent variables are: the mother’s average duration between births, her health status, the sex composition of her births, the total number of

marriages she experienced, and an indicator of parental care. We will also control for the following characteristics: the fact for a mother of having undergone the occurrence of war or epidemics during her reproductive life (i.e. between the ages of 15 and 49), her region / town / parish of birth, and the socio-economic status she experienced for longer time during her reproductive career. Given the lack of information in the data sources regarding the exact aspects that we want to investigate, some of the characteristics previously enumerated have to be included in the regression by means of proxies. This is the case of the health status of the mother and the indicator of parental care. These variables will be calculated indirectly, based on other information such as the number of stillbirths and the total number of infant and child deaths experienced by the mother, respectively.

Based on the findings of previous studies, we expect to find higher levels of death clustering (i.e. higher levels of inequality in the distribution of infant and child deaths within families) in populations with high overall mortality. For instance, at the very aggregate level, higher levels of lifespan inequality are found in populations with lower life expectancy at birth. Figure 1 shows the levels of life expectancy at birth and of Keyfitz' entropy – a measure of the inequality in the distribution of lifespans in a population, defined here as the ratio between the average number of life-years lost due to death,  $e\dot{t}$ , and the average length of life,  $e_0$  – for Sweden and for France during the 19<sup>th</sup> century, by sex. The figure illustrates that lower levels of inequality in the distribution of lifespans were achieved during the 19<sup>th</sup> century, as life expectancy at birth increased in both countries, but more in Sweden than in France. However, the measure of inequality illustrated in Figure 1 does not take into account the disparities that exist between families. Besides our expectations regarding the measures of death clustering, we expect the distribution of deaths to be determined by differences in various biological as well as social characteristics of the mother, in particular the length of the birth interval, the total number of births, the parental care, and the region.

We hope that this study will shed light on the association between different levels and distributions of mortality. In fact, despite the findings about the concentration of infant and child deaths within families, on the one hand, and the historical increase of life expectancy at birth (especially in Scandinavia), on the other hand, the association between being a record holder country in terms of average duration of life and the distribution of infant and child deaths has not been explored yet. Comparative research at different levels of analyses and aggregation, as we will do in the proposed study, will contribute to have a better idea of that relationship.

**Fig. 1. Life expectancy at birth and Keyfitz' entropy for Sweden and France during the 19<sup>th</sup> century, by sex**



Source: HMD, 1x1 period life tables by sex

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