Religious differences in cause-specific infant mortality in northern Sweden, 1860-1900

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Introduction

Infant mortality rates in Europe declined rapidly during the 19th century (Schofield et al., 1991). However, not all religious groups benefited equally from this development (Ekamper & Poppel, 2019; la Cour et al., 2006; van den Boomen & Ekamper, 2015; van Poppel et al., 2002). Religious affiliation has been shown to affect infant survival, yet little is known why some religious groups had lower infant mortality than others. We investigated the relationship between religious affiliation and cause-specific infant mortality. Using cause-specific mortality, we estimate and compare infant mortality risks due to different diseases and causes, such as air-, water- and food-borne diseases (Bengtsson & Lindström, 2003). Thus, providing a better understanding of the mechanisms causing religious inequalities in infant mortality during the demographic transition. In this preliminary analysis, we limit the study to all-cause infant mortality.

Aim

The aim of this study was to investigate the association between religious affiliation and cause-specific infant mortality rate. Specifically, we investigated, (1) the association between religious affiliation and infant mortality, (2) associations to water- and food-borne diseases, (3) variations over time 1860-1900

Data

Data was collected from the POPUM database covering Sundsvall region, 1860-1900 (Extraction ID: U210002) consisting of digitalised parish records (Vikström et al., 2002; Westberg et al., 2016). The sample consisted of all children born over the period, 50 417 births, within the 14 parishes surrounding the town of Sundsvall, see Figure 1. We selected information on birthdate, place of birth, date of death, cause of death, last observation date, parental occupation and sex of the children and their parents.
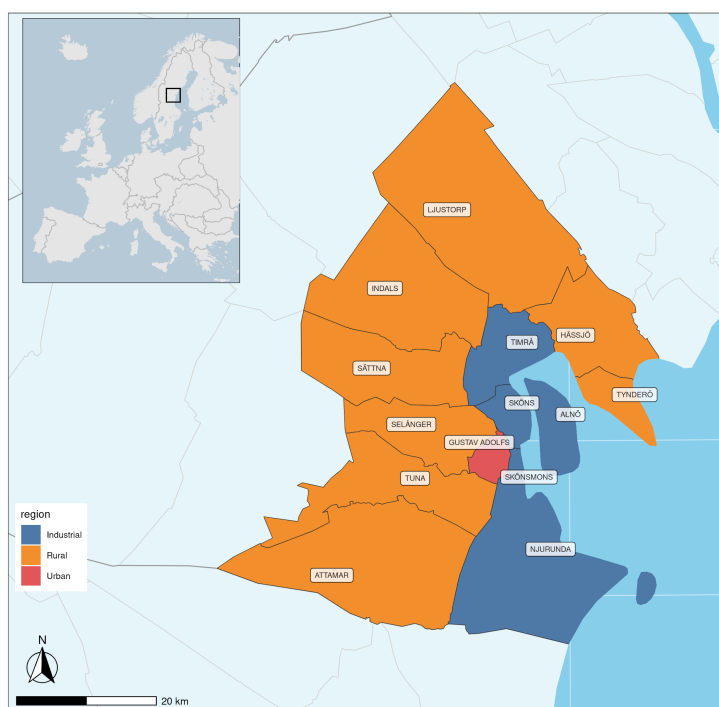
Figure 1: *Map of sample area in 1890*

Cause-of-death

Causes of death were coded using the SHiP system. The SHiP historical cause-of-death coding system is based on the ICD-10 coding system, which allows for systematic and comparative analyses of historical causes of death while retaining information from historical designations.

Religious affiliation

Religious affiliation was identified from notes in the baptism register of whether the child was baptized in the Lutheran state church. Parish records in Sweden, such as baptism registers, cover the total population regardless of religious affiliation. The parish minister was obliged to record whether the parents refused to baptise their child in the Lutheran state church (Kyrkoskrifningskomitén, 1891 §6). The notes contained information such as "Not baptized", "Father refuses to let the child be baptised" or "Mother is a Baptist". The only viable reason for refusing to baptise one's child in the state church, was if the parents had entered another authorized free church, such as the Baptist or Methodist (Bäckström, 1999; Lundkvist, 1977). Thus, any parent that did not baptise their child in the state church, can be considered affiliated with a free church. However, from the notes it is not possible to differentiate between different free church affiliations. Hence the analysis is limited to differentiating between State church and free church affiliates.

Free churches were Christian revival groups that formed their own congregation independently of the Swedish Lutheran state church. The largest groups in the Sundsvall region were the Baptist (established in 1855), the Swedish Missionary Church Methodist (1877), the Methodist Church (1879) and the Salvation Army (1885) (Bäckström, 1999; Lundkvist, 1977). These congregations gathered large numbers in mass baptisms, local meetinghouses and newly built churches (Gustafsson, 1953; Lindberg, 1985). Although expulsions were relatively common in the beginning, the congregations soon formed into stable groups where membership turnover was low (Lundkvist, 1977).

Data on religious affiliation was linked to population data on an individual level using information on first name, date of birth, place of birth and parents date of birth. Record linking was achieved using probabilistic record linkage, stratified by birth year and where names were matched using Levenshtein Distance (Sayers et al., 2016). Of 4,173 registered free church births, 3,391 (81.3 percent) were linked in this preliminary analysis.

Method

We estimated the effect of religious affiliation on infant survival using Cox proportional hazard regressions. Each child was followed for up to one year after birth. Formally we modelled the association between religious affiliation of the parents and survival, adjusting for confounders as:

$$\lambda(t) = \lambda_0(t)e^{X\beta}$$

where the hazard of death $\lambda(t)$ is a function of the baseline hazard $\lambda_0(t)$ represented by age in days and the exponentiated linear predictors $X\beta$. The model matrix X is composed of a civil status indicator, mother's age and calendar time, both specified as cubic splines with three degrees of freedom (Boor, 1978; Hastie, 1991/1997), and β is the corresponding matrix of coefficients. Visual analyses of the proportional hazards and tests of the Schoenfeld residuals supported the proportionality assumption of the Cox models. The models were constructed and evaluated using R and the survival package (R Core Team, 2020; Therneau, 2014).

Preliminary results

Infant mortality in the sample population followed similar patterns of decline as the total Swedish population (Figure 2). IMR was stable around 150/1000 births from 1860 to 1880 after which the rates declined to just above 50/1000 in 1900.

Figure 2: *Infant mortality rate in Sundsvall region 1860-1900*

Figure 3 shows the adjusted survival functions for infants by religious affiliation. The estimations were adjusted for calendar time, the age of the mother and their civil status. Overall, free church

affiliates had a 21 percent lower mortality risk than State church affiliates (HR 0.79, Table A2). After one, year about 90 percent of infants survived within the free church group while only about 86 % of the state church infants had survived the first year.
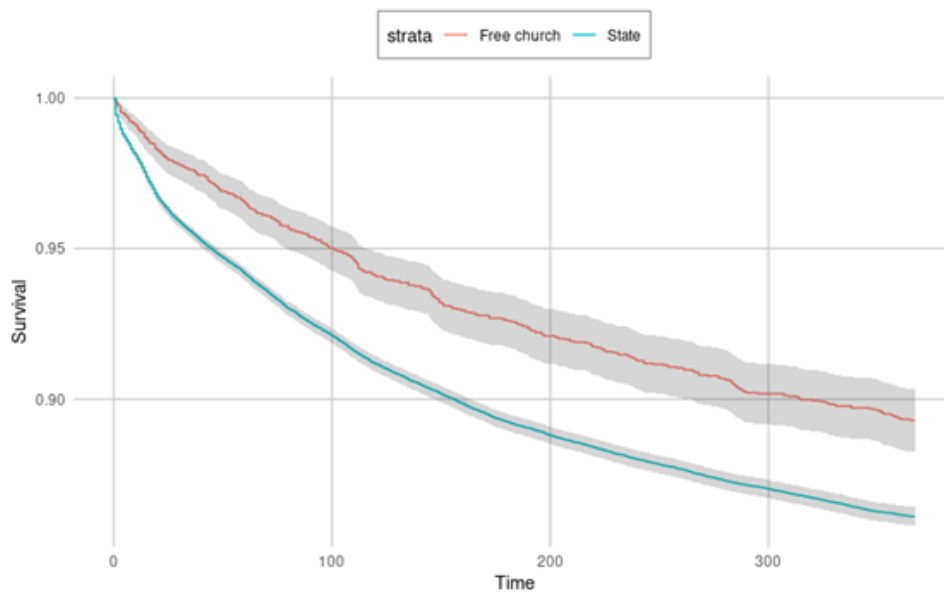
Figure 3: *Survival of infants born to State church and Free-church-affiliated parents, with 95 percent confidence intervals. See Table 2 for regression results.*

Conclusions

(1) Free church affiliation was associated with lower infant mortality risk.

Social capital generated by being affiliated with groups such as the free churches has been associated with improved health (Rodgers et al., 2019). Our preliminary results suggest that the social capital generated by free church affiliation was protective for infants in the 19th century. Access to strong social support and social connections was better for health than the negative effects of increased social pressures to conform to social norms, higher fertility, and being affiliated to a group with strong social control of behaviours. Initially, the free churches created weak social ties across class boundaries, before maturing and forming into tight-knit groups with strong social ties (Junkka, 2018). Furthermore, free church affiliates in the region had a relatively early fertility transition, limiting family size through spacing behaviours (Junkka & Edvinsson, 2016).

Our preliminary results indicate that free church affiliation had a positive effect on child survival. In future analysis we will explore how church affiliation was related to cause-specific infant mortality, to better understand the mechanisms which improved the health of free church infants.

Appendix

Table A1: Descriptive statistics of data

Variable	Label	Mean	Count	Min	Median	Max	IMR	N dead
Mother's age		31.333	50417	15.4	31.0	52.8		
Parents marital status	Betrothed	0.017	839				170.4	143
	Married	0.983	49578				136.3	6755
Birth date		1881	50417	1860	1882	1900		
Death date		1881	50417	1860	1882	1900		
Years observed		0.904	50417	0.003	1.000	1.000		
Death		0.137	50417	0.000	0.000	1.000		
Religious affiliation at birth	State	0.933	47026				139.0	6535
	Free church	0.067	3391				107.0	363

Table A2: Hazard ratios of infant mortality by religious affiliation at birth.

Term	HR	Standard error	Statistic	P-value
Free church (ref: State church)	0.79	0.054	-4.45	0.000
Year part 1	0.75	0.053	-5.35	0.000
Year part 2	0.72	0.121	-2.72	0.007
Year part 3	0.46	0.090	-8.62	0.000
Mother's age part 1	0.99	0.062	-0.10	0.916
Mother's age part 2	1.03	0.240	0.13	0.895
Mother's age part 3	1.69	0.146	3.59	0.000
Married (ref: Betrothed)	0.82	0.085	-2.35	0.019

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