

# **Socioeconomic and Kinship Factors in Infant and Child Mortality in Historical Slavonia<sup>1</sup>**

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## **Introduction**

Our prior research has shown that maternal mortality in south central Slavonia was strongly affected by social and political conditions that diminished the amount of male labor available to family farming and by the size and composition of a woman's kin networks (Hammel and Gullickson 2004, 2005). This paper extends the analysis to test the effect of these and other variables on the survival of offspring.

The intent of the work is not only substantive – to explain demographic conditions in the past – but in addition both practical and theoretical. In a practical sense, the insights gained into demographic outcomes by the application of historical and ethnographic knowledge in historical Slavonia are, in the presence of similar information, extensible to modern peasant societies, e.g. in Africa, South Asia, and Latin America, especially where extended household structures also exist. In a theoretical sense this work seeks to enrich demographic analysis by showing how ethnographic knowledge of microstructural factors is essential to a close understanding of the demographic behavior of social actors.

## **Theoretical background**

The literature on infant and child mortality (ICM) is large and varied; we do not

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attempt a full review. While ICM has long been a concern of epidemiologists (e.g. Yerushalmy 1945), a coherent integrated model of proximate determinants was first proposed by Mosely and Chen (1984). It highlights different contributory factors, primarily physiological, disease-related, socioeconomic conditions, maternal education and competence, and microsocial or “familial” factors. Many empirical studies have employed this framework; among historical works we note especially Preston and Haines (1991). Other important historical investigations include Imhof (1986), Pebley et. al. (1991), and Kertzer et. al. (1999). More recently, attention to ICM has focused on the results of disruption of civil life by political violence (Byarugaba 1994, Ibrahim et. al. 1996, Keely and Walman 2001, Urdinola 2003, WHO 2001). Such work especially reinforces our own conclusions on maternal mortality about the effects of disruption of male labor on family welfare. Regarding microsocial factors we also note differential mortality influenced by the gender-specific value of children to the family economy, and the importance not only of gender but also of the combination of gender and birth order to the survival of children. (Chen 1988, Hammel, Johansson and Ginsberg 1983, Skinner 1993).

The particular focus of this research is on the availability of female labor for the care of infants and children. We postulate that infants and children have lower survival chances when labor for their care is diminished. We propose that when male labor is diverted because of military and labor market conditions and women are forced to assume male tasks in subsistence farming, children suffer. However, we also propose that both the size and the structure of the household female labor pool are important. Where more women are available per child, survival should be higher. However, if women other than the mother of a child have competing interests, survival of that mother’s child will not benefit as much. These competing interests will include whether the other women are themselves married, how many children they have, and of what age and gender, and whether the other women are themselves nursing. Having other children will diminish the

availability of labor as a public good in the household or its kin network. Having older children, so that the familial unit is close to the point of fission from the larger familial aggregate, will diminish the availability of labor. To illustrate these effects properly will also require attention to other control variables.

## **Data**

Slavonia (Croatia) was the borderland between the Habsburgs and the Ottomans from 1698 until 1878. From 1745 to 1871 it was divided into a northern civil zone with an enserfed peasantry under Hungarian control, and a southern military zone under Austrian control with peasant serfs obliged to render perpetual military service (like the Cossacks in Russia). This distinction cut across an otherwise culturally and linguistically homogeneous Catholic population and allows controlled comparison of two populations under different political and socioeconomic systems. From its liberation by Austro-Hungarian forces in 1683 to the mid-nineteenth century, the region was subject to periodic heavy military mobilization. From the mid- eighteenth century on, it witnessed the collapse of feudalism, increases in wage labor, immiseration of the peasants, overpopulation, and the beginnings of heavy emigration. There were no innovations in agricultural practice other than introduction of the potato and maize, attempts at industrialization failed, extraction of forest products benefited only foreign interests, and transport remained primitive.

The data are family reconstitutions from seven contiguous Catholic parishes in south central Slavonia c. 1750-1900. Six parishes were in the Military Border of Croatia where male serfs were obliged to render military service and to work in fortress and road construction; one was in Civil Croatia where serfs were obliged to work corvee labor on latifundia. Of approximately 25,000 marriages, 100,000 baptisms, and 90,000 burials, a subset has sufficient linkage information to permit determination of parity and/or reconstruction of the agnatic networks that underlie the patrilineal extended and fraternal

joint households common in that time and place. We can determine parity and consanguineal kin for 8,737 mothers in 37,757 births because we have their baptismal and marriage records. We can find the consanguineal kin of fathers in 6,261 of the 8,737 for 27,846 of the 37,757 births because we have the fathers' baptismal records. Where we have occasional *LSA*, we have found good matching between those and the reconstitutions on the children of conjugal pairs and on sibling sets of coresident brothers. There are an additional 4,465 mothers whose marriages are known to us but whose baptisms are not (so that we cannot find their parents and siblings); these account for another 18,789 baptisms. There are an additional 16,475 mothers who had 37,712 births but for whom we have no marriage or baptismal record. The core of this analysis will use the 6,261 conjugal pairs with 27,846 children, for whom we can reconstruct kinship networks.

## Analysis

A child experiences a changing trajectory of exposure to risk and the intensities of those risks throughout the lifecycle of the household. A hazard analysis model with time varying covariates is best suited to analyze this process. As a base model, we use an elaboration of the model proposed by Pebley and Stupp (1987) which has become a standard model for analyzing infant and child mortality. This model is a piecewise constant hazard model, which assumes a constant baseline hazard rate within certain age groups from age 0 to age 5. Formally, the model is:

$$\log(\lambda_{ijkl}) = \alpha_j + \mathbf{X}'_{ijkl} \boldsymbol{\beta} + \delta_k + \gamma_l$$

Where  $\lambda_{ijkl}$  is the mortality rate for child  $i$  in age group  $j$ , born to mother  $k$  within the agnatic network  $l$ , and  $\mathbf{X}_{ijkl}$  is a vector of time-constant and time-varying covariates for that child in age group  $j$ . The constant term,  $\alpha_j$ , is a baseline constant hazard rate for age

group  $j$ , and  $\beta$  is a vector of coefficients that can be interpreted as the log-relative risk of these baseline hazard rates at each age. Our age groups are 0-1, 1-5, 6-11, 12-23, and 24-60 months.

Because we will be using counts of children in our analysis and these counts can be heavily affected by the survival of previous children, it is necessary to account for the clustering of mortality within the nuclear and extended family. The last two terms measure the extent of shared frailty for children born to the  $k$ th mother ( $\delta_k$ ) and the shared frailty for children living within the  $l$ th affinal network ( $\gamma_l$ ). Both  $\delta_k$  and  $\gamma_l$  are modeled as random effects, drawn from a normal distribution.

Some of the observed births in this dataset have no other observed event. The correct censoring time for such children is therefore unknown. The standard approach to this problem has been to use events on other family members to censor observations, but since our substantive interest is in kinship relations, this approach is problematic. Since we will not directly model the effects of father in this analysis, we censor all observations by the last observed event for the father.

Our main focus is on the covariates included in the models and their estimated effects. We separate these covariates conceptually into physiological, socioeconomic and environmental, and kinship variables for convenience, but strict separation is impossible. Gender is an example. Some part of differential risk is based on the sex of the child, but some part is based on the social treatment of sex, i.e. gender.

### *Physiological Covariates*

Although physiological variables are not the emphasis of this research, it is important to control for them in order to derive the net effect of the socioeconomic and kinship variables of interest. Important physiological variables include mother's age, birth order of the child, the length of the previous birth interval, and the survival of the

previous child. We generally follow the methods of our previous research in modeling these physiological effects.

Mother's age and the birth order of the child may both have a U-shaped relationship with child mortality. In general, age and birth order are indicators of a mother's maturity and experience in terms of childcare. However, extremely young and old mothers both face exaggerated childbearing difficulties, as do primiparous and high parity mothers, and these difficulties in childbirth often affect the health of newborn infants. Therefore, we include second order polynomial terms for these variables in order to capture potential non-linearity.

Both the previous birth interval and survival of the previous child are problematic for first births. We follow Pebley and Stupp's (1987) approach which treats the first birth as the reference for both a set of categorical birth intervals and a categorical variable indicating whether the previous child died prior to this birth. It is important to control for the survival of the previous child up to the index child's conception even with the inclusion of a family frailty term, because the death of a previous child and length of the previous birth interval are related.

We include an indicator variable for sex of the child and for children in multiple birthings. Multiple birthings can be very hazardous for children as well as mothers.

Finally, our data allow us to estimate the adult mortality rate in each calendar year. We expect that there will be a strong positive relationship between adult mortality and infant and child mortality due to shared health environments. Therefore, we include this adult mortality rate into the model in order to factor out year-to-year fluctuations in these overall health environments.

### *Socioeconomic and Environmental Covariates*

We are particularly interested in socioeconomic covariates which proxy for the withdrawal of male labor, because such withdrawals place greater strain on family

resources and may be detrimental to child health. Chief among the reasons for the withdrawal of male labor are the periods of military mobilization by the Austro-Hungarian Empire. We have information on these crisis periods, although we do not know which crises led to mobilizations within the parishes under study. Nonetheless, we have found that maternal mortality was significantly higher in these crisis periods. Thus we include a dummy variable to indicate a crisis period. Furthermore, six of the seven parishes were military parishes, and the men in these parishes had responsibilities which likely reduced their labor availability relative to the civil parish, even in times of peace, such as frontier guard duty, fortress construction, etc.. For maternal mortality, we found that all the military parishes had higher rates of mortality than the civil parish. We expect the same to be true of child mortality.

We have also found that maternal mortality and female non-maternal mortality both increased over historical time, suggesting greater immiseration with the decay of the feudal economic system and growing dependence on wage labor that drew men away from family farming. We expect this trend to hold for infant and child mortality as well, so we include a straight-line time trend into the model.

### *Kinship Covariates*

The reconstitution data permit us to count the consanguineal kin of the father and the mother of the index child. On marriage, sons resided with or near their parents and brothers, while wives joined their husbands. The kin networks that we count include the siblings and spouses of husbands and wives, thus the uncles, aunts, and cousins of their children. These networks are not necessarily identical to their households of residence, although they often are. Agnatic kin (related through males) resided jointly or in close proximity. Thus, wives and their children often lived in households with husband's parents, brothers, unmarried sisters, and his nephews and nieces. If such affinal kin of the wife were not coresident, they were likely to be in another house on the same farm, or on

the same village street, or section of a village. Our prior work on maternal mortality established that kin availability mattered in two important ways. First, larger kin networks were healthier overall, because household economies of scale could reduce the labor burden on individual women, thus increasing time available for health care. However, increasing the number of a woman's husband's brother's wives was disadvantageous due to interuxorial competition which may have led these wives to withhold shared labor. These politics were particularly problematic for junior wives in large households, who were at the bottom of an age-gender hierarchy.

We expect to see similar results for infant and child mortality because household labor burdens will similarly reduce time invested in child health care. However, we now have the added issue of how the composition of each woman's existing child set within the joint family will affect the mortality risk for the index child. These effects are likely to be complex. Non-productive children increase the labor demands on the mother and other members of the household, thus reducing time available for care of the index child. On the other hand, older children can sometimes assist in the care of younger children. As the density of children in a network increases, the communicability of infectious diseases also increases. Thus, we expect the relationship between the number of children in the household and the index child's mortality risk to be heavily affected by the age composition of the child set. We also expect that the effects will differ between siblings and agnatic cousins. Women with large sets of their own children will be less available and less interested in easing the burden on other mothers' childcare. The isolation of resources within nuclear units may rise with the age of these cousins, because wives will become more concerned about their own children when the potential fissioning of the joint household is imminent. On the other hand, as such cousins age, they contribute more to the household labor pool and should increase household welfare.

We include two variables to measure the effect of economies of scale within kin networks. The two variables measure the size of two different kin networks for the child.

The first kin network is made up of the affinal kin available to the mother of the child. The second kin network is made up of the consanguineal kin available to the mother of the child. Almost without exception, children were raised within the affinal kin network of their mother. Therefore, we expect that the effect of the mother's consanguineal network will be much smaller than the effect of the mother's affinal network.

The size of these kin networks is measured by counting the number of particular types of kin who are over 15 years of age. In prior work we have considered the parent's brothers (PB), the parent's brothers' wives (PBW), and unmarried parent's sisters (PZ). In the case of the mother's affinal network, the index parent is the father. In the case of the mother's consanguineal network, the index parent is the mother.

In order to assess the effects of interuxorial competition, we also separately include a count of the number of father's brothers' wives (FBW). In this format, FBW count both towards economies of scale in the household and towards intrakin rivalry. We expect that the direction of the effects will be opposite. Which effect is stronger indicates whether the "net" effect of having more father's brothers' wives in the household is helpful or detrimental to a child's health.

We also include a relative age rank variable to explore whether the children of junior brothers suffer relative to the children of senior brothers in joint households. This variable is identical to the variable used in our previous research and is scaled from a 1 (senior brother) to a zero (junior brother), with interval scoring for intermediate brothers. Father's without brothers are coded as senior brothers and given an additional indicator variable to signify any differences between themselves and truly senior brothers.

To explore the potentially different effects of the age composition of existing children sets within the affinal network, we will include counts of children belonging to the mother and FBW's in the age groups of 0-5, 5-10, 10-15, and greater than 15 years of age. A larger number of children in the existing household may indicate a more healthy childrearing environment for these children, which will be confounded with our

expectations about kin effects. The use of the frailty terms in the model help control for this confounder by accounting for clustering of child mortality within sibling and cousin sets.

## **Results**

The results of the piecewise constant model are shown in Table 1. Overall, the results for the socioeconomic variables are similar to those for maternal mortality, but the kinship variables show little relationship between the kinship network and infant and child mortality, suggesting that the care of infants and young children was largely internalized within the nuclear family.

The physiological relationships are generally in the expected direction. Mother's age has a non-linear effect such that the children of younger and older mothers have the highest levels of risk. Controlling for mother's age, children born at greater parity have reduced risk, most likely through the increased experience of the mother. The death of the mother and a twinning both dramatically increase the risk of infant and child death. The results for adult background mortality indicate that infant and child mortality was higher in years when adult mortality was higher. Only the results for previous birth interval are inconclusive. The death of the previous child actually appears to reduce the risk for the index child, but it should be remembered that this effect is in addition to the mother-level frailty term already in the model.

The socioeconomic variables are also consistent with expectations. The military parishes had higher mortality than the civil parish and mortality increased in general during crisis periods. Both of these results suggest that the removal of male labor from the household labor pool had an important effect on the resources available for childcare.

The positive effect for the year variable also indicates an increase in infant and child mortality over the time period, possibly also attributable to increasing diversion of male labor.

The kinship variables, on the other hand, fail to meet expectations. Unlike our prior results for maternal mortality, neither the size of the father's or mother's kin group had an effect on the relative risk for the index child, nor did the number of father's brothers' wives have a differential effect. The relative rank of the father among his brother also had little effect on relative risk. Almost all of these effects are in the expected direction, but they are minute in their substantive and statistical significance. We take these results to indicate that child-rearing activities were largely internalized within the nuclear family.

The results for numbers of children are complex, but clearly indicate that existing siblings were more a burden than a boon for the health on the index child. There is a clear non-linear relationship between the age composition and size of the sibling set. Siblings between the ages of 0-5 and over 15 increase the relative risk of death much less than those between the ages of 5-15. It seems likely that younger children are less damaging because of economies of scale in childcare for children of similar ages, and that the hazard of additional children declines for older children as they become greater producers within the nuclear unit.

The size and age composition of the cousin set has much less of a relationship to the mortality risk of the index child. Risk does increase from the 0-5 to the 5-10 age group, but the results for the 10-15 age group are anomalous. On the whole, it appears that cousins didn't consistently increase or decrease the mortality of their kin. As shown

by the results for adult kin, this is likely because childcare was internalized within each nuclear unit and thus there were no resources for cousins to spread thin.

## **Discussion**

We extended a model of the effects of physiological, socioeconomic, and kinship influences on maternal mortality to infant and child mortality. Effects in the first two sets of predictors have similar effects for both maternal and infant-child mortality. Kinship variables did not have strong or consistent effects on infant-child mortality. This outcome is surprising in view of the general tone of the ethnographies of late 19<sup>th</sup> and early 20<sup>th</sup> century Slavonia, which depict life in joint families as highly cooperative. For example, Lovretic in the classic work on the region (Otok, researched and published in the years after 1865) says, “People love and spoil their own and others’ children”. But at other points he notes a lack of cooperation: people do not assist pregnant or parturient women, women nurse their own children not those of other women. He does note that if a woman has many children, the older ones may take care of the younger. Thus, the detailed ethnography seems to support our tentative conclusion, that the care of children was strongly internal to the nuclear family unit, even when it was embedded in larger affinal and consanguineal networks. However, the ethnography in question is over a century old, largely folkloristic (devoted mostly to material culture such as peasant costume and plow types, also songs, tales, etc.). Descriptions of interpersonal relations are general and idealistic. The ethnography of the time was strongly ideological and associated with the rise of the Croatian Peasant Party and a population chafing under Austro-Hungarian domination. It would be hard to make a case that ethnographic knowledge was useless in

understanding statistical materials. On the basis of our experience here, it would be better to note a caveat. The ethnography needs to be examined critically. In this instance, Lovretic's claim that pregnant women received no help is belied by the statistical evidence that network composition was an important factor in their survival. His indication that the costs of child-rearing were internalized to the nuclear family is, on the other hand, borne out.

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Table 1 – Piecewise constant model of the hazard of death for infants and children, with a frailty term for mothers and affinal kin network, Slavonia 1750-1898

<b>Variable</b>	<b>Coefficient</b>	<b>SE</b>	<b>P-value</b>
<i>Baseline hazard</i>			
0-1 months	-0.593	0.085	<.001
1-6 months	-1.661	0.030	<.001
6-12 months	-2.027	0.032	<.001
12-24 months	-2.479	0.031	<.001
24-60 months	-3.286	0.032	<.001
<i>Physiological Variables</i>			
Mother's age	-0.014	0.005	0.002
Mother's age squared	0.00074	0.00023	0.001
Parity	-0.083	0.023	<.001
Parity squared	0.0018	0.0025	0.469
<i>Previous birth interval</i>			
First birth	-0.108	0.053	0.040
Short interval (<15 months)	0.006	0.042	0.879
Medium interval (reference)	-	-	-
Long interval (>30 months)	-0.031	0.028	0.273
Mother died	0.418	0.087	<.001
Male (female reference)	0.096	0.021	<.001
Twinning	0.930	0.047	<.001
Background mortality (per 1000)	0.009	0.002	<.001
<i>Socioeconomic Variables</i>			
<i>Parish</i>			
B	0.634	0.064	<.001
C (civil parish, reference)			
G	0.451	0.041	<.001
O	0.255	0.049	<.001
P	0.596	0.039	<.001
S	0.635	0.051	<.001
V	0.453	0.043	<.001
Crisis period	0.186	0.023	<.001
Year (origin=1815)	0.013	0.0006	<.001
<i>Kinship Variables</i>			
Number of adult consanguines for father	-0.005	0.013	0.688
Number of adult consanguines for mother	0.004	0.007	0.515
Number of father's brothers' wives	0.009	0.042	0.827
Father's relative age rank	-0.010	0.046	0.829
No father's brothers' wives	-0.014	0.057	0.811
<i>Number of siblings</i>			
Age 0-5	0.058	0.026	0.030
Age 5-10	0.136	0.026	<.001
Age 10-15	0.113	0.029	<.001
Age 15+	0.041	0.038	0.285
<i>Number of agnatic cousins</i>			
Age 0-5	0.006	0.019	0.752
Age 5-10	0.060	0.020	0.003
Age 10-15	-0.044	0.022	0.054
Age 15+	-0.010	0.020	0.627
Single child	0.070	0.043	0.099

