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The fatal season.
A study of extremely high 18th and 19th century winter neonatal mortality in northeastern Italy

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Contents

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Over the last few decades, numerous studies have sought to explain historical differences in the risk of dying during the earliest stages of life (see e.g. Vallin, 1991; Lee, 1991; Preston and Haines, 1991). Nevertheless, two important patterns remain less than fully explained. First, although infant mortality (the risk of dying during the first year of life) during the *ancien régime* was everywhere higher than 100‰, considerable differences existed between populations living in adjacent regions and countries (Livi Bacci, 1997, point 2). For example, in 1854, child morality during the first month of life (neonatal mortality) and during months 1-11 differed greatly among the regions of the Austrian Empire (including Veneto and Lombardy, which together make up a large portion of Northern Italy). In addition, secular trends may have significantly varied between neighboring populations (*idem*, 1997, point 6). Although these issues are not easily disentangled, they are crucial to understanding the historical determinants of infant mortality.

In this paper, we focus on infant mortality during the 18th and 19th centuries in Veneto, the region home to Venice situated in northeastern Italy. The history of population change in Veneto during the final centuries of the demographic *ancien régime* provides an informative case for understanding the fundamental role that changing levels of infant mortality played in influencing both population trends and demographic dynamics (Rossi and Rosina, 1998; Dalla-Zuanna et al., 2004). Population stagnation in Veneto during the 18th century (the final decades of the Republic of Venice) and the early 19th century can be directly associated with increased infant mortality (Rosina 1995). Moreover, it is not possible to understand the considerable emigration flow out of Veneto from 1880 to 1925 (a net loss of one million people, or 25-30% of the population) without taking into account the tremendous population pressure acting on the labor market. The former was in large part caused by a rapid decline in infant mortality, combined with a context of uncontrolled marital fertility, where the majority of the inhabitants worked in a backwards agriculture system.

Furthermore, the results of our analysis are potentially of interest, and applicable, well beyond the geographical region under study. Veneto shares this particular historical pattern of infant mortality (1650-1900) with other regions in Europe. This is especially true with regard to several bordering Italian regions (Emilia-Romagna, Lombardy, and Friuli-Venezia Giulia), but also to a number of areas in Germany and in the former Austrian Empire. While the mountainous zones experienced distinct demographic trends, infant mortality in several large and crowded regions of Europe (mainly in the plains and low hill terrain) increased during the 18th century and then dramatically dropped during the second half of the 19th century. That a similar secular pattern of infant mortality occurred across a number of regions suggests that there may exist a common explanation for this change, especially as other areas of Europe experienced quite different demographic levels and trends[1]. Finally, the decline in infant mortality during the mid-19th century marks the first phase of the Italian Demographic Transition (see Rosina, 1995). Research on the beginnings of infant mortality decline in Veneto is thus also the study of the dawn of the Demographic Transition in Italy.

Our aim is to describe the remarkable pattern of infant mortality in Veneto during the century of 1750-1850 and, through use of recently available data on daily temperature[2], to further investigate the association between the former and the risk of dying in the first days and weeks of life during the 18th and 19th centuries. The organization of this article is as follows. First, we briefly describe the economic and social conditions characterizing Veneto during the 18th and 19th centuries, with a focus on the working class. Second, we illustrate the overall trend, age pattern, and seasonal pattern of neonatal and infant mortality in several areas of Veneto from 1650-1900, and enrich this picture with comparisons of other Italian and European areas. Third, we described the data used for the micro-analysis. Fourth, by combining daily temperature data with a nominative parish dataset, we analyse the statistical association between the risk of dying in the winter during the first 30 days of life and the external temperature during the first half of the 19th century. In the final section, we discuss several possible interpretations for very high winter neonatal morality among children born in Veneto between the 17th and 18th centuries, as well as indicate possible directions for future research.

1 A complete comparative map of infant mortality for the regions of Europe from 1650-1900 is not available. However, it is possible to make comparisons by combining the results from a number of different studies. On the secular trends of infant mortality in several northern Italian regions, refer to the cited article of Del Panta (1997) and Del Panta and Livi Bacci (1980). For Friuli-Venezia Giulia see Breschi (1999). For a comparison of secular trends in Lower Austria, the Austrian Alpine region, and other regions in the Alps, see Viazzo (1997). The absence of an increase in infant mortality in the mountainous areas has also been confirmed by a study on Carnia (in the northern area of Friuli – Breschi, 1999). Some data for Germany – which partially depict the secular trend experienced in Veneto – were collected by Flinn (1981, Appendix).

2 A rigorous comparison of infant and neonatal mortality by season in Veneto with the other regions of Italy is only possible beginning with data from late 1860s, as Veneto did not become part of the Kingdom of Italy until 1866 (after the war won by Prussia and Italy against the Austrian Empire).

1. The difficult living conditions in Veneto at the turn of the 19th century

Studies of Italy's economic history suggest that during the 1700s, the general living conditions of the working class significantly deteriorated. Combined observations of population estimates, real wages, and per capita income from 1700-1859 reveal that while the population doubled (from 13 to 26 million inhabitants), real hourly wages were cut in half, and per capita income decreased 20% (Malanima, 2006). One possible interpretation is that the significant increase in population which followed the end of the great epidemics (the last significant plague occurred in 1630 in northern Italy and 1667 in southern Italy) produced excessive population pressure on an area already characterized (at the end of the 17th century) by high levels of urbanization. Indeed, at the time, Italy, along with the Netherlands, had the highest population density in all of Europe. In addition, Malanima (2003, p.288) points out that: *Italy completely missed the First Industrial Revolution, the age of coal, iron and mixed farming. It was impossible to adapt the English model to the available natural resources. The lack of coal, the scarcity of iron and the dry soils of the peninsula, with the only exception of part of the Po Valley, was thus an obstacle too difficult to overcome considering the technological level of the time. The relative backwardness of the peninsula grew during the 19th century. From the late Middle Ages to the end of the 19th century, Italy followed the downward curve from a condition of progress to a state of backwardness.*

Within the larger context of declining living conditions, it is essential to understand the specific social and economic history of Veneto (Rosina and Zannini, 2004)[3]. In 1630, the last great plague dealt a devastating blow to the Republic of Venice, wiping out 40% of the population. Over the following century, the number of inhabitants grew rapidly, replacing the human void left by the epidemic and growing to 2.2 million by the mid-18th century, or 40% greater than the size of the population immediately preceding the plague of 1630. As in other places, substantial population growth in Veneto was sustained by an increased productivity guaranteed by corn crops (rather than wheat) and by the spread of "industrial crops" such as the mulberry tree. Inhabitants simultaneously struggled, however, with a dramatic decrease in the real value of wages and the consequent need to increase per capita working hours. In addition to these problems, during the 17th and into the first half of the 18th century, Venice began a slow but steady decline, gradually loosing its secular ability to attract wealth as European commerce began to move out of the Mediterranean and across the Atlantic Ocean. Finally, along with the increase in population, entire forests were cut down (even in the high hill areas) in order to make room for the now near omnipresent cultivation of maize and mulberry trees. Although (to the best of our knowledge) thorough research has not been done on this topic, we presume that relentless deforestation led to an increasing scarcity of wood, needed to heat homes in the winter (Lazzarini, 2002. pp. 57-62; Zannini and Gazzi, 2003).

Over the course of the 18th century and into the early 19th century, the nutritional health of several populations in Europe greatly deteriorated (for a review see Livi Bacci, 1990, chapter 5). Several studies show that northern Italy similarly experienced an extensive decline in the quality of nutrition. In the region of Lombardy, for example, draftees born in 1750 had an average height of 168.5 cm, compared to 164.5 cm for those born during the first half of the 19th century (A'Hearn 2003). Although (as far as we know) data on height of this quality for the 18th-19th centuries are not available for other Italian regions, a number of clues suggest that this dramatic negative trend was also experienced in Veneto. As suggested above, one of the principal causes of increasingly poor nutritional health and height loss may have been decreasing income. Another important factor influencing nutritional health was the above mentioned progressive (and for the poorest, almost total) substitution of wheat with corn. This modification began during the last decades of the 16th century, and was completed by the beginning of the 19th century (Fornasin, 1999; Livi Bacci, 1990). A serving of *polenta* (corn meal mush) of equal weight to a portion of bread has significantly less caloric power. In addition, maize does not have any vitamin PP, thus a diet

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[3] The Veneto region is examined in light of its current borders, thus excluding the provinces of Pordenone and Udine, which now belong to the region of Friuli-Venezia Giulia. At the beginning of the 19th century, approximately two million inhabitants lived in Veneto; one hundred years later this number had risen to three million.

based solely on polenta facilitates the spread of pellagra, a vitamin deficiency disease (PP stands for Pellagra Prevention). Pellagra affects metabolism and was a leading cause of death in many areas of northern Italy, including a number of districts in Veneto. In 1881, the first year the causes of death were recorded on a national scale, pellagra was high on the list for northeast Italy (Livi Bacci, 1986). As late as 1881, Sormanni wrote: *Of weak parents... poorly nourished, are born wispy and sickly offspring. We have witnessed the predominance of this frailness in Lombardy and Veneto, home also to the greatest endemic infections: malaria, scrofula, and pellagra...*"

2. Winter neonatal mortality: a description

Infant mortality in Veneto steadily increased from 1650 to 1800, starting at 250‰ in the mid-17th century (the ending point of a 300-year period of severe and recurring plagues) and eventually reaching a high of 350‰ by the end of the 18th and during the earliest decades of the 19th century. The levels of infant mortality in Veneto during the period of 1750-1850 are among the highest ever recorded for a large area over a significant amount of time. Indeed, among the regions of the Austrian Empire in 1854, the greatest risk of dying during the first month of life is observed in Veneto **(table 1)**. Following this period, however, infant mortality in Veneto steadily began to decline. By the early 1900s infant mortality had dropped to 150‰ **(figure 1)**.

In a number of places in Veneto, infant mortality increased during the 18th century (Del Panta, 1997; Rosina, 2000; Zannini and Rosina, 2004)[4]. Most of this increase was due to negative variation in winter neonatal survival (**figure 2**; see also Breschi and Livi Bacci 1986, 1997). Using several detailed analytic tools, we calculated secular trends in the probability of dying during the first month of life by season of birth for a number of parishes and villages spread across the region. For each parish presented in **figure 3**, changes in neonatal mortality for children born during the cold season played a determinant role in the overall secular trend of infant mortality.

Take, for example, the case of Adria, a town of nine thousand located on the left bank of the Po River, near the Adriatic Sea (from which the city takes its name). The data available from 1676-1899 for this town are of quite good quality (Rossi 1970, 1977; Rossi and Tesolat, 2005). The secular trend of infant mortality in Adria is as follows: 1651-1700: 207‰; 1701-1750: 254‰; 1751-1800: 279‰; 1801-1850: 329‰; 1851-1899: 220‰ (Rossi, 1970, p. 133). During the 18th century, neonatal mortality doubled for children born during the winter, reaching as high as 400‰ in the early 1800s. This very high level persisted throughout the first half of the 19th century. In the subsequent period of 1850-1900, winter infant mortality dramatically declined. In contrast, throughout the entire period from 1676-1850, neonatal mortality and mortality in the first 2-11 months of life for children born in the summer did not change.

In the parish of Battaglia (located 15 km from Padua), the increase in winter neonatal mortality during the period of 1750-1850 was not due to any exceptional events, although this trend is somewhat complicated by large annual oscillations typical of small communities during the *ancien régime* **(figure 4)**. Moreover, data from Battaglia show that the growth in winter mortality was mainly due to that which occurred during the first week of life (return to **figure 3)**.

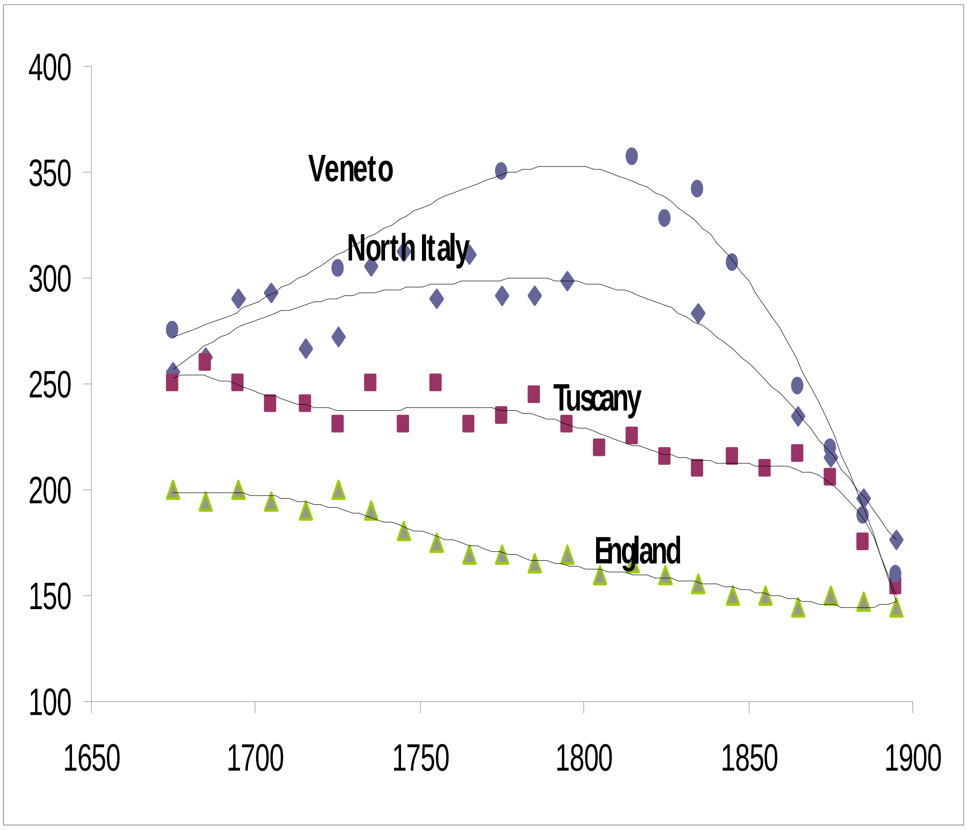
[4] At the turn of the 17th century, spurred by decrees from the council of Trent and Paolo V's 1614 edict, parishes in Veneto began to regularly record baptisms and deaths in the ecclesiastic parish registers. Over the years and through the work of many scholars, data for numerous parishes in the region have been gathered in a non-nominative manner (for a review see Zannini and Rosina, 2004). The quality of this data is generally good, better that that observed in other areas of Italy where often neither births nor the deaths of children who died immediately after birth were registered (D'Angelo et al., 2003; Rossi, 1970, 1977). As for each burial, the parish priest usually indicated the age at death (in weeks or months for early deaths). It is thus easy to calculate the probabilities of dying during the first week (early neonatal mortality), the first month (neonatal mortality), and the first year of life (infant mortality). Moreover, in calculating these indicators, it is possible to distinguish the former by the children's month of birth. In this paper – to the best of our knowledge – we report data for all of the parishes in Veneto where infant mortality indices were calculated using these criteria of classification.

Table 1. Probability of infant death (x 1,000) around 1854 in the provinces of the Austrian Empire

Regions (in German)	N. of Births	Stillbirths and month 0	Months 1-11	Year 0
Österreich unter der Enns	63,387	177.5	228.1	365.1
Österreich ob der Enns	21,411	154.3	218.1	338.8
Salzburg	4,264	175.4	217.9	355.1
Steiermark	31,088	140.0	151.6	270.4
Karnthen	9,648	144.0	116.0	243.3
Krain	13,724	93.6	140.5	221.0
Görz, Gradisca, Istrien etc.	18,631	154.3	168.7	297.0
Tirol und Vorarlberg	25,702	134.4	108.0	227.9
Böhmen	184,905	126.6	155.2	262.1
Mahren	74,837	109.2	150.9	243.7
Schlesien	17,213	128.6	164.5	271.9
Krakau	5,266	104.6	156.1	244.4
Galizien	165,846	115.5	210.3	301.5
Bukowina	18,096	92.6	140.1	219.7
Lombardien	103,920	165.3	135.7	278.6
Venedig	*79,965*	*215.4*	*112.3*	*303.5*
Ungern	323,137	140.3	175.9	291.5
Serbische Wojwodschaft und Temeser Banat	77,044	128.2	129.6	241.2
Kroatien-Slawonien	28,372	126.0	220.7	318.9
Siebenburgen	71,686	99.0	111.4	199.5
Militargranze	42,151	136.4	192.0	302.2
KRONLÄNDERN	1,380,293	137.6	164.6	279.5

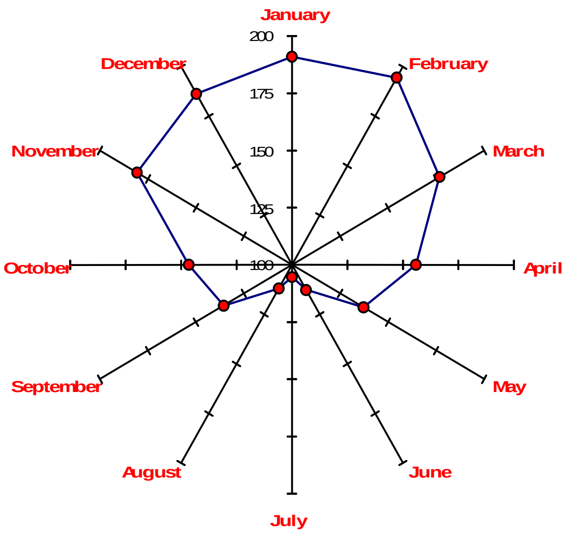
Source: our calculation on original data from the Tafeln zur Statistik der Osterreischen Monarchie (1854)

Figure 1. Secular trends in infant mortality rates (‰) in some areas of Italy and in England. 1675-1900



Sources: For Veneto 1675-1775: Zannini and Rosina, 2004, page 36 (mean level of: 5 parishes, 1651-1700; 9 parishes, 1701-1750; 16 parishes, 1751-1800). For Veneto 1800-1900: Del Panta, 1997, page 15. For England: Woods, 1997, page 76. For Tuscany and North Italy: Del Panta, 1997, pages 15-18. In order to emphasize the secular trends, data are interpolated with polynomials.

Figure 2. Neonatal mortality during the first month of life in Veneto (Italy=100). 1872-1879



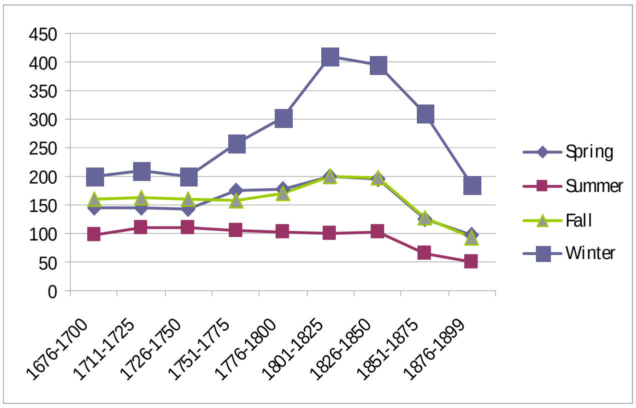
Sources: Rosina and Zannini, 2004

In order to focus on that which occurred during the first month of an infant's life, we considered two parishes where neonatal mortality did not start to decline until 1850 (Agna) and 1860 (Casalserugo). In **table 2**, infant mortality in these two parishes during the first half of the 19th century is compared with two different contexts in the 18th century: Alì (a hill parish in northern Sicily, where temperatures were about the same as those in the Veneto plains in July, and about 10°C higher in January) and England (where temperatures were about the same as in the Veneto plains in January, and around 6°C lower in July).

There are certainly differences between the Veneto parishes and the other two contexts presented in **table 3**; see for example the probability of death in months 1-11 and years 1-4. On the other hand, these dissimilarities seem minimal when one looks at the differences in the probability of dying during the first month, and above all, during the first week (with the exception of the first day). The probability of dying in days 1-6 was six/seven times higher in Agna and in Casalserugo than in Alì and in England. The relevance of winter neonatal mortality is also clearly depicted by the results presented in **table 3**, which show significant seasonal differences in neonatal mortality in Agna and Casalserugo.

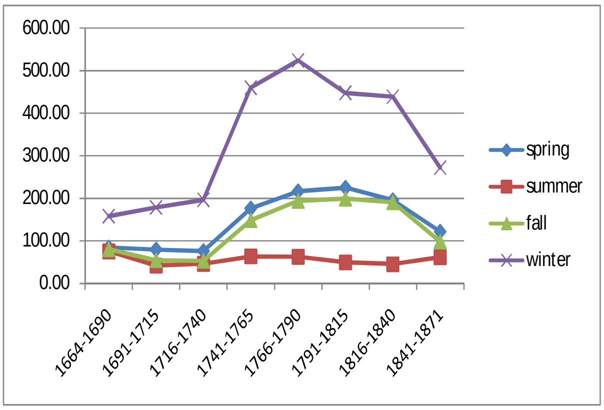
Figure 3. Probability of death by season of birth in some parishes of Veneto (1650-1900). Some ages during the first year of life

Adria (province of Rovigo) 1676-1899
(mean number of births a year: xx)
FIRST MONTH



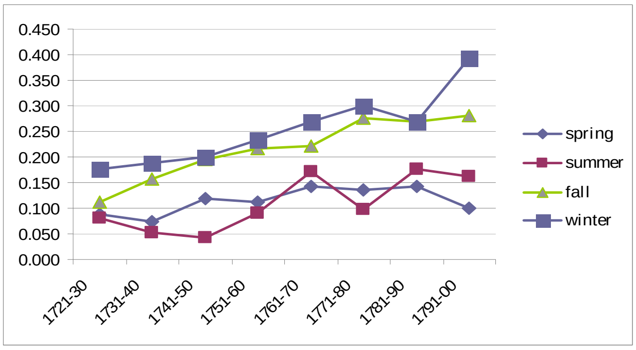
Source: Rossi and Tesolat, 2007

Battaglia (province of Padua) 1664-1871
(mean number of births a year: 72)
FIRST WEEK



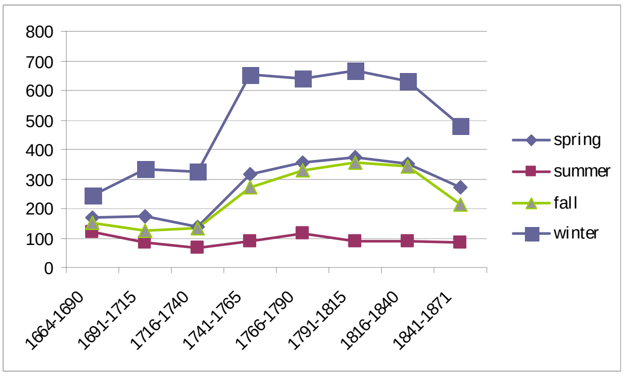
Source: Furegato, 2007

Salzano (province of Venice) 1721-1800
(mean number of births a year: 78)
FIRST MONTH



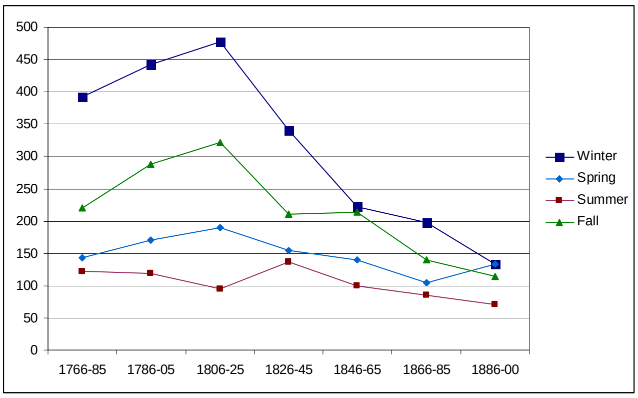
Source: Unpublished data personally communicated by Andrea Zannini, year?

Battaglia (province of Padua) 1664-1871
(mean number of births a year: 72)
FIRST MONTH



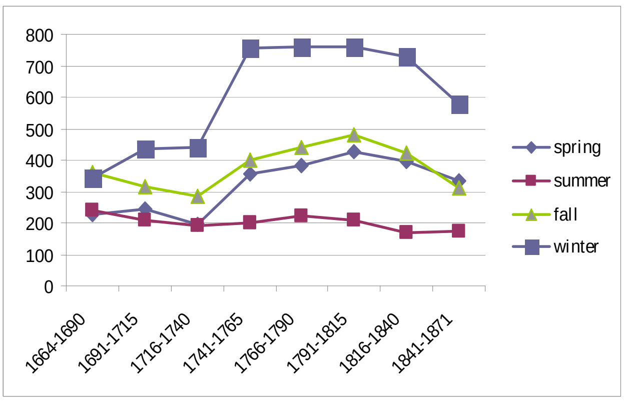
Source: Furegato, 2007

Altichiero (province of Padua) 1766-1900
(mean number of births a year: xx)
FIRST MONTH



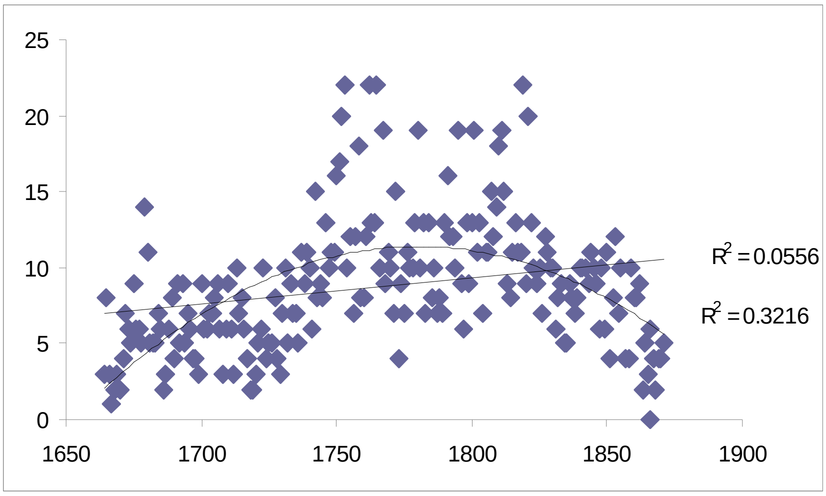
Source: Rossi, 1996

Battaglia (province of Padua) 1664-1871
(mean number of births a year: 72)
FIRST YEAR



Source: Furegato, 2007

Figure 4. Number of deaths during the first month of life in the parish of Battaglia. 1664-1871



Note: during the same period, the number of births in Battaglia does not change (70-80 a year)
Source: Furegato, 2007

Table 2. Probability of dying (‰) by age in Casalserugo (Padua, Veneto), Agna (Padua, Veneto), Alì (Messina, Sicily) and England. Children aged 0-4 born during the 18th and 19th centuries

Age		CASALSERUGO	AGNA (*)	ALÌ (SICILY)	ENGLAND
		Born in 1818-66	Born in 1816-47	Born during the 18th century	Born during the 18th century
Day	**0**	23	26	30 (**)	29
	1-6	154	189	25	28
	7-29	164	179	43	35
Month	**1-5**	75	68	52	56
	6-11	39	31	33	41
Year	**1**	78	66	41	51
	2-4	58	73	67	64
First…	**day**	23	26	30 (**)	29
	week	173	210	54	56
	month	309	351	95	89
	year	386	414	170	175
Years 1-4		131	144	104	111
Years 0-4		467	512	258	268

(*) For Agna it is also possible to calculate the probability of a stillbirth (corresponding to an infant's death before being baptized): 38‰ of babies born in 1816-47 died before being baptized.
(**) This probability is estimated, as the number of children who died during the first day was underreported.
Sources: The probabilities for Casalserugo, Agna, and Alì are calculated using nominative linkages. For Alì, see D'Angelo, Dalla-Zuanna, and Rosina (2003). For England, see Wrigley and Schofield (1981, page 226)

Table 3. Probability of dying (‰) in the first month of life by season in Casalserugo and Agna during the first half of the 19th century. Stillbirths are not included

	Winter	Spring	Summer	Fall
Casalserugo (1818-66)	584	294	107	265
Agna (1816-47)	618	353	154	332

Sources: Data from nominative linkages

3. Data

By means of the previously described macro (aggregated) data, it was possible to study the secular trend in infant mortality by season and age at death for several Veneto parishes. In order to enhance our analysis of the association between temperature and the risk of dying during first month of life, we used available micro (individual) data, focusing on the first half of the 19th century (i.e. when infant mortality in Veneto was extremely high (see again **figure 1**)). A significant portion of our empirical checks was made possible by an investigation of the links between temperature and the risk of death in the first month of life during the winter, while controlling for other variables such gender, social class, etc. The micro-data used for this study come from a community in Veneto (Casalserugo, situated 10 km from Padua) where infant mortality was higher than the regional average during the mid-19th century (1820-1866) and where the decline was slower and started later. On the one hand, this is a limitation to our research, as the microanalysis is specific to a local case. As we suggest in the conclusion, our analyses should be repeated for other localities. On the other hand, there existed a high risk of dying in the very first stages of life in Casalserugo, a parish located in a region which during this time period had one of the highest neonatal mortality rates in all of Western Europe. Situating the analysis in this context enables us to highlight the micro-connection between temperature and neonatal risk of dying under “extreme” circumstances.

We used two kinds of micro-data. The first consists of *civil registers of births and deaths* which each parish priest (or rabbi, in the Jewish communities) was required to compile during the period of Austrian rule (1815-1866 in Veneto), in addition to their ecclesiastic registers of baptisms and burials. The civil registers were often checked by state authorities, as testified by their frequent stamps and notes on the register pages. They are generally easier to read than the ecclesiastic registers, as they were pre-printed and their overall quality is quite good. As reported above, in this study, we use the civil registers from the parish of Casalserugo. In order to analytically study infant mortality, we have linked the events of birth and death recorded in the civil registers to the same individual by using data reported at each event as “linkage-keys”: family name, given name, the name of the father, and the family name and given name of the mother. Since the (often approximate) age at death was reported in the death registers, it was also possible to calculate the linkage performance: 99% of the deaths of children who died within the first five years of life can be linked to their births. In Casalserugo, the number of births reported in the civil register overlaps with the number of baptisms in the ecclesiastic registers[5]. The second micro-dataset used concerns *corrected daily temperature (minimum, maximum, and mean) and atmospheric pressure*, recently published for several European towns during the period of 1700-2000 (**table 4**). Data for Padua have been reliably comparable since 1774.

The two datasets just presented were merged and organized into a person-period dataset. The period (unit of observation) is every specific day from birth to the end of the first month of life. Casalserugo is located only 10 kilometers from Padua and thus temperatures in the two places should be very similar. Consequently, for each day, the minimum temperature has been added into the dataset as the main explanatory variable. For a child who was still alive at the end of the first month, the observation is right-censored. For a list of the available daily variables, see **table 5**. The discrete-time approach is particularly suitable in the presence of ties. As one can observe in **table 5**, the number of events in each time-unit (especially in the first days of life) is very high[6]. Merging the two datasets was possible only for Casalserugo, as Agna is located far from Padua and daily data on temperature were not available.

5 In another parish where the same nominative linkage procedure was applied and performed about as well (Agna, 40 km far from Padua), the number of births in the civil registers is higher than the number of baptisms, as children who died before being baptized were still reported in the civil register. Since almost all of the non-baptized newborns of Agna died on the same day of birth, we consider them to be stillbirths. The tables reported in the *Tafeln zur Statistik der Osterreischen Monarchie* from 1827-1965 provide additional data on infant mortality (Rossi and Fanolla, 2007, see also **table 1**). For several years, data on stillbirths were given separately. For example, in 1854 this source reports a proportion of 1.3% stillbirths in Veneto and 1.5% in the Empire as a whole. It is possible that the criterion adopted in Agna (inclusion in the Civil Register of children who died before baptism) was the general rule, whereas the standard employed in Casalserugo (inclusion in the Civil Register only of children who had been baptized) was an exception.

6

Table 4. An example of corrected meteorological data available for Padua (1725-1998)

Day	Celsius degrees Min	Max	Mean	Pressure
…				
01/JAN/1810	1.3	4.7	3.0	1025.3
02/JAN/1810	0.5	4.9	2.7	1032.4
03/JAN/1810	-0.6	2.1	0.8	1030.3
04/JAN/1810	0.3	2.3	1.3	1027.3
…				

Source: Camuffo and Jones (2002). In this same book, similar series are reported for Milan (Italy): 1763-1998; Cádiz (Spain): 1786-1996; Stockholm (Sweden): 1722-1998; Belgium (multi-site): 1767-1998; Uppsala (Sweden): 1756-1998; St. Petersburg (Russia): 1743-1996.

Table 5. Variables in the person-period data set for Casalserugo (1818-1867)

	Number	%		Number	%
Age at death (days)			**Age at baptism (days)**		
0-1	100	4.2	0	596	24.9
2-3	170	7.1	1	1,058	44.2
4-6	141	5.9	2	373	15.6
7-13	226	9.4	3	149	6.2
14-30	96	4.0	4+	216	9.0
31+	1,659	69.4	**Duration of marriage (years)**		
Sex			0	126	5.3
Female	1,162	48.6	1-4	774	32.4
Male	1,230	51.4	5-9	651	27.2
Year of birth			10-14	429	17.9
1818-19	84	3.5	15-19	291	12.2
1920-29	486	20.3	20+	121	5.1
1930-39	465	19.4	**Occupation of the mother**		
1940-49	476	19.9	Agriculture	1,876	78.4
1950-59	485	20.3	Other	516	21.6
1960-67	396	16.6	**Occupation of the father**		
Month of birth			Agriculture	1,894	79,2
1	178	7.4	Other	498	20,8
2	184	7.7	**Total**	**2,392**	**100,0**
3	278	11.6			
4	255	10.7			
5	279	11.7			
6	146	6.1			
7	182	7.6			
8	213	8.9			
9	193	8.1			
10	181	7.6			
11	162	6.8			
12	141	5.9			

 Data (available upon request) were processed using the SAS System.

4. Results

A detailed analysis of the association between temperature and the risk of neonatal death was carried out using our micro-dataset. First, we looked for further confirmation of newborn over-mortality during the winter. Second, we produced detailed estimates of the probability of death within the first thirty days of life for those births which occurred in the months of December, January, and February. Lastly, we examined the analytical relationship between temperature and mortality during the winter.

In our first model, we estimated the effects of the season without considering specific climatic data. We used a logistic regression where the response variable was death (or not) in the first month of life in Agna and Casalserugo **(table 6)**. The risk of dying during the first month of life is very high (31%). This is especially true in the winter (58%) compared to the summer (11%) and confirms the descriptive patterns displayed in **table 3 –** the starting point of our analysis.

Table 6. Neonatal mortality by season in Casalserugo (1818-1857)

Season of birth	Probability of death	Odds ratio	95% confidence limits	
Summer (J-J-A)	10.7	1	Reference	
Autumn (S-O-N)	26.5	3.2	2.2	4.4
Winter (D-J-F)	58.4	11.6	8.3	16.3
Spring (M-A-M)	29.4	3.5	2.6	4.8

Note. The odds ratios are the result of a logistic model, where the response variable is death (or not) in the first month of life. Other covariates in the model include: sex, year of birth, social class of the parents, distance marriage-birth, distance birth-baptism (see table 3). The total number of births is 2,392.

In a second model, we applied a discrete-time event history logistic regression to the detailed data of Casalserugo, concentrating on the three winter months. These are the months with the highest neonatal mortality of the year[7]. In total, 503 children born in the winter (8,328 person-days) and 294 events (deaths before the end of the first month of life) are included in the dataset. We allowed for a correlation among children within the same family by using the GEE (Generalized Estimating Equations) approach (Diggle et al. 1994). This tool aids in controlling for unobserved characteristics shared by children of the same mother.

The main explanatory variable is the minimum temperature of the day, included in the models as a time-dependent covariate. The other explanatory variables were mainly included as control factors. In order to account for the bell-shaped baseline risk of death in the first month, we considered either age as a continuous variable by including a quadratic term on the logit scale (Model A), or age as a categorical variable in suitable classes (Model B). In order to better explain the effect of temperature on neonatal mortality, we fitted several lagged models to the same data-set. However, the minimum temperatures during the preceding days were not statistically significant if the temperature of the current day was included in the model as a covariate **(table 7)**.

The pattern of the risk of death by age (in days) is shown in **figure 5**. The probability of dying in the wintertime dramatically increases, reaching a peak in the second and third day of life and then subsequently decreasing. In other words, the most critical period is during the first week, omitting the first day. The same model, when applied to children born in the less cold months, shows that the probability of dying monotonically decreases.

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[7] In order to test the consistency of our results, we employed another (unpublished) model in which we included the month of March and obtained very similar results.

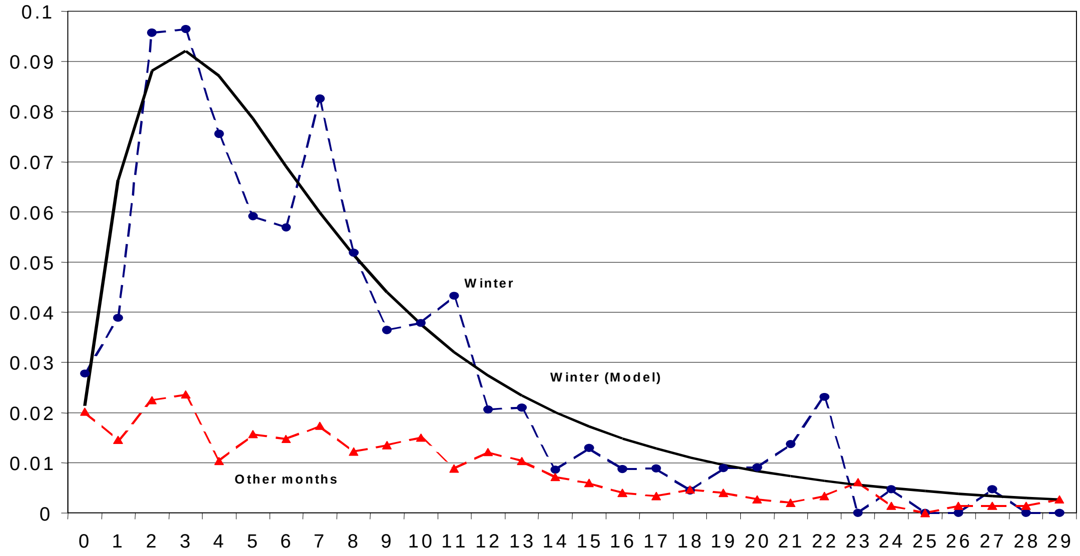
Table 7. Discrete-time Event History Analysis of daily mortality in the first month. Children born in December, January, and February in Casalserugo (1818-1857)

	Model A Age as a continuous variable and family cluster effect			Model B Age as a categorical variable, interaction age & temperature		
	Estimate	Std. error	P-value	Estimate	Std. error	P-value
Intercept	-3.75	0.278	<0.0001	-3.16	0.071	<0.0001
Ln age	2.09	0.305	<0.0001			
(ln age)^2	-0.74	0.082	<0.0001			
Age 0-1				-0.15	0.160	0.3397
2-3				1.01	0.115	<0.0001
4-6				0.64	0.111	<0.0001
7-13				0.02	0.152	0.9232
14 +				0	---	---
December	0	---	---	0	---	---
January	0.03	0.141	0.8419	-0.03	0.086	0.6902
February	0.05	0.146	0.7410	0.04	0.088	0.6356
Male	0	---	---	0	---	---
Female	-0.05	0.118	0.6960	-0.02	0.06	0.7009
MIN temperature C°	-0.05	0.015	0.0009	-0.05	0.019	0.0163
MIN * Age 0-1				0.00	0.044	0.9635
2-3				-0.04	0.031	0.2654
4-6				-0.03	0.030	0.3688
7-13				0.06	0.038	0.1122
14 +				0	---	---
	Intra-family correlation: 0.0132					

The effect of temperature on the survival of winter newborns is substantial and strongly significant. A decrease of 1°C corresponds to a 5% increase in the daily risk of death during the first month of life (**table 7**). According to both models A and B, the daily risk of death during the third and fourth days of life varies from 8% to 13% to 22% if the minimum temperature varies respectively from +5°C to 0°C to –5°C. It is interesting to note that with the inclusion of the minimum temperature in the model, the effect of the month of birth (December, January, or February) is no longer statistically significant. This is a notable result, as some authors have suggested that the survival chances of children are related to the health conditions of their mothers during several susceptible periods of their pregnancies (particularly the second trimester), and that these conditions may vary seasonally (i.e. due to energy stress induced by the harvest cycle; see Scott and Duncan, 2002, chapter 13). This may also hold true in Casalserugo, but for those unlucky children born during the wintertime, the cause of death seems to be overwhelmingly a matter of external temperature. The interaction between temperature and age is not significant, nevertheless the effect of temperature is stronger during days 2-6 (i.e. from the 3rd to the 7th day of life). Furthermore, the probability of death is significantly higher during days 2-6 than during the second week of life (analytical results not shown). If this result is considered together with the shape of the daily-risk function (see **figure 5**), we again have confirmation that the most critical period was the first week of life, omitting the first day.

In conclusion, our analysis provides empirical evidence that for the unlucky children born during winter, the risk of dying during the first month of life was extremely responsive to external temperature, particularly during the first week (and above all the second and third days).

Figure 5. Daily probability of dying during the first month of life by season in Casalserugo (1818-1857): observed and predicted values from model A (see Table 9).



Discussion: cold as a direct cause of death in a poor and malnourished social context

The significant increase in infant mortality in Veneto during the 18th century, and its subsequent rapid decline in the second half of the 19th century was caused mainly by considerable variation in neonatal mortality in the wintertime. The worst time period in this regard was from 1750-1850, when the probability of dying in the first month of life during the colder months (December, January and February) reached levels as high as four hundred per thousand births. These levels are significantly higher than those observed in other areas of Italy and Europe (i.e. Tuscany and England) where winter temperatures were similar to those in Veneto, but winter neonatal mortality was much lower. With specific regard to the first month of life, the risk of dying in the winter months was not homogenous: the period of highest risk was clearly during the first week, mainly the second and third days.

Although we carefully analysed the statistical association between temperature and the risk of dying during the first thirty days of life in Veneto during the first half of the 19th century, the available data do not allow us to reliably delve further into the causal mechanisms. On the other hand, by pooling our results with other findings in the literature, it is possible to suggest several potential explanations, as well as directions for future research.

Information regarding the cause of death, reported in the burial records of Veneto parishes from the 18th and 19th centuries, is vague and does not fit contemporary disease classificatory schemes. Nonetheless, several of the more plausible illnesses should be considered, as they may in part have been responsible for low survival rates during the 18th century. The observed seasonality of neonatal deaths was probably not due to endogenous causes linked to pregnancy, birth, or congenital deformities, as these tend to appear in relatively the same measure throughout the year. Digestive related illness and contagious diseases require a significant amount of time to have a fatal effect, and also do not tend to affect people in the winter more than at any other time. Diseases such as diarrhea do, however, have a seasonal pattern, but peak in the summertime for weaned children (Kale, 2004). Respiratory illnesses (pneumonia, bronchitis, pleurisy, and bronchopneumonia), on the other hand, are more common in the winter. An empirical means of examining the possibility of disease as a causal factor of very high winter neonatal mortality is to analyze the evolution of the daily risk of death following birth. In fact, the newborn is at a higher risk of dying of respiratory diseases during the second and third weeks of life, as shown by the earliest available infant mortality data of good quality, detailed by cause and age at death (Istat, 1934, pgs. 128-131).

On the contrary, the winter increase in infant death in Veneto during the 17th century was mainly due to that which occurred during the first week of life. This suggests that high winter neonatal mortality in Veneto during 1750-1850 was caused directly by the cold, or (1) the rising inability of newborns to survive low temperatures at birth, and/or (2) the increasing inability of parents to protect their children from the cold. In 18th and 19th century Veneto, several issues may have augmented these risks. More specifically, it should be underlined that low-weight newborns are less able react and adapt to the temperature shock typical of delivery, especially when external temperatures are low (see Jeghers, 1976; WHO, 1997; Costello, 2000; Kambarami and Chidede, 2003; Knobel and Holditch-Davis, 2007). Accompanying the increase in winter neonatal mortality in Veneto during the 1700s, there may have simultaneously been a rise in the number of babies born at low birth weights, combined with an inability of parents to aptly care for the former. Evidence of general malnourishment suggests that underfed mothers may have given birth to low-weight infants. According to contemporary data collected in developing countries, the risk of a mother delivering a underweight newborn (< 2,500 g) increases for each cm she is below adequate height, for each kg underweight, and for cm below satisfactory mid-upper arm circumference **(**Lechtig et al., 1978; WHO, 1995; Ramakrishnan, 2004; Ashdown-Lambert, 2005**).**

The growing proportion of malnourished mothers may have been caused by a general worsening in the life conditions and health of the inhabitants in Veneto, above all in the Padana lowlands. Indeed, during the 18th century and into the earliest decades of the 19th century, northern Italy experienced a dramatic economic decline (see the beginning of this article). Cold temperatures during this period may also have affected a greater number of newborns due to the increasing diffusion, during the winters of the 17th and 18th centuries, of "infanticide by neglect" (Knodel and van de Valle, 1979, p. 230). It is not easy to imagine extensive rational strategies of "post-neonatal control" such as abandonment or infanticide (Mason, 1997) which, for some unknown reason, were enormously more diffused during the winter. However, it is possible that scarce attention paid toward children – not unlike that seen during other seasons or previous centuries – had much worse consequences during colder periods, especially in a setting characterized by a lack of material resources. Early baptism – even if not more diffused then in the previous centuries – may also have been especially dangerous for frail and low-weight children of weak mothers. On the other hand, such parental behavior would likely fall into a category of "too much (spiritual) attention" rather than "infanticide by neglect".

From 1750-1850 the living conditions of the working class in Veneto were much worse than the preceding century. From a Malthusian perspective, population growth which followed the end of the plague epidemics was not accompanied by significant changes in productive capacity, or by any preventive checks on uncontrolled population growth. In other words, the preventive Malthusian brakes did not work in Veneto during the 17th and 18th centuries. The average age at first marriage in the mid-18th century was relatively low (20-21 years old), practically identical to the marrying age a century earlier (Rosina and Zannini, 2004). In other areas in Italy, however (such as in Tuscany), population growth following the end of the epidemics slowed due to a rise in the average age at marriage (Breschi and Rettaroli, 1995). The notion that increasingly high winter neonatal mortality in Veneto over the course of the 18th century and into the 19th century can be explained by the deteriorating physical conditions of mothers and by the impossibility of parents to defend their children from the cold fits with knowledge of the region's economic and social history.

This explanatory chain (a general worsening in living conditions → underfed mothers → low-weight newborns → higher neonatal winter mortality) is complicated by the rapid drop in winter infant mortality in Veneto during the second half of the 19th century. This decline cannot be directly associated with an improvement in nutrition, in that the poor health conditions described above did not significantly change for most of the 19th century (as attested to by the stationary statures of draftees, and persistent high levels of mortality and morbidity caused by pellagra). There exist many signs however, that beginning in the mid-19th century, awareness began to grow of the importance of caring for an infant in its earliest moments of life, both at the familial level and at the socio-political institutional level (Derosas, 2003). Moreover, contemporary research from developing countries has shown that with a small degree of extra care (specifically, quickly drying and carefully covering the infant as soon as it is born), the risk of being subjected to cold injuries can easily be diminished also for under-weight children. However, much work remains to be done, as many of these studies are somewhat fragmentary and at times partially contradictory (WHO, 1997; Kambarami and Chidede, 2003; Darmstadt, 2006).

We conclude with some reflections concerning possible lines of future research.

First, more extensive studies using the extremely clear, simple, and complete pre-printed registers of birth, deaths, and marriages for the provinces once part of the Austrian Empire would allow for rich comparative analysis. By means of these historical records, further work might address not only the topic of infant mortality, but also other important population trends of the 19th century, such as the demographic transition, its timing, geography, and causes.

Second, the association between daily temperature and mortality could be more fully explored in other territorial contexts, thanks to the availability of lengthy series of tested and verified published data on temperatures in other cities (see the bottom of **table 4**; see also Camuffo and Jones, 2002, attached CD).

Third, in order to gain a more in-depth understanding of the hypothesized causal factors of high winter neonatal mortality during the century 1750-1850, more data are necessary. Analysis of the links between neonatal mortality and external temperatures could be enriched by considering other indicators that also oscillate across months or years. For example, the prices of essential materials such as firewood and grain typically tended to fluctuate in urban contexts, where these goods were not self-produced and had to be bought. Other direct measures of seasonal variation in working class nutritional status could be obtained by collecting data on the weight and/or the body-mass-index of draftees. Data on mothers from some developing countries suggests that these aspects are quite closely related to the harvest cycle. As weak mothers produce fragile children – who in turn are more susceptible to death caused by the cold – the seasonal pattern of nutrition may interact with the seasonality of temperatures, influencing neonatal mortality.

Finally, additional data on the private and public care of infants would help clarify and shed new light on why northern Italy, notwithstanding persistent malnutrition, started so early on the road towards the Health Transition. Likely, these data are mainly qualitative, and would best be pursued by exploring the rich archives of the 19th century.

5. References

A'Hearn B. 2003. "Anthropometric Evidence on Living Standards in Northern Italy, 1730-1860", *The Journal of Economic History*, 63, 2, 351-381.

Ashdown-Lambert J.R. 2005. "A review of low birth weight: predictors, precursors and morbidity outcomes", *The Journal of the Royal Society for the Promotion of Health*, 125, 2, 76-83.

Breschi M. 1999. (ed.) *Vivere in Friuli. Saggi di demografia storica (secc. XVI-XIX)*, Forum, Udine, Italy.

Breschi M. and M. Livi Bacci. 1986. "Saison et climat comme contraintes de la survie des enfants", *Population*, 1, 9-36.

Breschi M. and M. Livi Bacci. 1997. "Month of Birth as a Factor in Children's Survival", in A. Bideau, B. Desjardins and H. Pérez Brignoli (eds.) *Infant and Child Mortality in the Past*, 157-173, Clarendon Press, Oxford, UK.

Breschi M. and R. Rettaroli. 1995. "La nuzialità in Toscana, secoli XIV-XIX", in M. Breschi and L. Del Panta (eds.) *Le Italie demografiche. Saggi di demografia storica*, 21-43, Udine.

Camuffo D. and Ph. D. Jones. 2002. (eds.). *Improved Understanding of Past Climatic Variability from Early Daily European Instrumental Sources* (with CD-ROM), Springer, London, UK.

Costello A. 2000. "New methods for monitopring neonatal hypothermia and cold stress", in A. Costello and D. Manandhar (eds.): *Improving Newborn Infant Health in Developing Countries*, Imperial College Press, London, UK.

D'Angelo S., G. Dalla Zuanna and A. Rosina. 2003. "Massimo risultato con il minimo sforzo. Ricostruzione nominativa semiautomatica della sopravvivenza infantile, e analisi del regime demografico di Alì nel XVIII secolo", in M. Breschi, R. Derosas and P.P. Viazzo (eds.) *Piccolo è bello. Approcci microanalitici alla ricerca storico-demografica*, 67-92, Forum, Udine, Italy.

Dalla Zuanna G., A. Rosina and F. Rossi. 2004. (eds.) *Il Veneto. Storia della popolazione dalla caduta di Venezia a oggi*, Marsilio, Venezia, Italy.

Dalla Zuanna G., S. Bergo and S. Bonomo. 2005. *La mortalità infantile nel Veneto nella prima metà del XIX secolo. Una ricostruzione nominativa per due parrocchie padovane*, paper presented at Giornate di Ricerca sulla Popolazione, Italian Statistical Society, 16-18 February, Padova, Italy.

Darmstadt G.L. et al. 2006. "Introduction of community-based skin-to-skin care in rural Uttar Pradesh, India", *Journal of Perinatology*, 1-8.

Del Panta L. 1997. "Infant and Child Mortalità in Italy, Eighteenth to Twentieth Century: Long-Term Trends and Territorial Differences", in A. Bideau, B. Desjardins and H. Pérez Brignoli (eds.) *Infant and Child Mortality in the Past*, 1-4, Clarendon Press, Oxford, UK.

Derosas R. 2003. "Watch out for the Children! Differential Infant Mortality of Jews and Catholics in Nineteenth-Century Venice, *Historical Methods*, 36, 3, 109-130.

Diggle, P.J., K.Y. Liang and S.L. Zeger. 1994. *Analysis of Longitudinal Data*, Clarendon Press, Oxford, UK.

Flinn M.W. 1981. *The European Demographic System*, Harvester Press, Brighton, UK.

Fornasin A. 1999. "Diffusione del mais e alimentazione nelle campagne friulane del Seicento", in M. Breschi (ed.), *Vivere in Friuli. Saggi di demografia storica*, 21-42, Forum, Udine, Italy.

Jeghers H. 1976. *Accidental Hypothermia, Prepared for Medical Grand Rounds St. Vincent Hospital*, Worcester, Mass, http://www.jeghers.com/annts/ACCIDENTALHYPOTHERMIA.html.

Kale P.L., V.L. Andreozzi and F.F. Nobre (2004) "Time series analysis of deaths due to diarrhoea in children in Rio de Jeneiro, Brazil, 1980-1998", *Journal of Health Population and Nutrition*, 22, 1, 27-33.

Knodel J. and E. van de Walle (1979) "Lessons from the past: policy implications of Historical fertility studies, *Population and Development Review*, 5, 2, 217-245.

Lazzarini A. 2002. (ed.) *Diboscamento montano e politiche territoriali. Alpi e Appennini dal Settecento al Duemila*, Milano, Franco Angeli.

Lechtig A., H. Delgado, R. Martorell, D. Richardson, C. Yarbrough and R.E. Klein. 1978. "Effect of maternal nutrition on infant mortality", in W.H. Mosley (ed,) *Nutrition and Human Reproduction*, Plenum Press, New York and London, USA-UK.

Lee C.H. (1991) "Regional inequalities in infant mortality in Britain, 1861-1971: Patterns and hypotheses", *Population Studies*, 45, 55-65.

Livi Bacci M. 1986. "Fertility, Nutrition and Pellagra. Italy During the Vital Revolution", *Journal of Interdisciplinary History*, 16, 3, 431-454.

Livi Bacci M. 1990. *Population and nutrition*, Cambridge University Press, Cambridge, UK.
Livi Bacci M. 1997. "Introduction", in A. Bideau, B. Desjardins and H. Pérez Brignoli (eds.) *Infant and Child Mortality in the Past*, 1-4, Clarendon Press, Oxford, UK.
Malanima P. 2003. "Measuring the Italian Economy. 1300-1861", *Rivista di Storia Economica*, 19, 3, 265-295.
Malanima P. 2006. "An Age of Decline. Product and Income in Eighteenth-Nineteenth Century Italy", in *Rivista di Storia Economica*, 22, 1, 91-133.
Mason K. 1997. "Explaining fertility transition", *Demography*, 34, 4, 443-454.
McKeown T. 1976. *The Modern Rise of Population*, Academic Press, New York, USA.
Preston S.H. and M.R. Haines 1991. *Fatal Years*, Princeton University Press, Princeton, NJ, USA.
Ramakrishnan U. 2004. "Nutrition and low birth weight: from research to practice", *American Journal of Clinical Nutrition*, 79, 1, 17-21.
Rosina A. 1995. "La popolazione del Veneto durante la dominazione austriaca. Un tentativo di ricostruzione (1815-1865)", *Bollettino di Demografia Storica*, SIDES, 23.
Rosina A. 2000. "La popolazione di Venezia, 1633-1797: una ricostruzione delle dinamiche evolutive" in A. Rosina and F. Rossi (eds.), *Il sistema demografico alla fine delle grandi epidemie. Venezia, il Dogado, Chioggia tra Seicento e Settecento*, CLEUP, Padova, Italy.
Rosina A. and A. Zannini. 2004. "Mortalità infantile", in G. Dalla Zuanna, A. Rosina and F. Rossi (eds.) *Il Veneto. Storia della popolazione dalla caduta di Venezia a oggi*, 177-194, Marsilio, Venezia, Italy.
Rossi F. 1970. "Storia della popolazione di Adria dal XVI al XIX secolo", *Genus*, 26, 1-2, 73-167.
Rossi F. 1977. "Crisi di mortalità ad Adria nel contesto ambientale dei secoli XVII-XIX", *Genus*, 33, 3-4, 83-118.
Rossi F. and A. Rosina. 1998. "Il Veneto fra Sette e Ottocento", *Bollettino di Demografia Storica*, 28, 89-114.
Rossi, F. and F. Tesolat. 2005. *Analisi della stagionalità in un contesto di alta mortalità infantile. Adria, 1675-1900*, paper presented at Giornate di Ricerca sulla Popolazione, Italian Statistical Society, 16-18 February, Padova, Italy.
Scott S. and C.J. Duncan. 2002. *Demography and Nutrition*, Blackwell Publishing, Oxford, UK.
Sormanni G. 1881. "Geografia nosologica", in MAIC, *Annali di statistica*, serie II, vol. 6, Roma, Italy.
Viazzo P.P. 1997. "Alpine Patterns of Infant Mortality in Perspective", in A. Bideau, B. Desjardins and H. Pérez Brignoli (eds.) *Infant and Child Mortality in the Past*, 61-73, Clarendon Press, Oxford, UK.
WHO. 1995. *Maternal anthropometry and pregnancy outcomes: a WHO Collaborative Study*. Bull World Health Organ 73 (suppl.) 1-98.
WHO. 1997. *Thermal protection of the newborn: a practical guide*, Department of Reproductive Health and Research, World Health Organization, Geneva, Switzerland.
Woods R. 1997. "Infant Mortality in Britain: A Survey of Current Knowledge on Historical Trends and variations", in A. Bideau, B. Desjardins and H. Pérez Brignoli (eds.) *Infant and Child Mortality in the Past*, 74-88, Clarendon Press, Oxford, UK.
Wrigley E.A and R.S. Schofield. 1981. *The population history of England, 1541-1871. A reconstruction*, Arnold, London, UK.
Vallin J. (1991) "Mortality in Europe from 1720 to 1914: Long-term trends and patterns by age and sex", in R. Schofield, D. Reher and A. Bideau (eds.), *The decline mof mortality in Europe*, Oxford, 38-67.
Zannini A. and D. Gazzi 2003. *Contadini, emigranti e "colonos". Tra le Prealpi venete e il Brasile meridionale: storia e demografia, 1780-1910*, Fondazione Benetton Studi Ricerche, Canova, Treviso, Italy.

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