The Sardinian experience of the lowest Italian infant mortality at the turn of the twentieth century. True or false empirical evidence?

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THE SARDINIAN EXPERIENCE OF THE LOWEST
ITALIAN INFANT MORTALITY AT THE TURN OF
THE TWENTIETH CENTURY. TRUE OR
FALSE EMPIRICAL EVIDENCE?

By Marco BRESCHI, Massimo ESPOSITO,
Stanislao MAZZONI, and Lucia POZZI

INTRODUCTION

The temporal trend and the geographical patterns in the decline of infant mortality in Italy, after national unification (1861), are quite well known. Indeed, since 1862, official statistics (Istat, 1958; 1965; 1975) allow to calculate annual infant mortality rates (and its component: neonatal and post-neonatal), as well as stillbirth rates for the whole country and for each region.

The reduction of mortality in the first years of life played a crucial role in the variation of health transition patterns which marked the Italian regions: the departure time and quickness of the decline were territorially differentiated. Therefore it is not surprising that considerable research has been done on infant and child mortality transition in terms of temporal evolution, geographical differences, cause specific structure, etc.¹ On the contrary, stillbirth has received very little attention due to bias in the related official statistics.

The limitations of official sources, even not absent in current statistics (Gourbin and Masuy Stroobant, 1995a; 1995b; Woods, 2008a, 2008b), are well known and documented for the past (Woods, 2009). This complex issue has recently been the subject of careful analyses focused on the philological contents of stillbirth historical documentation, the criteria of classification adopted, and their consequences on the measures of stillbirth and neonatal mortality (Mooney, 1994; Woods, 2005; 2009; Davies, 2009; Gourdon, Rollet, 2009). In general, it has been observed in all Western countries improving registration accuracy particularly during the twentieth century. In Italy the number of stillbirths increased until about 1925, and the subsequent rapid decline were pro-bably due to changes in the accuracy of the definitions of “live-born” and “stillborn” babies. In fact, the impression of a steady decline in infant mortality rate (IMR) since about 1870 is somewhat weakened, if we consider the joint evolution of stillbirth and infant mortality rate (Del Panta, 1997). Indeed during some decades this ratio shows an appreciably slower reduction.

This example demonstrates the prudence which needs to be exercised, when dealing with these aggregative mortality indicators, especially since our aim is that of making international
comparisons. In Italy, a similar caution, as it has been recently observed (Woods, 2009), is also needed to compare the evolution of infant mortality in different areas of the country\(^2\).

According to the official sources, in the last decades of the nineteenth century, two different models of high infant mortality characterised the Italian provinces. The first one was peculiar to the north-east and the centre of the country, the other one was a typical feature of the southern provinces. The age structure of these two models was completely different. In the first one the very high level of IMR was mainly linked to an unusual frequency of babies who died within the first month. In the other one post-neonatal mortality represented the basic and most important component. However, the number of deaths in the first month, as measured in the official statistical sources, might be affected by the varying quality and completeness of the records of “stillbirth” throughout the country.

In short, on the basis of these official sources, it is possible to sketch out, at the national and regional level, the evolution of both stillbirth and neonatal mortality rates. The overall evolution appears tricky at the national level, but especially at the regional one. The empirical evidence, probably, reflects mainly different applications of the various recording procedures of stillbirths and early neonatal deaths, rather than actual differences in the temporal evolution of stillbirth rates.

The aim of this paper is primarily to reconsider the evolution of infant mortality in the general process of gradual improvement in the registration of stillbirths. We also intend to accurately retrace, for the Sardinian town of Alghero, the structure of mortality in the first month of life and its trend over time and to propose a new analysis of its determinants according to our revised estimates.

The next section is in fact dedicated to the topic of stillbirths identification and recording procedures. Follows a brief overview of the evolution of stillbirth and infant mortality in seven regions characterised by strong differences in the structure (neonatal and post-neonatal) mortality. In order to disentangle the Italian experience of stillbirth, we focus our attention on the town of Alghero, in the Italian region with the lowest neonatal and infant mortality rate. In the fourth section, besides describing the essential socio-demographic traits of Alghero, we present the results of a detailed analysis of the civil status records (births and deaths) for the period 1866-1925.

In the fifth section, we apply a micro-analytical approach, at the individual level, to verify whether the inclusion of the category that we label “false stillbirths” modifies the identification of the most relevant determinants of early neonatal mortality rates.

## Stillbirth Registration Practices

Up to now past Italian stillbirth registration practices have not been carefully reconstructed. Even though the government authority was aware of the necessity of providing the country with a unique national vital statistics system\(^3\), the specific conditions operating at the local level were complicated and highly differentiated in the years following the creation of the Italian Kingdom (1861).
The realisation of a unique national vital statistics system (births, deaths and marriages) was extremely fast, considering the difficulties of homogenising the various recording practices inherited from the different formerly independent States of the Italian peninsula (Istat, 1961).

In this regard it is important to emphasise that, until the short interlude of the Napoleonic domination, the church authority had been always responsible for the registration of births, deaths and marriages.

After the Napoleonic interlude, the parish priests, even if with differences in the various parts of the country, were given responsibility for keeping the civil records. They were required to make out both civil and parish records. This duplex function was well established in the Grand Duchy of Tuscany, in the Kingdom of Lombardy and Venetia, as well as in the Kingdom of Sardinia. In the municipalities of the Kingdom of Two Sicilies, instead, the local civil authorities took charge of the collection of vital statistics. On the opposite, in the Papal States, which included Latium, Marche, Umbria and part of Emilia-Romagna, a civil vital statistics registration system did not exist.

This diversified departure situation had further deteriorated as a consequence of a) the complex and often traumatic expansion process of the new Kingdom (with the annexation of the Veneto regions and the Mantua districts in 1866, of Roma and Latium in 1870); b) the process of continuous administrative reorganisation with territory exchanges between different regions; c) the difficult training of local teams of civil officers.

Furthermore, the development of a troublesome and prolonged state-Church fight played a relevant role. On the 1st January 1866, indeed, the first national Civil Code of the Italian Kingdom came into force and established the exclusive legal state authority for the registration of vital statistics. Religious marriages were no longer recognised by the state.

These legislative proceedings profoundly changed secular customs and traditions attached to marriage. The Church was losing its primary and unique role over the formation and life of the new families. Thus, it reacted by declaring null and void any civil marriage and by strongly inviting parishioners to place religious marriage before civil marriage (Rocchi, 1893). This warning of the Church had obviously hold over a catholic population that was used to celebrate marriage in church and follow catholic beliefs. Thus, the new institute of marriage was hardly accepted by many people from the Italian most catholic areas and this concretely means a number of civil marriages 10% lower than the religious ones in the years following the introduction of the law (Bodio, 1880; Somogy, 1965). Only at the end of the nineteenth century, and only in some Italian areas, the contrast between state and Church was reduced. However there is general agreement on the fact that the phenomenon of religious marriages still existed until 1929, when the fascist government officially recognised the religious marriages.

Before 1929, couples married only in church had no civil rights. In particular, the state did not recognise the spouse and the children as legitimate heirs, and, furthermore, the latter were recorded in the civil registers as illegitimate, biasing the official statistics on illegitimacy (Benini, 1911; De Vergottini, 1965).
In fact, the proportion of illegitimate births passed from about 4% in 1862-64, to 6.2% in the three-year period after the introduction of the law, and, finally, to over 7.5% in mid-80’s⁷: as a consequence of this fictitious increase, infant mortality and particularly neonatal mortality differentials between legitimate and illegitimate children decreased.

Moreover, it is quite plausible that the civil status officers during the first decades after national unification did not register the total number of births: in particular a proportion of those infants born by couples married only in church and dead during or soon after the delivery might have been not included.

The legal criteria adopted by the Italian Kingdom favoured serious problems and errors in the births and deaths registration (Bodio, 1876). In particular, two elements engendered great confusion: a) parents had five days to notify to the civil status officers the birth of a child; b) the new Italian government adopted the concept of “legal viability” (“vitalità legale”) which meant, in practice, that the infant was defined “alive born” (“nato vivo”) if he was alive at the time of notification; while, according to the bureaucratic diction, the baby was considered as “born not alive” (“nato non vivo”) – practically stillborn – if deceased at the time of notification, regardless of the condition of viability at birth.

Given the high mortality, many children were so classified as “born not alive” in the register of births. Moreover, parents whose babies died before the notification (aged less than 5 days) were exempted from the duty of presenting the infant to the civil officer and for this reason it did not exist any death certificate redacted by a medical necroscope nor a corresponding record in the register of death⁸.

The General Directorate of Statistics gave different instructions though⁹: babies who died before the notification, but gave vital signs had to be computed as babies born alive. This discrepancy between the legal and the statistical criteria caused differences amongst the Italian communes in the classification and recording of stillbirths and neonatal deaths, attested by the contemporary official sources. The General Directorate attested in various occasions an exceptionally high number of stillbirths in various Italian communes. In particular, a ministerial circular dating 1879 (MAIC, 1879) listed 110 municipalities where the stillbirth rate was in 1877 “manifestly excessive”; the great majority of these municipalities were located in the northern and central regions and in more than 1/5 of cases, the rate exceeded 200 per thousand. In so doing, the ministry paid less attention to the municipalities – mainly in southern Italy – where the phenomenon of stillbirths was virtually non-existent.

The statistical system of stillbirths recording improved in the mid-80s of nineteenth century, in particular (as discussed in the next paragraph) in the northern regions. It was long and convoluted: Italy has in fact conformed to international criteria for the definition of live birth and stillbirth only since 1958 (Istat, 1975, 7). However, the situation remained confused for a long time, as shown by the Italian answer given within the Special Committee on Infantile Mortality: “Infants dying in utero or during birth are deemed to have been born dead; all other, born
alive. A child born alive, but dying before registration of birth is, at law, stillborn, but for statistical purposes is counted as a ‘live-birth’” (Report on Special Committee on Infantile Mortality, 1912, 37).

Through continuous pressure on mayors and heads of civil status offices, the indications coming from the General Directorate of Statistics began to be implemented. Notwithstanding the rules set out in the Civil Code, the communes began to include in the category of stillbirths “creatures came to light only born dead or who died in childbirth” and to exclude from this category “all those creatures who died in the interval between birth and the day of their presentation to the state civil office” (MAIC, 1879).

Despite the continuous observations, the communes continued to adopt different criteria in the registration of stillbirths (Di Comite, 1968). And, as the Italian Statistical Institute recognises, only with the reorganisation of the statistical services (1926), the offices came to a correct application of criteria and a careful analysis (“through direct correspondence with com-munes”) of statistics on stillbirths, births and infant deaths (Istat, 1957, 105).

**STILLBIRTH IN ITALY ACCORDING TO THE OFFICIAL STATISTICAL SOURCES**

From an initial extremely confused situation, the process of stillbirth registration improvement started, with different times and patterns in the various regions, from the mid 80’s and especially the first years of the 90’s, when the criterion of the effective viability at birth suggested by the General Directorate of Statistics was applied more and more. The progressive improvement is evident in the national stillbirth rate trend (fig. 1).

After the sudden variations in the first years following national unification, we can observe a gradual increase in the stillbirth rate passing from about 20 to 40 per thousand at the end of the nineteenth century. After the negative First World War parenthesis, stillbirth rate knew a slow and almost constant reduction, again interrupted during the Second World War. According to the official statistical sources, in the 1950’s the stillbirth rate returns to the level observed after national unification.

This path, even if based on official statistical sources, does not reflect the effective, but unfortunately unknown trend of this demographic phenomenon in Italy. The general picture is extremely differentiated at the territorial level (Lenzi, 1954; Istat, 1975; Del Panta, 1997; Pozzi, 2000; Breschi, Fornasin, 2007). In order to simplify our description, we have chosen to analyse, beside the Sardinian island, the following regions: Piedmont and Lombardy in the north, Tuscany and Marche in the centre, Calabria and Sicily in the south.

This choice has been motivated for different reasons. First of all we have excluded the regions characterised by significant territorial changes (Veneto, Umbria, Latium, Abruzzi and Campania) or annexed to the Italian territory after the First World War. The seven selected regions (among the remaining eleven) have been chosen with the aim of guaranteeing a whole country coverage, including different models of stillbirth rate in terms of timing and pattern and also showing very diversified situations in terms of early life mortality structure.
The analysis is carried out using graphical representations. The following graph (fig. 2) synthesises the evolution of stillbirth rates, according to the official statistics, in the seven selected regions, expressed by 7 years period moving averages calculated for ninety years (1864-1953).

Calabria and Sicily, as well as Sardinia, were characterised by extremely low initial levels of stillbirth rates (the area included in the ellipsis). The strong increase in stillbirth rates observed in these regions and their level in line with those of the other ones, at the beginning of the twentieth century, reveal the significant limitations of stillbirth registration practices (Ulizzi, Novelletto, 1984; Woods, 2009).

The impression of an erroneous registration of stillbirths in the South and in the islands is strengthened by observing that their levels in the first decade after national unification (5-15 per thousand) were significantly lower compared to the ones recorded almost one hundred years later (40 per thousand in Calabria and Sicily).

**Fig. 1 Stillbirth rate (per thousand), Italy 1864-1959**

![Graph of stillbirth rate](image)

Source: Elaborations on official MAIC, DIRSTAT and ISTAT statistics

Also in the northern and central regions, with the only partial exception of Lombardy, during the nineteenth century, a progressive increase in stillbirth rate was observed: an additional proof of a plausible improving registration. On the contrary, the following slow decline was due to the progress experienced in life conditions, in different times and forms, by the populations in the north and centre of the country, after the First World War.

For these same regions we can offer, thanks to an estimation procedure realised for overcoming the limitations of the statistical documentation for the years 1891-1906 (Istat, 1975; Breschi, Fornasin, 2007), an analysis of the evolution of neonatal mortality rates, expressed by 7 year period moving averages (fig. 3). Also in this case, the south and the islands show initial moderate levels (60-80 per thousand) and a relative advantage, in comparison
with the other regions, still evident in the first years of the twentieth century. In Sardinia, as Coletti sharply focused in 1908, the advantage is clear and resists after the Second World War. Quite the reverse, mortality selection during the first month of life was more elevated in the northern and Adriatic regions (Marche) with risks doubling the levels recorded in the southern regions. To explain these relevant differentials, the climate influence has been recently pointed out by several scholars (Breschi, Livi Bacci, 1986; Breschi et al., 2000a; Derosas, 2009; Dalla Zuanna, Rosina, 2009; 2011). Mortality selection in the first month of life in the northern and central regions affected mostly the babies born during the winter months. Their selection was so strong that it increased the mortality risks of the whole corresponding birth cohort.

Fig. 2 Stillbirth rate (per thousand) in seven Italian regions, 1864-1953 (moving averages)

Source: Elaborations on official MAIC, DIRSTAT and ISTAT statistic.

Fig. 3 Neonatal mortality rate (per thousand) in seven Italian regions, 1864-1953 (moving averages)

In the immediately following ages, the southern advantage almost completely disappeared. Post-neonatal mortality rates (fig. 4) were always significantly higher in Sicily and Calabria. More moderate levels, but still high, were recorded in Sardinia were the diffusion of breastfeeding after the first birthday of the child, mitigated mortality selection, in particularly due to gastrointestinal diseases (Coletti, 1908; Pozzi, 2000; Gatti 2002; Matta, 2010). The regions of the north always knew more moderate levels, with the exception of Lombardy where an early weaning, favoured by the intensification of female working activities – not only in the industrial sector (Pozzi, Rosina, 1999) –, prevented significant reductions before the 1920’s and 1930’s.

The last figure offers a general view of mortality selection in the first year of life (fig. 5).

The disparities north-south and east-west are less clear. Sardinia emerges as the region with the lowest death risks until the end of the nineteenth century, thanks to a combination of extremely low neonatal mortality rates and post-neonatal mortality rates in line with the national average.

Considering the whole first year, the advantage of the southern regions decreased; indeed, their lower neonatal mortality is more than counterbalanced by the high selection after the first month. To this regard, Tuscany and Piedmont are the regions which more benefited from the general mortality decline started at the end of the nineteenth century. On the opposite side, Lombardy is the region with the highest infant mortality rates until the 1930’s: between 1864 and 1933 about 200 babies on 1000 born did not survive at their first birthday. This means a significant loss of human capital, considering the relevant economic progress of Lombardy, particularly from the beginning of the twentieth century (Daniele, Malanima, 2007). An economic growth paid by the population: the duty is even higher if one takes into account also the elevated stillbirth rate recorded in Lombardy since national unification – in this case the selection reaches 230 per thousand.
This calculation is unconventional and implies an inadequate statistical documentation. The limitations of stillbirth records seem well evident, bearing in mind the empirical evidence, as well as the remarks offered by the officers of the General Directorate of Statistics (see note 9) and also by several scholars of the time (Bodio, 1876; Raseri, 1879; Maggiore Perni, 1880; Guzzoni degli Ancarani, 1913).

If we apply the same calculation criteria to the data of Sardinia, one of the regions with the slowest and latest economic development of the country, between 1864 and 1933, the loss of human capital amounts to 170 per thousand (150, considering only infant mortality).

The gap with Lombardy is large: exclusively in terms of infant mortality it is about \( \frac{1}{4} \), while considering also stillbirth rates, the gap increases.

In light of the statistical registration limitations (of births, stillbirths, and deaths in the first days of life), we can speculate about the real wideness of regional (and even more provincial and municipal) disparities. The question is perfectly plausible, considering also the first provisional check applied to birth and death civil records in few Sardinian municipalities (Breschi et al., 2007).

In the first five-year periods after national unification, the number of deaths in the first week of life – which comes only from the legal “live born”, i.e. the babies still alive at civil status notification – is so low that early neonatal mortality is only around 5-8 per thousand. This means a level largely lower than the one recorded in Sardinia at the end of the 1920’s (16-17 per thousand) when the official statistical documentation on the number of deaths in the first days of life is at our disposal.

How one can explain these very low levels of stillbirth, as well as perinatal and neonatal mortality? Are they a specific trait of Sardinian and southern regions demographic evolution? Or are they at least partially a result of a defective and incomplete registration of demographic events?

In order to understand more in depth the problem, we analyse this question from a different point of view.
As anticipated above, we shall now observe close up infant mortality selection in a Sardinian municipality.

**A FIELD VERIFICATION**

*The community*

Alghero is a large coastal town in north-western Sardinia that, before national unification, constituted with the regions of Piedmont and Liguria the Kingdom of Sardinia. According to the first Italian Census (1861), Alghero, with its 8,891 inhabitants, was the fourth municipality in the island. As well as in the rest of the region, Alghero economy was essentially based on the primary sector which absorbed more than half of the male labour force. Being located along the coast, the city hosted a significant presence of fishers, sailors and coral fishers as well as artisans and traders. These two socio-professional groups were well balanced and amounted to the 45% of labour force. The socio-economic structure also included a limited (2%) but relevant group of well-off individuals, formed by the few local nobility exponents and the more frequent – even if still a minority - professionals and executives.

More than ¾ of Alghero population were almost completely illiterate, as everywhere in Sardinia. The city hygienic conditions were critical, as various national surveys as well as a large variety of documents (petitions, requests and protestations) kept in the historical archive of the local municipality attest. The sewer system was very poor; the population was thickened, particularly in the dirty harbour side alleys, where the water was insufficient and of bad quality. The hygienic problems of the city were partially solved at the end of the nineteenth century and even more in the first decades of the twentieth century.

Compared to the interior municipalities of the island, Alghero was better served with medical cares which were in any case defective and insufficient (Gatti, 1999; Putzolu, 1993). According to the National Survey on the hygienic conditions of the Italian municipalities realised in 1885 by the General Directorate of Statistics (MAIC, 1886), Alghero could count on 6 medical doctors, 3 pharmacists and 3 registered midwives (this doesn’t necessary mean that they had an adequate professional training). The municipal administration had a contract with the local hospital, administered by the Congregazione della Carità, for the cure of indigent citizens. According to various lists of the indigent families kept in the local municipality historical archive, about 40% of the families were classified as “poor”.

*The sources*

The demographic information is based on civil records of birth, death and marriage which were introduced in the island in 1866, according to the rules of the newly unified Kingdom of Italy. Our analysis covers the years 1866-1925.10

All the data reported in the civil records have been nominally digitised; we have then carried out the standard cross check procedures in order to reconstruct the individual biographies as well as the family histories.

We have integrated and controlled for coherence the information reported in the civil records with data included in
other sources of different origin, like military enrolment records, some limited and partial records deriving from the Population Register and the original family sheets of the 1921 Alghero census. Lastly, we have combined the demographic information derived from the civil status registers with the data contained in the parish registers of baptisms, burials and marriages.

The consequences of the state-Church conflict in terms of marriage recording procedures have been largely solved: we were able to reconstruct the correct temporal sequence of the various demographic events: marriage and children’s births independently of kind of marriage (civil/religious) (Breschi et al., 2009).

Furthermore, we have analysed, as we shall illustrate, stillbirth recording procedures in the civil documentation as well as in the parish one.

Even if inevitable imperfections are remaining, we can follow at the nominative level the biographies of the children born in Alghero between 1866 and 1925, particularly for the children born in the families formed since 1866. Only for these children, indeed, we have at our disposal the information on the family of origin: they constitute about the 71% of the total number of births. For this large set of individuals, roughly corresponding to the children of the families formed between 1866 and 1920, we propose in the last section of this article a micro analytical study on early-life mortality.

**Stillbirths registration in the municipality of Alghero**

The objective difficulties in still births categorisation in a time when the great majority of deliveries were not medically assisted (by a medical doctor nor by a trained midwife) make particularly complex the measure of still birth rate as well as in general late foetal mortality.

After a careful examination of the information reported in the Alghero civil records of birth, we can conclude that, in the first years after national unification, the civil status officers diligently observed the principle of legal viability (tab. 1). Between 1866 and 1875 we find 4,569 birth records: of these, 206 records refer to infants dead at civil status notification. As we can observe from the data reported in the table, 199 of these 206 records include the diction “born not alive”, while for the 7 remaining we have found the wording “still born” in 3 cases, “born and dead during the delivery” in 1 case, and the specific information on the age at death only for 3 babies. Just for these last three babies we can ascertain that they were “false stillborn”. Of any help is the information eventually contained in the death records.

The diction “born not alive” means only that the infant was not alive at the time of birth registration. For more details see section 2.

For these 206 infants “not alive” at civil status notification, we find the reference to the “exemption from civil status presentation” attached to the declaration signed by the necroscopical medical doctor and consequently there isn’t any record of death which might have helped us to settle the age at death.

In mid 1880’s we can notice the first effects of the General Directorate of Statistics requests of identifying the real “stillborn”. The wording “stillborn” appears with a certain regularity and tends to be more frequent in the following decades while the diction “born not alive”
becomes less frequent. Nevertheless during the years 1884-1891 the dictons “born not alive”, “stillborn” and “born and dead during the delivery” were alternatively used: an indirect sign of a still present uncertainty in births registration procedures.

Only since 1892, the criteria dictated by the General Directorate of Statistics were applied. From this year, in the civil records of birth we find almost exclusively the wording “stillborn” and, in the mean time, in the remaining cases referring to infants who died before civil status notification is almost always indicated the number of hours of days elapsed between birth and death. This last procedure is not due to a longer interval between birth and civil status notification (tab. 2). The comparison between the date and the hour of birth and the date of registration reported in the records of birth show that the great majority of “stillborn” (81.3%) was notified to the civil status authority within 24 hours after birth. This proportion will amount to almost 94% if we include also the notifications done within the second day of life. This means that most of these infants died soon after delivery.

Looking back to table 1, it is interesting to notice the limited number of death records referring to infants dead few days after delivery (column g). In the sixty years analysed (1866-1925) we have found only 164 death records relative to infants dead aged less than 6 days, corresponding to a mortality selection between 6.1 per thousand (=163/26605) and 6.4 per thousand (=163/26605-1091), according to the denominator selected.

These values are exceptionally low: for instance they are lower to mortality in the first day of life recorded in Italy, as well as in Sardinia, at the beginning of the 1970’s.

These data suggest the hypothesis of an uncompleted registration of deaths occurring soon after birth and this hypothesis is strengthened by the high

<table>
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<th>Source</th>
<th>Birth registers</th>
<th>Death registers</th>
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<tr>
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<td>Born not alive</td>
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<td></td>
<td>(a)</td>
<td>(b)</td>
</tr>
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</table>
number of born “not alive” at civil status registration with the indication of a specific age at death. The number of these events, between 1866 and 1925, is equal to 216. It is higher than the already mentioned figure of 163 infants dead in the first 5 days of life recorded in the register of deaths. It is worth recalling that for no one of these 216 cases a death record exists and they should not have been counted in the official number of deaths and, consequently, in the official measures of infant mortality.

This could explain the exceptionally low neonatal mortality recorded in Alghero, as well as in the rest of the island. If we add these 216 deaths to the 163 recorded in the register of deaths, relative to the first 5 days of life, mortality selection reaches 14.7 per thousand, \((163+216)/(26605-(1091-216))\), a value which is more than double compared to the one obtained using only the events reported in the records of death.

Also infant mortality rates should be corrected and raised and in the specific case of Alghero (see tab. 1) their value would be comprised between 200.2 \((=5107/[26605-1091])\) and 206.9 \((=[5107+216]/[26605-(1091-216)])\) per thousand, depending on the denominator adopted.

Our conjecture is confirmed by the data reported in the official annual volumes edited by the General Directorate of Statistics. These publications contained detailed information on present population movement for each municipality of the Italian Kingdom. We have verified that, except for few little discrepancies, the number of official stillbirths (distinguished by sex) of each year corresponds to the total number of “born not alive” (col. b, table 1) plus “stillborn” (col. c, table 1)\(^\text{13}\). As well as official live births correspond to the difference between the total number of births and the amount of “stillbirths”, excluding the births taking place outside Alghero municipal territory, but referring to couples there resident. The same is generally true also for the deaths.

Our analysis shows at least for the community of Alghero that the official statistical publication underestimates infant mortality, particularly early neonatal mortality. If we apply to the
mortality data of the whole Sardinian region a correction similar to the one we have at first estimated for Alghero (of at least 7 points per thousand), infant mortality rate is close, or perhaps even a bit higher, since national unification, to the corresponding rate recorded in Tuscany and Piedmont. The lowest Italian infant mortality record during the nineteenth century would be at least questioned, if not confuted: the result has to be connected with the size of the correction to be done for the other regional data – which have not been carefully analysed –, but the impression of a more biased and defective registration of still birthrates and early neonatal mortality rates in the southern regions and in the islands is strong.

We have also compared civil status data with the parish register records for the years 1866-1891. The results of this cross check might be summarised as follows:

a) The parish records, unlike the civil ones, that referred to “stillborn” (and “false stillborn”) babies are more frequently included among the burials and less among the baptisms. For the years 1866-1891, for each “stillborn” baby found in the register of baptisms we have found 1.5 in the burials register. This result has to be linked, at least partially, with the Alghero use of giving the baptism – at least the “official” one (i.e. the baptism celebrated in church at the presence of the godfather and the godmother as well as relatives and friends) –, few days after birth and not on the same day of birth or the immediately following as usually observed in other areas of the country. Considering the high risks of death in the very first days of life, the longer the distance between birth and baptism the higher the baby’s probability of dying before the baptism and consequently the “missing” baptism record relative to this baby.

b) At least for the years examined, the numbers of “stillborn” (and false “stillborn”) babies are more frequent in the civil records than in the religious ones. In the parish registers we have found 176 (37%) of the 473 “stillborn” babies registered in the civil status registers. On the opposite side, the presence of stillborn babies recorded only in the religious sources is almost negligible. In 5 years, selected as a sample, we have identified only the case – moreover uncertain – of one baby recorded in the burials registers absent in the civil records.

c) Lastly, we can affirm that more than half of these 176 babies recorded in the religious registers belong to the category “false stillborn”. For 113 of these 176 babies in the burial record is reported a specific “age at death”: in most case hours or even fractions of hours but, occasionally, 1 or 2 days.

In the light of this careful examination carried out using both civil and parish records for Alghero, the measure of stillbirth in Italy appears even more an enigma without solution. At least in our case study, the official data include among the category “stillborn” babies a number of babies, correspondent to one third at least (but probably even more) of “false stillborn” babies who should have been computed as alive born babies and also included in the category “neonatal” deaths. On the basis of the checks and comparisons we have done, we may propose a new reconstruction possibly more plausible of stillbirth rate evolution and, consequently, on mortality in the first year of life. This reconstruction wouldn’t be without limitations and its capacity of
representing the real evolution of stillbirths rates and early-life mortality would remain uncertain. Even if the “actual” reconstruction remains beyond us, in the next section we shall analyse some factors which might help to understand the real nature of these events improperly categorised as “stillbirths”.

A MICRO-ANALYTICAL APPROACH FOR THE ANALYSIS OF NEONATAL MORTALITY

Here we present the results of a micro-analytical analysis based on individual and family biographies, carried out to verify the presence of eventual significant differences in the determinants of neonatal mortality rates, correlated with the insertion or vice-versa the exclusion of infants classified as “not alive” at civil status notification. The aim of this empirical test is of course not that of measuring and quantifying the level of mortality selection in first days in the community of Alghero. Here we intend only to verify if the inclusion of these babies categorised as not alive implies a different interpretation of the determinants of early neonatal mortality. We used a logistic regression where the response variable is death (or not) in the first thirty days of life in Alghero. We have distinguished the following age groups: the first week of life (0-6 days), and the remaining three weeks (7-29), because they correspond respectively to “early neonatal mortality” and “late neonatal mortality”. As described before, the first category (0-6 days) is the only one affected by the data registration quality. We allowed for a correlation among children within the same family by using a two level random intercept logistic regression approach. This tool aids in controlling for unobserved characteristics shared by children of the same mother.

We have predisposed two models. The covariates are exactly the same: the only difference consists in the population at risk. In the first model we have not included the so called “stillborn” infants, while in the second one the category is included. The first model corresponds to the official statistical documentation, while the second one includes the total number of births, without considering the inaccurate and imprecise distinction between “live birth” and “stillbirth”.

The choice of the variables included in the model derives from the characteristics and the quality of the data at our disposal. For the past in particular, it is very difficult to have regular information on gestation, types of child-birth, health status of the newborn at birth, etc. These variables are of decisive influence and no wonder considered in great detail in the conceptual frameworks about the proximate determinants of early-life mortality proposed in the literature (Cramer, 1987; Shah et al., 2000; Misra et al., 2003; Oris et al., 2004; Titaly et al., 2008; Vandresse, 2008). In Italy, these variables which later on were regularly registered, were not included in the civil records of the time (Istat, 1957).

Considering the characteristics of our data set, the births included in the analysis are a sub-set of the total number recorded between 1866-1925. They refer to the children born from the marriages celebrated since 1866. Only for these infants we are able to identify some relevant demographic variables which refer to the new born: birth order, maternal age, mother’s and father’s literacy,
mother’s previous reproductive history (birth interval and viability of the child previously born)\textsuperscript{18}. The total number of children whose family of origin is known amounts to 18,300 (and to 18,865, if we include the category of stillborn babies). This number corresponds to about 71% of the total number of births recorded between 1866 and 1925.

The models permit to estimate the effect of various factors of different origin, biological, socio-economical and environmental on neonatal mortality. These variables are: sex, year and order of birth, single and multiple birth, length of birth intervals and outcome of previous child, mother’s age, season of birth, mother’s and father’s literacy, father’s occupation.

Before commenting the results of the statistical analysis, further clarification about the socio-economic variables is needed. The data on literacy do not measure the effective level of parents’ alphabetisation, but only certify the eventual presence of the signature of both parents in their marriage certificate. We refer only to father’s occupation. Mother’s occupation has not been used because the occupational categories used for women were too indefinite and in most cases the wording “housewife” was reported.

Alghero population has been segmented in four socio-economic groups: the largest group is that of ‘farmers’ (more than half of the total), which includes all the professions related to the land cultivation (independently of the land property and stability of the contract) and also cattle-breeding and sheep farming activities; the “sailors” category (about 23%) includes all the sea related activities, fishing, coral fishing and also proper sailors and crew members. The category “artisans and traders” includes the people occupied in the various handicraft activities and the shopkeepers as well as the traders on the local and regional market. Finally the tiniest “bourgeoisie” category (2%) includes few nobility exponents, executives, and professionals.

A last elucidation on the age at death is necessary. In this analysis we have used the age at death calculated on the basis of the nominative record linkage realised between birth and death. However, we should mention that the comparison between the ages calculated with this procedure and the ages officially reported in the civil death records reveals that this information was transcribed with great accuracy. In almost all cases, the age at death for the children who died before the first birthday is expressed in months and days.

The results of our analyses are resumed in table 3. The first two models examine early neonatal mortality (first week of life). Particularly, the first application includes only the children registered as born alive while the second one refers to the total number of births (live and still). The third application takes into account late neonatal mortality (7-29 days). In this case, we have used a single model, because the population at risk is composed by the babies who survived at the beginning of the second week of life. Finally the fourth and fifth application refer to the whole neonatal mortality experience (0-30 days after birth) and in this case too we have two different models: one including only live births and the other one including both live and still births.
### Tab. 3 Parameter estimates for logistic models of mortality, Alghero 1866-1925

<table>
<thead>
<tr>
<th></th>
<th>0-6 days excluded stillbirths</th>
<th>0-6 days included stillbirths</th>
<th>7-29 days</th>
<th>0-29 days excluded stillbirths</th>
<th>0-29 days included stillbirths</th>
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<tr>
<td></td>
<td>Odds P=Z</td>
<td>Odds P=Z</td>
<td>Odds P=Z</td>
<td>Odds P=Z</td>
<td>Odds P=Z</td>
</tr>
<tr>
<td><strong>Year of birth</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.014 0.003</td>
<td>0.989 0</td>
<td>0.991 0.019</td>
<td>1 0.934</td>
<td>0.988 0</td>
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<td><strong>Sex</strong></td>
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<td>1</td>
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</tr>
<tr>
<td>Female</td>
<td>0.847 0.171</td>
<td>0.823 0.014</td>
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<td>0.77 0.002</td>
<td>0.783 0</td>
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<td></td>
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<td></td>
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<tr>
<td></td>
<td>1.092 0.003</td>
<td>1.05 0.044</td>
<td>1.041 0.216</td>
<td>1.068 0.007</td>
<td>1.04 0.048</td>
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<td><strong>Previous birth</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Child &gt; 2 years</td>
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<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Child &lt; 2 years, dead</td>
<td>2.23 0</td>
<td>1.936 0</td>
<td>1.543 0.011</td>
<td>1.744 0</td>
<td>1.723 0</td>
</tr>
<tr>
<td>Child &lt; 2 years, alive</td>
<td>1.062 0.755</td>
<td>1.277 0.06</td>
<td>1.861 0.72</td>
<td>1.045 0.747</td>
<td>1.182 0.125</td>
</tr>
<tr>
<td>First born</td>
<td>2.547 0</td>
<td>2.64 0</td>
<td>1.926 0</td>
<td>2.217 0</td>
<td>2.38 0</td>
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<tr>
<td><strong>Twins</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Singleton</td>
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<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Twin</td>
<td>11.894 0</td>
<td>9.602 0</td>
<td>8.348 0</td>
<td>12.11 0</td>
<td>11.057 0</td>
</tr>
<tr>
<td><strong>Mother’s age</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 25 years</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>25-35 years</td>
<td>1.02 0.908</td>
<td>1.133 0.254</td>
<td>0.853 0.271</td>
<td>0.898 0.349</td>
<td>1.031 0.737</td>
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<tr>
<td>&gt; 35 years</td>
<td>1.26 0.335</td>
<td>1.654 0.002</td>
<td>0.851 0.463</td>
<td>1.03 0.862</td>
<td>1.379 0.019</td>
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<tr>
<td><strong>Birth season</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Winter</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Spring</td>
<td>0.606 0.004</td>
<td>0.808 0.06</td>
<td>1.044 0.777</td>
<td>0.838 0.136</td>
<td>0.894 0.237</td>
</tr>
<tr>
<td>Summer</td>
<td>0.836 0.28</td>
<td>1.114 0.326</td>
<td>1.019 0.904</td>
<td>0.945 0.631</td>
<td>1.091 0.352</td>
</tr>
<tr>
<td>Autumm</td>
<td>0.744 0.063</td>
<td>0.927 0.476</td>
<td>0.867 0.347</td>
<td>0.816 0.074</td>
<td>0.908 0.287</td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Farmer</td>
<td>0.744 0.196</td>
<td>0.88 0.44</td>
<td>0.988 0.949</td>
<td>0.865 0.349</td>
<td>0.892 0.395</td>
</tr>
<tr>
<td>Mother</td>
<td>1.378 0.116</td>
<td>0.819 0.213</td>
<td>0.712 0.063</td>
<td>0.68 0.01</td>
<td>0.745 0.024</td>
</tr>
<tr>
<td>Both</td>
<td>0.394 0.611</td>
<td>1.013 0.929</td>
<td>0.722 0.055</td>
<td>0.82 0.139</td>
<td>0.903 0.377</td>
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<tr>
<td>Unknown</td>
<td>0.956 0.917</td>
<td>0.825 0.5</td>
<td>0.744 0.405</td>
<td>0.825 0.513</td>
<td>0.794 0.33</td>
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<tr>
<td><strong>Head’s SES</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Farmer</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Fisherman</td>
<td>0.918 0.605</td>
<td>1.065 0.616</td>
<td>1.112 0.464</td>
<td>1.058 0.632</td>
<td>1.121 0.264</td>
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<tr>
<td>Artisan</td>
<td>0.985 0.934</td>
<td>1.061 0.66</td>
<td>1.181 0.292</td>
<td>1.058 0.661</td>
<td>1.103 0.365</td>
</tr>
<tr>
<td>Upper class</td>
<td>0.614 0.399</td>
<td>0.77 0.444</td>
<td>0.348 0.152</td>
<td>0.468 0.1</td>
<td>0.667 0.188</td>
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<tr>
<td>Unknown</td>
<td>0.447 0.281</td>
<td>0.852 0.655</td>
<td>0.525 0.285</td>
<td>0.487 0.135</td>
<td>0.755 0.368</td>
</tr>
<tr>
<td><strong>2a</strong></td>
<td>1.4999 (0.2965)</td>
<td>2.0711 (0.2166)</td>
<td>0.8494 (0.2475)</td>
<td>1.1358 (0.1808)</td>
<td>1.5074 (0.1498)</td>
</tr>
<tr>
<td>Events</td>
<td>325</td>
<td>890</td>
<td>363</td>
<td>688</td>
<td>1253</td>
</tr>
<tr>
<td>Births</td>
<td>18300</td>
<td>18865</td>
<td>17795</td>
<td>18300</td>
<td>18865</td>
</tr>
</tbody>
</table>

The relative frequencies are shown only in the age category “0-29 days” (stillbirths included), because the other models differ only in decimal values.
Let us consider the results of our analysis on early neonatal mortality. The year of birth is always statistically significant, but with an opposite effect in the two models. In the model including also stillbirths, it tends to a reduction of the risk of dying, as expected considering the general process of mortality decline. While with the other model, we find the opposite effect, confirming the limits of the official records of death. The quality of the registration improves as we have seen, with a reduction of the category “false stillbirths” and a correspondent increase in the number of deaths soon after birth, with a consequent augmentation of early neonatal mortality rates.

Most of the results confirm our expectations regarding the different effects of the various variables in the first days of life. The importance of maternal characteristics for the survival of the newborn emerges quite clearly, particularly in the model with “stillbirths”.

During the early neonatal period, mother’s age at childbirth, her health conditions, approximated by age and birth spacing and order are extremely important. Medical literature strongly supports the relevance of the strictly “biological” variables and the “congenital” weakness of children born to mothers of advanced age (Frets et al., 1995; Van Katwijk, Peters, 1998). In the past, however, such “biological” risks were amplified (Van de Walle, 1986; Thornton, Olson, 1992; Kramer et al., 2001) by the precarious and compromised conditions of working mothers who were depleted by many pregnancies as well as the working hardships in certain rural areas (Rollet, 1995; Reid 2001).

In the model with “stillbirths”, mortality rates among infants born to mothers aged 35 or more were much higher than those referring to children born to younger mothers: the relative risk is on the order of 1.6. This strong effect of mother’s age is no more statistically significant if “stillbirths” are not included in the analysis.

Several scholars (Casterline, 1989; Lynch, Greenhouse, 1994; Miller, 1989; Oris et al., 2004; Preston, 1996; van Poppel, Mandemakers, 1997; etc.) point out that age is associated with other risk factors: high birth order, large number of children in the household, short birth interval, outcome of previous birth. Even when the age of the mother is controlled, the category “firstborn” runs a significantly higher risk of dying (about 2.5 times).

In the mean time, the risk tends to increase – 5.9% – with the order of birth. The situation was even more difficult if the index child belonged to a family where another child had been born and died in the previous two years. Too many children in a short temporal trend, in a difficult family context caused an excessive stress on the mother which immediately affected the survival chances of her children.

As mentioned before, we do not have information on gestation length, childbirth types, and health status of the newborn, but the relevance of these variables might be perceived considering over mortality of twins in the past.

Twins20 were subject to nearly nine/eleven times the risk of death at birth or immediately after birth in comparison with a singleton child (tab. 3). Besides the major risks during childbirth, twins tend to be delivered earlier than singletons, resulting in a smaller size at birth (Almond et al., 2005). They are consequently more vulnerable than other children even
if they are not smaller for their gestational age. Multivariate analysis shows that these risks were broadly independent of other factors (Reid, 2001). The Alghero’s figures are similar to the relative risks of multiple deliveries in other places and eras (Wrigley et al., 1997; Reid, 2001; Skyrthe et al., 2002).

All the effects of these bio-demographic variables are stronger and almost always statistically significant when we include in the analysis the still-born category. This happens also if we consider the sex of the newborn. The relative female advantage recurring in the aggregate statistics is confirmed at the individual level: the female relative risk is 18% lower. Anyhow, this result is significant only in the model including the category of the stillborn children. We can suppose that if we leave them out, we exclude the early deaths which were mostly related to a strictly biological and genetic interpretation.

The family context in terms of social status, measured on the basis of father occupation and parents’ literacy, doesn’t seem to have a clear effect on children survival. The well off children show relative risks of death lower, but this result is not statistically significant. Literacy, in both models, doesn’t have a decisive influence on early neonatal mortality: a result connected with the limits of the measure proposed (parents’ signature in their marriage record), but explainable also for other reason. Before the introduction of more modern and effective medical techniques in childbirth assistance, as well as baby care procedures immediately after birth, mortality risks were mainly induced more by the biodemographic and genetic conditions than to the socio-cultural characteristics of the family. The protective effect related to parents’ literacy, in Alghero, seems decisive only later in childhood (Breschi et al., 2011).

Alghero results would confirm the hypothesis of predominant bio-genetic factors at the very beginning of life. This empirical evidence is frequently registered even if not always for historical contexts (Reid, 2001; Óris et al., 2004). Indeed, many case studies conclude that social mortality differentials were absent or weak, while several studies in other contexts have shown a neonatal mortality differential according to the social status of parents (Bengtsson, 1999, 120-125). However, often, when a relationship is found, it is sometimes a positive one, not a negative one as expected: the babies of the wealthy people died more. This result is unexpected and involves the correct quality of the registration procedures: a social selectivity in the accuracy of registration could be a simple explanation – the births and infant deaths of the wealthy being better recorded (Bengtsson, 1999; Rollet, 1994; Wrigley, Schofield, 1981; etc.).

The completeness and quality of the registration procedures were also conditioned by the eventual presence of a medical doctor or at least of a qualified midwife during childbirth (Woods, 2007; Gourdon, Rollet, 2009): which was more frequent within the well off families.

Finally we should also take into account that as the child grows up, biological and genetic factors become less important, while social and cultural factors turn out to be more relevant.

The results might be different considering only the first week of life (early neonatal mortality) or, as it more frequently happens, including the first month of life (neonatal mortality).
And again, the results of the analysis depend on the correct or not identification of the stillborn babies and on their eventual inclusion or exclusion in the models. For Alghero, as we have seen, the presence or at the contrary the absence of this category doesn’t change the analysis results in terms of social effects (father’s occupation and parents’ literacy).

In other Italian populations – always at the micro-individual level - remarkable differences by socio-economic status (SES) have been registered in the risk of dying in the first week of life. In Venice, in the years 1850-69, the risk of dying for the wage workers’ children was 20 per cent less than that of their counterparts born in day-labourer families. This gap increased to 30 per cent for newborns of artisans and shopkeepers. The number of middle-class inhabitants was probably too small to give significant results by SES (Derosas, 2009).

Also in the Tuscan village of Casalguidi, lower mortality risks in the first ten days of life have been found for the children of the few well off families, but also in this case the reduced number of observations suggests great caution (Breschi et al., 2000a and 2004; Oris et al., 2004).

Preliminary indications come also from the analysis carried for two villages located in Friuli:21 the analysis shows reduced – but not always statistically significant – mortality risks in the first month of life for the children born to the few wealthy parents. All these case studies, located in the north and in the central part of the country, were also characterised by significant mortality differentials (in the first week and in the first month of life) according to birth season.

Along the Adriatic side, neonatal (early and late) mortality differentials were particularly strong: mortality selection of those babies who were born during the winter season, in the years 1872-1879, was 3-4 times higher compared to the correspondent value observed for those born during the summer (Breschi and Livi Bacci, 1986). Between the second half of the eighteenth century and the first one of the nineteenth century, mortality differentials in some villages of Veneto reached exceptional levels: after one week of life the babies born during the winter were decimated (40-50%), about 10 times more than those born during the summer (Dalla Zuanna and Rosina, 2011). These differentials were so strong that they still persisted in the 1950s when infant mortality rates were reduced of about 10 times (Lenzi, 1960).

The season of birth effect progressively became less pronounced and even disappeared in the south and in the islands (Breschi and Livi, 1986). In Alghero we have not found any significant seasonal effect, at least in the model including the category “stillborn” babies. If we leave out this category, the risk of dying for the babies born during the spring season is significantly lower (40%) compared to the corresponding risk for the infants born during the winter. This result is difficult to interpret, because, as we shall see, the influence of birth season is absent in the weeks of life immediately following the first22.

According to recent studies, SES differentials in neonatal mortality were found only in particular environments and areas of the country. In the north and in the centre, low winter temperatures, combined with a very humid
climate, might have been more dangerous when a family was indigent and did not have enough money to heat the house, exposing the baby to additional risks of dying. This wasn’t the case in the more Mediterranean areas, like in Alghero, where the minimum daily temperature, even during the winter, was on average above 5°C and only very occasionally descended below 0°C; while in Venice and in Veneto countryside this temperature was very frequently reached (Derosas, 2009; Dalla Zuanna, Rosina, 2011).

This hypothesis is not easy to verify. On one hand, relatively few studies have examined the variation in temperature vulnerability by socioeconomic status. Most of these studies (almost all concerning modern populations) do not find any association between socioeconomic deprivation and vulnerability, but this result has been attributed to the ecological design of many of these studies, and to the crude indices of socioeconomic status used (Ballester et al., 2003; Ekamper et al., 2009). On the other one, on the basis of very preliminary results, we have not found a significant increase in neonatal mortality during the coldest winters: a further confirmation of the more temperate Alghero winter climate, insufficient to trigger the negative health consequences for the babies documented for other Italian regions. These consequences have been described for Venice by Derosas (2009) as both direct and also indirect, i.e. mediated through the link between maternal malnutrition, temporary nutritional stress during late gestation, frailty of newborns and additional seasonal stress caused by the very low winter temperatures.

Furthermore, we have not found any significant effect of the cyclical fluctuations in the wheat prices on neonatal mortality, all ages considered (0-6, 7-29 and 0-29 days).

This result, in line with other recent studies and empirical analyses carried out, could be affected by the quality of the price documentation that we have at our disposal. We could count only on the annual prices series until 1890 and this doesn’t allow us to adopt the most suitable temporal interval to detect the complex and indirect interrelationships between economic crises, maternal health condition and neonatal mortality.

The supremacy of bio-demographic factors results even more relevant immediately after the first week of life. The model adopted in this case does not suffer from the errors of identification/classification of stillborn babies. For the babies in this age group, the relative risk decreases over time (about 1% per cohort). The females were subjected to lower mortality rates (less than ¼) compared to the males. The firstborns as well as the children of women who experienced less stress before short birth intervals and experienced the death of a previous child resulted more vulnerable. The season of birth did not have any significant effect and SES did not exert a relevant influence on mortality differentials even if the values for more educated couples and mothers resulted lower and close to statistical significance.

The last two models, which refer to the whole neonatal mortality experience, require a short comment. The difference between them consists again in the population at risk: the first model includes only the children born alive and the second one all the children born, no matter if alive or still.
The results follow closely what observed in the analysis of early neonatal mortality. The limits of the data emerge when we analyse, according to the official statistical documentation, only the children born alive: the effective and gradual decline in mortality is diminished by the progressive improvement in the recording procedures of stillbirths. Year by year an increasing number of “false stillborn” children were classified in the correct way as children born alive and dead in childbirth or soon after.

Also in this case the influence of biodemographic variables emerges and, as observed before for early neonatal mortality, the effect is more intense if the analysis includes the total number of children. Only in this case, in particular, children of older mothers experienced higher risks of dying (more than 1/3).

The only interesting difference refers to the socio-economic variables. Children of more educated mothers experienced a lower mortality risk of at least ¼ compared to the babies whose parents did not sign their marriage certificate. Many studies have been carried out which recognize the crucial relevance of literacy (especially maternal literacy) in children’s upbringing and health care for past and present populations.

CONCLUDING REMARKS

With this article we have intended to disentangle the complex question of the measure of stillbirth in Italy. The official related statistics of the newly formed Kingdom of Italy were affected by imperfections and biases, particularly in the decades following national unification. In the various regions the recording procedures and their limits were so differentiated that they could even distort the geography as well as the temporal trend in stillbirth and neonatal mortality rates.

The south and the islands were characterised by low (probably too low) levels of early neonatal mortality; at the opposite, the centre and large northern areas of the country showed stillbirth and neonatal mortality rates so high to result almost abnormal.

As mentioned in official documents (MAIC, 1879) and medical researches of the time (Guzzoni degli Ancarani, 1913) and more recently observed (Pozzi, 2000; Woods, 2009), the official sources on stillbirths were probably affected by more serious biases in the southern regions.

Furthermore, in the first decades after national unification, at the local level, it is possible to detect strong variations of opposite signs in stillbirth and neonatal mortality rates. These changes testify a continuous adjustment, not always linear, in the recording procedures of stillbirths on the one hand and of live births and early life deaths on the other.

Thanks to a detailed analysis of the Alghero civil records of birth, death and marriage, we have called into question the Sardinian record of the lowest Italian infant mortality in the decades after national unification.

This potential disproof derived from the extension to the Sardinian region of a speculation based on a careful examination of Alghero civil status and parish records. At least for that community, the official data underestimate infant mortality, particularly early neonatal mortality.

If we apply to the whole Sardinian region a correction similar to the one estimated for Alghero, infant mortality...
rate, after national unification, is close, or perhaps even a bit higher, to the corresponding rates recorded in Tuscany and Piedmont.

A hypothesis so subverting requires further controls to be verified. Unfortunately these validations require time and economic resources because it is necessary to analyse, interpret and link the information reported in each civil status record. These controls have to be carried out in different communities scattered all along the country; only in this way it will be possible to reconstruct the evolution of stillbirth and neonatal mortality rates, at the national and territorial level, in the decades following national unification.

Using the rich Alghero data set, constructed at the individual level, we have then realised a multivariate analysis on the determinants of early mortality in a Mediterranean context. To this regard, this article is quite innovative: the very few studies carried out in Italy at the micro-individual level refer to communities located in the north and centre of the country.

The results of our analyses confirm the overwhelming predominance of the bio-demographic variables, referring to both mother and child. Modest if not absent is the socio-economic effect, measured through father’s occupation.

The overall picture deriving from the various statistical applications is very similar, but the predominance of the bio-demographic variables is more pronounced when still-births are included into the analysis. In this last case, the effects are not only always statistically significant, but they are clear and always in the expected direction.

Additional risks could be found when the infant was a male, firstborn or high order baby, when the mother was older, had frequent childbirths and her previous child had died. A complex of circumstances which describes a condition of maternal deprivation caused by too many pregnancies and childbirths and a family context which raised mortality risks for children.

Mother’s age at childbirth, particularly in Sardinia, deserves further attention. A large amount of studies suggests the association of late parental age with the chance of delivering a healthy child for both past and present populations. Maternal ageing, starting from early thirties, has been reported to increase the risk of maternal and foetal pathologies, obstetric problem, miscarriage, and adverse pregnancy outcome (Fretts et al., 1995; Van Katwijk, Peters, 1998).

In the populations of the past, an additional mortality risk for the newborn identifies this association. In Alghero, as mentioned, the children of older mothers (35 years and above) experienced an early neonatal mortality risk (0-6 days) higher of 1.3-1.6 times compared to those of younger mothers (<25 years). This effect, besides being higher, is also statistically significant only in the model including stillborn babies and it doesn’t persist beyond the first week of life. To this regard a more robust effect has been found in the few studies, conducted at the individual level for other Italian communities in the past (Derosas, 1999; 2003; Oris et al., 2004).

Alghero data seem to support the results of recent studies about the present association between late maternal age and risk of adverse pregnancy outcome. According to these studies, Sardinia is the only region in Italy where the association is weak and its population, particularly in the interior part of
the island, is considered a potential “case of reproductive longevity” which shows the aptitude to late reproduction at lower cost for neonate survival and health (Astolfi et al., 2002; 2007; 2009).

Finally SES variables do not play any significant differential role, particularly in the model including also the category “stillborn” children. Independently of their explicative ability, the absence of variables like gestation, health mother’s condition, childbirth characteristics and baby’s health status doesn’t allow us to understand the complex, indirect relationships between SES and early neonatal mortality. In the absence of all these variables, the predominance of biodemographic variables comes out. Otherwise SES variables might become relevant, when other external factors – the climate more than any others – raised the condition of stress to which a newborn was exposed before, during and immediately after birth.

This consideration is just an interpretative hypothesis. Only further empirical verifications will help us to sort out the uncertainties which still dominate our understanding of the various factors affecting survival of babies at birth and in their first month of life in past populations.

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Notes

1. The bibliography on infant and child mortality in Italy is very wide. For an overview, see: Del Panta, 1997; Pozzi, 2000; 2002; Pozzi and Robles González, 1997; Manfredini and Pozzi, 2004.

2. “Italy offers an excellent example of what we would expect to see in a country with improving registration coverage. National rates of late-fetal mortality only reached credible levels during the early decades of the twentieth century because regional differences in registration quality had narrowed by them. Rates in the south rose to match those in the north and then stayed at a higher level longer” (Woods, 2009, 82).

3. To prove that, it is sufficient to remind the organisation of a National Census immediately after the establishment of the new Kingdom (1861).

4. The idea of centralising the counting of demographic data collection was discussed within the Italian government in order to reduce the wide arbitrariness which characterised these procedures at the local level, as a consequence of the different statistical pre-unification systems. On this subject and other aspects referring to the statistical data collection at the local level in the first years after national unification, see Favero, 2001.

5. Napoleon introduced civil vital records (separate by parish records) in Italy as early as 1804 in some regions and by 1809 in most of the country.

6. This differential resulted higher, around 15%, obviously, in Rome and Latium, where civil marriages were introduced in 1871.

7. Illegitimacy rose considerably especially in the ex-territories belonging to the Papal States, where about 1 child out of 5 was recorded as illegitimate. This phenomenon, connected to the very high number of religious marriages in those areas,
was somehow solved through natural legitimations after civil marriage and thanks to a specific decree. At the end, in the ex-provinces of the Papal States about half of illegitimate births were legitimatized (Benini, 1911).

8. Consequently, the age at death of the newborn is unknown and therefore we cannot determine if the child classified as “born not alive” had lived a few hours, and even a few days. The relative burial could not take place without the order of the registration officer (by the “medico necroscopo”), but this permission was not necessary for the babies who had died before notification as they were not legally recognised by the state.

9. We have analysed various official Circulars and formal instructions released by the General Directorate of Statistics (MAIC, 1865-1879) as well as notes and comments on the recording procedures of still births by the “Giunta Centrale di Statistica”, a Statistical Committee of the Italian Government. Here we mention only some of the most significant ones.

10. The civil status records kept in the Alghero municipal historical archive refer to the same years. We would like to thank the staff of the archive, Baingio Tavera and Gianfranco Piras, for their helpfulness and kindness.

11. The municipal territory corresponds to the parish territory.

12. We shouldn’t forget that the deceases should be notified to the civil status authority within 24 hours from the moment of death: another indirect proof of the very short life length of these newborns.

13. The babies classified as “born and dead during the delivery” (col. d, table 1) were counted from time to time as stillborn babies or as alive born babies. This alternative classification causes the great majority of the discrepancies observed between the official statistics and the figures calculated on the basis of the civil records of death.

14. Also in the Ales dioceses, in the south of the island, before national unification, the religious registers underestimated the number of babies who had died in the first hours of life, and even more stillborn babies (Gatti, 1993). However, in all likelihood, the more completed registration in the civil status records has to be connected with the penalty for omission in notification (10-200 liras).

15. A detailed scrutiny of these 176 records reveals a specific age at death for 113 of them; in 45 cases we have found the wording “stillborn”; in 5 cases the wording “dead immediately after birth”; in 1 case the wording “dead during birth”. In 10 cases the field “age at death” is empty. Finally for 2 we have only the baptism record and any information on death. We should mention that for 21 of these 113 cases, with a specific age at death, the hour at death reported in the burial record corresponds to the hour at birth declared in the civil status record of birth. These 21 babies could be “real” stillborn babies as well as alive born babies dead immediately after birth.

16. In this approach, level one are the births and level two are the families. Data were processed using STATA-GLAMM.

17. The certificate of “childbirth” was introduced in Italy at the end of the nineteenth century, but it was used only for the babies born in hospital. At that time the women living birth in the hospital were very few and selected; in most cases they were un-married mothers. Taking into account the whole reproductive history of each woman in order to understand the risk factors for her babies health is of crucial importance; see a recent study carried out in the Udine hospital (Driul et al., 2010).

18. All the variables controlled, the model results are almost the same considering the total number of births as well as the subset of births used in the following analyses.

19. Indeed, if we exclude from the model the covariate controlling for unobserved characteristics shared by children of the same mother, the relative risk further increases.

20. In the period analysed, we have found only double childbirths.

21. These are very preliminary results referring to two villages of Friuli, Treppo Carnico and Sant’Odorico, in the middle of the nineteenth century. The well off families were very few as well as limited was the social stratification of the villages. For further details, see Breschi et al., 2010.

22. However we can suggest that the role of environment was particularly intense not so much during childbirth as in the following hours.
At least in Veneto, the temperature effect was particularly aggressive in the second-third day of life (Dalla Zuanna, Rosina 2011): this effect could be explained considering the dangerous consequences of a too early baptism. For Alghero, in the analysis carried out without the category “still-born” babies, we leave out a significant part of the deaths occurred immediately after birth and in the first day of life. In this case, in fact, the deceases in the second day of life represent more than a half of the deaths registered for the first week.

23. Heating was very expensive: in the northern cities, 5.5 kilos of good firewood cost as much as 1 kilogram of grain (Breschi et al., 2000b).

24. Actually we do not have at our disposal a real series of Alghero daily temperatures for the entire period under examination. For this reason we have estimated the Alghero temperature thanks to a series reconstructed for the city of Sassari, the chief town of the province, within a large project Clim-Agri (www.scia.sinanet.apat.it). In Alghero, the winter minimum temperatures are normally higher (0.8-1.1 centigrades) and the summer maximum temperatures lower (about 0.8 centigrades). For more details on the Sardinian series of the temperatures, see Pinna, 1954; Brunetti et al., 2006.

25. See the previous note.

26. For a synthesis, see Bengtsson, 2004; Oris et al., 2004.

27. The series of wheat prices has been reconstructed on the basis of the corresponding series of Sassari – the chief town of the province - and Cagliari the chief town of the region located at 200 km of distance (Delogu, 1959). At the moment the series includes only the average annual prices for solar year until 1890. For many succeeding years we have the monthly average prices. Waiting for the data collection to be completed, we have chosen to include the variable price in the model, distinguishing the high price years from those characterised by low ones.

28. See footnote 1.

29. As far as we know, the only study on infant mortality, conducted at the individual level, in a southern Italian community, is a research on Ali, a Sicilian community (Dalla Zuanna et al., 2003). This article is an interesting analysis particularly for the clever and thrifty collection and use of eighteenth century data. Ali is located in a high hilly area and for this reason the seasonality of early mortality recorded in this community was more pronounced (particularly during the winter) in comparison with the entire Sicilian island.

30. This aspect is confirmed by the intra-family correlation which is statistically significant and equal to 30% in the model on early neonatal mortality (0-6 days) including stillbirths.

31. By the way these studies take into account only live born infants.

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SUMMARY

According to the Italian statistical official sources, in the decades after national unification (1861), Sardinia was the region with the lowest neonatal and infant mortality rate in the country and a stillbirth rate significantly lower than the national average. The principal aim of this article is to reconsider the evolution of infant mortality in the island taking into account the general process of improving registration coverage of those vital events (stillbirths and early neonatal deaths) whose recording was crucial for the correct measurement of infant mortality.

The official statistics of the newly formed Kingdom of Italy were affected by imperfections and biases, particularly in the decades under examination. In the various regions the recording procedures were so differentiated that they could even distort the geographical as well as the temporal trend in stillbirth and neonatal mortality rates. In Italy, as well as in many other countries, the topic of stillbirth identification and recording procedures has received up to now little attention.

A detailed analysis of a large and reach data set reconstructed for the north western Sardinian town of Alghero, at the individual nominative level, derived from civil and parish records of birth, death and marriage, allows us to show that official data – at least for that community –, underestimate infant mortality, particularly early neonatal mortality. This result calls into question the Sardinian record of the lowest Italian infant mortality. Further controls in other communities are necessary to verify a hypothesis so subverting.

In the final section of this article we carry out a multivariate analysis on the determinants of early life mortality in Alghero. The results confirm the overwhelmingly preponderance of bio-demographic variables, while the socio-economic effect appears to have been modest if not absent.

RÉSUMÉ

Selon les sources statistiques officielles italiennes, la Sardaigne, dans les décennies qui ont suivi l’unification nationale (1861), présentait le plus faible taux de mortalité néonatale et infantile du pays et un taux de mortalité nettement inférieur à la moyenne nationale. L’objectif principal de cet article est de voir à nouveau frais l’évolution de la mortalité infantile dans l’île, en tenant compte des progrès de l’enregistrement des décès (mort-nés et décès néonataux précoces) dans la période, élément essentiel d’une bonne évaluation de la mortalité infantile.

Les statistiques officielles du nouveau Royaume d’Italie comporment des lacunes et des biais de collecte. Selon les différentes régions, les pratiques d’enregistrement ont été différentes au point d’affecter les taux de mortalité néonatale et de mortalité néonatale, tant entre régions que selon les périodes d’observation. Cette question de la définition et des règles d’enregistrement des mort-nés a été l’objet de peu de travaux, en Italie comme d’ailleurs pour nombre d’autres pays.

La reconstruction de la population d’Alghero (nord-ouest de la Sardaigne), à partir de sources nominatives civiles et religieuses, a permis d’apporter des éléments remettant en cause le « record » sard en matière de mortalité infantile. Les données officielles – au moins pour la communauté d’Alghero –, la sous-estimation largement, en particulier pour la mortalité néonatale précoce. Des recherches complémentaires restent cependant nécessaires pour vérifier cette hypothèse qui boucle une opinion largement admise.

La dernière partie de cet article propose une analyse multivariée des déterminants de la mortalité précoce à Alghero. Les résultats confirment la prédominance des facteurs bio-démographiques, l’effet des variables socio-économiques étant particulièrement faibles.