Standard Life Tables for Western and Southern Europe from Antiquity to the Black Death

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1. Introduction

1.1. Objectives of the study. Osteological data from cemeteries is one of the few sources available for gathering information on the mortality of common people in ancient historical periods. Indeed, very few quantitative written sources record the number of deaths during antiquity and the Middle Ages in Europe, and even less report deaths by age, indispensable information for any study on the demographic aspects of mortality in the past. While funerary inscriptions often contain an indication of age at death, such information tends to be fragmentary, referring to groups selected by sex, age, and social class and thus not useful to uncovering the mortality trends of entire populations (Hopkins 1966; Saller 1994; Scheidel 2001).

A wide number of studies do provide distributions of estimated age at death of excavated skeletons, the result of hard work by physical anthropologists. Unfortunately, however, it is often very difficult to understand the reliability of these estimates, or to define, from these distributions, the mortality regime that determined them. The objective of this paper is twofold: (1) suggest a method to move from the age distribution of deaths of a single cemetery to its death probability profile; (2) build standard life tables directly deduced from European necropolises, which can be used as terms of comparison with respect to other necropolises or a group of necropolises.

Our standard life tables (SLT) are inferred from human remains between antiquity and the appearance of the Black Death in 1347-49, excavated from 75 cemeteries located across a vast region of Western and Southern Europe and selected following rigorous quality criteria. These tables can be used as a baseline to estimate mortality using data from other sites.

After discussing the state of the art and the challenges and advantages of using skeletal data for demographic analyses, in Section 2 we describe our data and methods, in particular the selection criteria of the 75 cemeteries; the way we construct the probability of dying at different age spans for each cemetery; and how we create the SLTs. In Section 3, we compare our SLTs with other sources, as well as use the SLTs to both evaluate the pattern of mortality of a single site and study the variability of mortality over time and space.

SIDeS, «Popolazione e Storia»,
2/2021, pp. 73-97. DOI: 10.4424/ps2021-8

1.2. The quality of skeletal data for studying mortality in the past. Scholars have discussed several issues relative to using skeletal samples to study mortality regimes of the past. We sum up here just the main issues, referring to other studies (for further discussion Acsádi, Nemeskéri 1970; Barbiera, Dalla-Zuanna 2009; Ségui, Buchet 2013; Milner *et al.* 2019).

First, *cemeteries may not entirely reflect the living population of a given area or period, particularly with regard to children*. This can occur due to selection factors operated by the communities themselves, whereby certain groups are buried elsewhere or excluded from the cemeteries for social, economic, religious, or other reasons (Barbiera *et al.* 2017). Children under the age of 5 were often buried separately, in dedicated cemeteries, or in single burials scattered around settlements (Barbiera, Dalla-Zuanna 2009). Moreover, the preservation processes of cemeteries, graves, and bones can alter the original composition of a graveyard, such that children, for instance, might be underrepresented not only because they were buried elsewhere but also because their bones are very fragile and can easily disappear with time, leaving no trace. It is also possible that a part of the original cemetery was destroyed by later activities, such that the first set of burials is only partly excavated. As this randomly selects and excludes some funerary areas, it is still possible that the ultimate available sample is representative of a living population (as demonstrated by Ségui, Buchet 2013). Yet, the deliberate exclusion of some categories of individuals or the bone fragility of certain groups can alter our sample in a systematic way. While the first concern can be overcome by considering a wide sample of cemeteries, the second matter must be accounted for in analyses and interpretation of the data. As the most recurrent problem noted in various ancient cemeteries is the underrepresentation of children under the age of 5, we consequently exclude individuals in this group in our estimation of overall mortality (Barbiera, Dalla-Zuanna 2009; Barbiera *et al.* 2018).

A second important issue concerns *the estimation of age at death using skeletons*. The ability to reliably define age at death based on osteological remains has been debated over the last several decades (Acsádi, Nemeskéri 1970, cap. III; Hoppa, Vaupel 2002; Ségui, Buchet 2013). The methods of age estimation are typically based on skeletal collections preserved in museums, for which the ages and sex are known. However, the nature of such collections can alter the methods developed. For instance, a reference population may not be complete and representative of all ages and of both sexes, certain age groups may be over-represented, or may be lacking for one sex or the other; reported ages are potentially not precisely recorded (Bocquet-Appel, Masset 1982; Usher 2002). Moreover, a sample population could include only a selection of individuals of certain socioeconomic or health statuses, who underwent different senescent processes. The methods of age estimation developed would therefore reflect the biological age of that specific sample, without being precisely applicable to skeletal populations from other contexts. In fact, it has largely been demonstrated that skeletal age is biological, defined by phases of growth and change that different bones undergo during an individual lifetime. These can be accelerated or slowed by various aspects, such as genetic predisposition, nutrition, and life standards. Thus, populations with varying nutritional regimes, or different ethnic and social groups, as well as males and females, can experience distinct biological ageing processes, meaning that different biological age markers can correspond to different chronological ages (Howell 1976; Boldsen 1997). The observed tooth development in a child mandible can, for example, be related to different chronological ages across populations (Hoppa 2002; Ségui, Buchet 2013), given that children develop their permanent teeth earlier in well-nourished populations compared to poorly nourished ones (Kemkes-Grottenthalter 2002). This is a crucial matter, and can have a significant impact on different steps of anthropological analyses. When applying the methods of age definition to ancient samples, we expect that senescence was uniform, meaning that the demographic processes that we observe in contemporary collections were the same as in the past. The important assumption here is that even if a biological marker of a certain age on one person will never correspond to exactly the same age in another person, biological processes nevertheless do happen within a certain age range. Ages at death are accordingly assigned wider ranges, for instance of 5 or 10 years or using probability distributions (Usher 2002; Milner *et al.* 2019). In the sample considered, the former approach was adopted by the various anthropologists who analysed the data.

A third significant issue is that *post-maturity age assessment is a difficult task*. While children and juveniles display numerous traits that change with age in a sufficiently regular way to permit estimating age at death with minimal error, senescent changes in adult bones are degenerative rather than developmental (Boldsen *et al.* 2002). This means that age-at-death estimates based on mature and older individuals are never really precise, and involve a considerable degree of error. A common practice to overcome this problem is to lump skeletons together into an open-ended terminal age interval, often at 50+, or 40+ (Steckel et al. 2018). The SLTs of Coale and Demeny (model West, level 1) and Woods_{20} (both with e_0 around 20 years) estimate deaths after age 60 as 20% of deaths occurring after age 5. This percentage is reached or exceeded in only 15 of the 75 cemeteries we consider here, while in 31 sites the percentage of over 60 is less than 10; in 6 cemeteries no skeleton has been estimated as 60 or older (Acsádi, Nemeskéri 1970, 157; Hoppa 2002; Ségui, Buchet 2013). This is indubitably a matter that should be taken into account when studying mortality from skeletal samples, as we further discuss below.

A fourth issue concerns the *possibility of obtaining direct information on the mortality regime from data on the distribution of skeletons by age*. Acsádi, Nemeskéri (1970, 53) among the conditions to be able to study mortality starting from cemeteries require that "there had been no abrupt changes in the size and structure of the studied population, and no great migration had taken place", that is, that the population, in the years of use of the cemetery, was essentially stationary. In the life-tables built in their book, these authors always take the hypothesis of stationarity for granted, even if they always advise to pay attention to the possibility that the results are distorted by previous strong migratory movements (Acsádi, Nemeskéri 1970, 68).

In the years following 1970, thanks also to the availability of standard life-table with associate stable population, some scholars have better specified this condition.

Sattenspiel and Harpendig (1983) show how – even assuming that the data are complete and that the ages at death are correctly estimated – the age distribution at death of the exhumed skeletons corresponds to that of the mortality table only if the population from which the skeletons come from is "strictly" stationary: even without migration, a small deviation from the stationary condition is sufficient for the average age of the skeletons to overestimate or underestimate the actual life expectancy at birth. However, the same authors state that "for analyzing cemetery populations with a time depth of many generations, growth rates are practically null (492). Moreover, random fluctuations due to small numbers compensate for each other (Weiss, Smouse 1976). Consequently, if the cemeteries from which the skeletons come were used for a long time, "the stationary assumption is probably reasonable" (Sattenspiel, Harpendig 1983, 492). In the sample here considered, cemeteries were used for several generations as their chronology testify (see Table A1 in the Appendix).

Despite these limitations, we argue that it is possible to construct SLTs that both help to shed greater light on the mortality regime in pre-Black Death Europe and that provide an important building block in analyses of individual cemeteries. First, as mentioned, we must give up considering mortality before the fifth year of age. Second, we can only include cemeteries of reliable quality and used for a long span of time, thereby discarding hundreds of sites for which only fragmentary data is available. Third, the estimates of the probabilities of death of post-mature individuals need to be considered with great caution.

2. Materials and methods

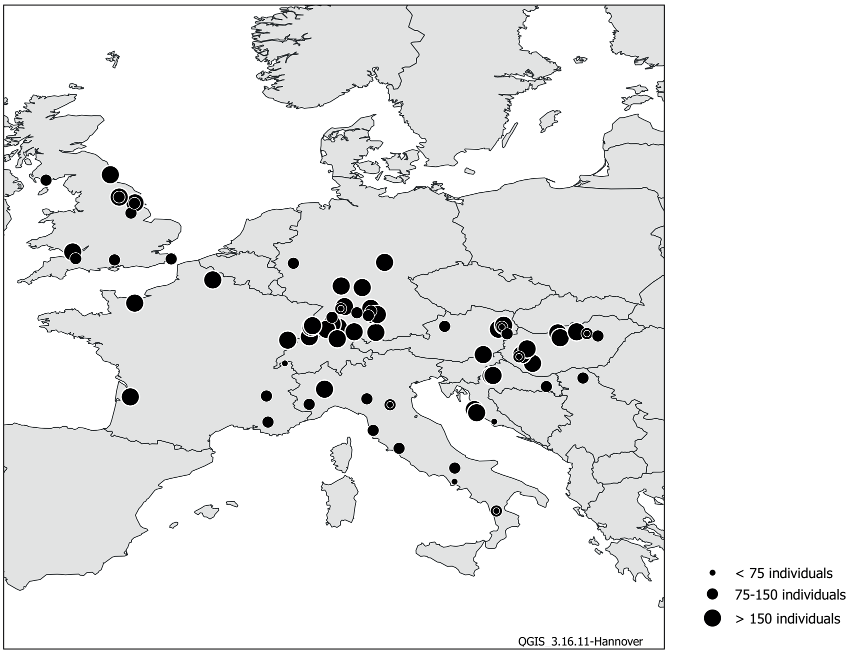
2.1. The choice of cemeteries. Given the above-described challenges inherent to paleodemographic analyses, we chose cemeteries that have the following characteristics:

– At least 40 dead individuals (with the exception of the French site Thonon, Les Ursules, where the data are of excellent quality and refer to 34 skeletons).
– Sub-adult individuals (aged 0-19) are classified into 5 or 10-year age groups. This criterion means excluding from the analyses hundreds of sites, used in previous studies employing less strict selection standards (Barbiera, Dalla-Zuanna 2009; Barbiera *et al.* 2017; Barbiera et al. 2018).
– Age at death is unknown for less than one third of skeletons; that is, less than 33% of the skeletons are very badly preserved or in fragments. Among our 75 selected sites, we consider 4 cemeteries that only slightly exceed 20% of undefined age, while for 53 sites all the excavated skeletons were intact and could be thoroughly assessed.
– Cemeteries should have been used for at least 100 years.

Following these criteria, we construct our standard life tables using a sample of 17,107 individuals buried across 75 cemeteries, excavated in an area covering what is now the United Kingdom, France, Germany, Austria, Hungary, Croatia and Italy, plus one site in Switzerland and another in Serbia. We chose these sites based on the quality of their published data, which guarantee a sufficiently reliable sample of deaths by age (see Figure 1 and Table A1 in the Appendix).

We compare our tables with those extrapolated from Steckel et al. (2018,

Fig. 1. *Map of the cemeteries used to construct the standard life tables*



7) (referring to a similar chronological period and to a partly matching area of Europe)[1], the SLTs of Coale and Demeny (C&D) published in 1983, and that suggested by Woods (2007) for Southern Europe[2].

2.2. The probability of dying in each site. To estimate the probability of dying – the ratio between the deaths at a given age class and the individuals exposed to the risk of death (i.e., the living at the beginning of that age class) – we classify all the available skeletons for each considered site into five-year age classes for children and juveniles (0-4, 5-9, 10-14, 15-19) and ten-year age classes for adults (20-29, 30-39, 40-49, 50-50 e 60+). This sophisticated classification is, however, available for only few of the published cemeteries. For the remaining sites, we adopted the following procedure:

1. We start from the published age distribution of the excavated cemetery.
2. The skeletons that have been classified according to wider age groups or into groups that overlap two age classes or more are assigned to the defined age groups following the death distributions of the Italian life table of 1872 (see Table A2 in Appendix), which has one of the lowest life expectancy at birth (e_0=29.8) among all the tables included in the Human Mortality Database[3].
3. After step 2, the remaining skeletons with unknown age are proportionally allocated following the distribution of skeletons of known ages at death. Because in all the selected cemeteries these skeletons represent only a minimal proportion of the sample, their allocation does not alter substantially the original pattern.
4. On average across the 75 sites, the authors of the anthropological analyses

attributed just 11% of the skeletons of adults over 30 to the 60+ age group. This is unrealistic, also given the fact that even with a low life expectancy (e_0~20), 30% of the individuals aged over 30 die after age 60 (see the SLTs of Coale and Demeny and Woods). Therefore, to avoid underestimating the mean age at death, due to an excessive number of deaths of young adults compared to those of the elderly, we attribute a fixed proportion of 30% of skeletons aged 30+ to the 60+ class. In each cemetery, the remaining 70% of the skeletons attributed to the wide age class of 30-59 are then assigned to the three sub-classes: 30-39, 40-49 e 50-59 according to the effectively detected distribution.

After having developed points 1-4, to reconstruct the life tables for each cemetery, we adopt the Halley method, based on the hypothesis of stationarity. That is, we assume that populations are closed to migrations, with a growth rate equal to 0 and a birth rate equal to the death rate (Distaso 1979; Santini, Del Panta 1982; Bellhouse 2011). These assumptions, applied to cemeteries that were used for at least one century, are plausible (Weiss, Smouse 1976; Sattenspiel, Harpending 1983). In fact, the natural growth rates of European populations in antiquity and the Middle Ages were very low, likely much lower than ±0.5‰ (Biraben 1979; McEvedy, Jones 1979; Lo Cascio, Malanima 2005; Barbiera, Dalla-Zuanna 2009) and population mobility, even if not absent, was surely lower than in the contemporary period, especially since most of the 75 sites are located in rural areas (Barbiera *et al.* 2018).

If these assumptions hold, the survivors to a certain age are all those individuals that died after reaching that age; that is, the sum of all the deaths that occurred from that age on. The probability of dying thus equals:

$$\mathbf{q_x=D_x/\Sigma D_i} \quad \text{with } \mathbf{i} \text{ ranging from } \mathbf{x} \text{ to the last age } \mathbf{\Omega} \qquad [1]$$

Formula [1] offers the advantage that the probability of dying calculated for a certain class **x** does not rely on the age distribution of deaths in the younger or the older age classes. This is particularly important when working with skeletal data. For example, the estimate of the probability of death at age 5-9, calculated as the ratio of deaths at that age to the total deaths from age 5 onwards, does not depend on the reliability of the attributions of deaths beyond the 10th birthday. More broadly, since age attribution – as we have seen – tends to be more precise for sub-adult skeletons (Masset, Bocquet-Appel 1977), if the assumptions underlying Halley's method are correct, mortality estimates for children should be relatively accurate.

To facilitate the application of this methodology to other necropolises, in Table 1 we report, in full, the mechanism adopted to construct the probability of dying for the French cemetery of Saint-Martin-De-Fontaney (Calvados), dated to the 6th century AD.

Row A of Table 1 shows the original data of a selected cemetery, as identified by anthropological analyses. Among all the considered sites, that of Saint-Martin-De-Fontaney is the most poorly documented: juveniles are identified within a 10-year age class (that is, 10-19) and for many adults age at death is defined within 20-year age classes (that is, 20-39 and 40-59). Meanwhile, no information about age at death is available for 24% of the skeletons. Finally, only 15% of the skeletons age 30+ is attributed to the older age group of 60+. Regardless, we use this cemetery as an example to show that even badly documented cemeteries can still be used to estimate mortality by applying the method suggested herein.

Tab. 1. *Reconstruction of the probability of dying in Saint-Martin-De-Fontaney – Calvados (6th century, France)*

	0-4	5-9	10-14	15-19	20-29	30-39	40-49	50-59	60+	Sub-adults 10-19	Young 10-19	Mature 10-19	Unknown 10-19	Total
A	47	75	---	---	15	106	29	83	53	94	239	8	238	987
B	47	75	45	49	134	226	32	88	53	---	---	---	238	987
C	62	99	59	65	177	297	43	115	70	---	---	---	---	987
D	62	99	59	65	177	240	35	93	157	---	---	---	---	987
E	987	925	826	768	702	525	285	250	157	---	---	---	---	---
Q	0.063	0.107	0.071	0.085	0.252	0.457	0.121	0.372	1.000	---	---	---	---	---

Source: Pilet, 1994.
A: Original published data. Absolute values
B: Distribution into 5 and 10-years age classes of individuals classified in broader age groups, following the life table of Italy in 1872
C: Redistribution of skeletons of unknown age into all age classes from 0-4 to 60+, following the known distribution of deaths
D: Redistribution of skeletons aged 30+ within the four age groups: 30-39, 40-49, 50-59, and 60+
E: Individuals exposed to risk of dying at the beginning of each age class ($\Sigma \mathbf{D_i}$ from the age class in the corresponding column up until that including individuals aged 60+)
Q: Probability of dying (**D/E**).

In row B, we distribute the skeletons aged 10-19, 20-39, and 40-59 in 5-year and 10-year age classes, following the distribution of deaths $\mathbf{d_x}$ registered in the life table of Italy in 1872. For example, in the Italy table, in the broad class 10-19 the proportion of deaths in the age group 10-14 was 0.475, while it was of 0.525 in the 15-19 age group; we thus split the 94 juveniles aged 10-19 according to these proportions: 94 x 0.475 = 45 number of individuals dying between 10-14 years of age and 94 x 0.525 = 49 individuals dying between ages 15-19. Note that the skeletons of this necropolis, for some ages, have been classified using a double classification (for example: age 40-49: 29, age 50-59: 83, age 40-59: 8), probably based on different state of conservation of the remains. In this case, the attributions to the two decennial classes are taken for granted, while the 8 skeletons attributed to the 40-59 class have been divided into the two ten-year classes using the methodology described here, that is, dividing them according to the deaths for the individual ages 40-59 of the Italian table for 1872 (in this case: 3 in class 40-49 and 5 in class 50-59).

Row C then distributes the 238 deaths of unknown age, according to the distribution of known skeletons. For instance, the 75 skeletons aged 5-9 represent 0.10 of the known sample; we therefore add to this age class 238 x 0.10 = 24 individuals of unknown age. This means we ultimately have 75 + 24 = 99 individuals estimated as dying between 5 and 9 years of age.

Next, row D adjusts the age distribution of individuals over age 30 to avoid the underrepresentation of skeletons aged over sixty. Thirty per cent of the individuals aged over 30+ are attributed to the 60+ age class. In this case, 525 x 0.3 = 157 is the estimated number of individuals dying after age 60. The remaining 70% of the skeletons aged 30+ are attributed to the 30-39, 40-49, and 50-59 age classes according to the age at death identified by the anthropologists carrying out the analyses. For instance, individuals dying in age class 30-39 are estimated as follows: (525 x 0.7 x 297) / 455 = 240.

Following Halley's assumption of stationarity, in row E we calculate the number of the individuals exposed to the risk of dying at the beginning of each age class as $\Sigma \mathbf{D_i}$.

Finally, we estimate the probability of dying **Q** as the proportion of: **D/E**, following formula [1].

2.3. Standard Life Tables. To summarize the mortality trends observed in the considered cemeteries, we construct three Standard Life Tables: a "central" table that describes the average mortality regime, and two standard life tables that mark higher and lower mortality levels.

To calculate the central table we apply three different procedures.

1. The probability of dying in each age class in the standard life table is estimated as the mean of the probabilities of dying calculated for each of the 75 sites.
2. The probability of dying in each age class in the standard life table is estimated as the median of the probabilities of dying calculated for each of the 75 sites, following the procedure used by C&D (1983) to construct their SLTs.
3. The number of deaths in each age class estimated in the 75 sites are summed together, building a single series of deaths, distributed by age. The probabilities of dying are then constructed applying formula [1] to this summative new series. This is the choice adopted by Steckel et al. (2018).

We obtain different results with the third procedure depending on whether or not we assign the undefined skeletons in each site according to the known distribution of deaths. Our preference, however, is to distribute unknown skeletons, so as to give more weight to the sites with a highest number of excavated individuals.

After comparing the three procedures, we select the probability table that best summarizes the 75 cemeteries, which we label as "median." We then compare this life table with 4 probability series published in the literature, through the estimation of index numbers $\mathbf{100 \times q_x/q_{x,Median}}$. We calculate in full the median life table from the fifth birthday on, starting from the probability of dying estimated at different age classes. To estimate $\mathbf{L_x}$, we accept the traditional hypothesis that deaths are evenly distributed over time within each age class, such that this is calculated as the average number alive individuals in the interval between exact ages x and x+n (Table 3). Regarding the last age span, we expect that mortality above 60 follows the same trend as in $C\&D_{W1}$ with $\mathbf{e_{60}}$=9.0. The results would not change if we accepted the mortality trends suggested by $Woods_{20}$ for the last age groups, with $\mathbf{e_{60}}$=9.7.

Similarly to the median life table, we construct the two tables that represent higher and lower levels of mortality, using the probability of dying at different ages defined by the first and the third quartile. As discussed in greater detail below, we are able to employ index numbers to discuss the mortality regime in a single cemetery or the variability of mortality over time and space.

3. Results

3.1. The Standard Life Tables. Table 2 compares the probabilities of dying of the central life tables calculated following the procedures (1) to (3) presented in Section 2.3. We see from the first rows that the three procedures give very similar results. We ultimately chose to use the results of procedure (2) – median probability of dying – as they are less influenced by extreme values, which, in our case, could be the result of a wrong assessment of ages at death or due to particular mortality trends occurring in some sites. We call this table: **median**.

In the second and third parts of Table 2 and Figure 2 we can compare **median** with the tables extrapolated from the data published in Steckel *et al.* (2018); with the SLT of $C\&D_{W1}$ (Model West, level 1, $\mathbf{e_0}$=19.0); that of $Woods_{20}$ ($\mathbf{e_0}$=20); and the life tables of Italy in 1872[4] ($\mathbf{e_0}$=29.8) and Russia in 1896-97[5] ($\mathbf{e}_0$=29.4). Note that Steckel et al. decided to err on the side of caution, and not trust the estimate of age at death from individuals dying after 40 years of age.

These comparisons highlight several characteristics of our **median** life table.

First, mortality in age 0-4 in **median** and in Steckel is only 20-25% of that registered in $C\&D_{W1}$ and $Woods_{20}$ and 25% of that calculated for Italy in 1872 and Russia in 1896-97.

Second, in Italy in 1872 and Russia 1896-97 for all age classes between five and sixty years of age, the levels of mortality are much lower than those found in the other four tables considered. If for age classes 5-9 the differences are low, for adolescents and especially for adults the differences are quite relevant.

Third, the **median** probabilities of dying for the age groups 5-19 are similar to those in the $Woods_{20}$ standard life table, and a bit higher compared to those in Steckel and in $C\&D_{W1}$, while mortality in the **median** 20-39 age group is at an intermediate level relative to that in the $C\&D_{W1}$ and $Woods_{20}$ SLTs. Finally, for the 40-59 age group, our results align with those found by $C\&D_{W1}$ and are slightly higher compared to $Woods_{20}$.

In Table 3, all the functions of the median life table are estimated, from the fifth birthday on. In the last columns, we compare the values of $\mathbf{e_x}$ calculated in our table with those proposed by $C\&D_{W1}$ and $Woods_{20}$. The $\mathbf{e_x}$ values between 5 and 20 years of age in the **median** life table fall between those found by $Woods_{20}$ and $C\&D_{W1}$. After 20 years, life expectancy in **median** is instead a bit lower than that suggested by $Woods_{20}$ and $C\&D_{W1}$, with life expectancy at birth at about 19-20 years.

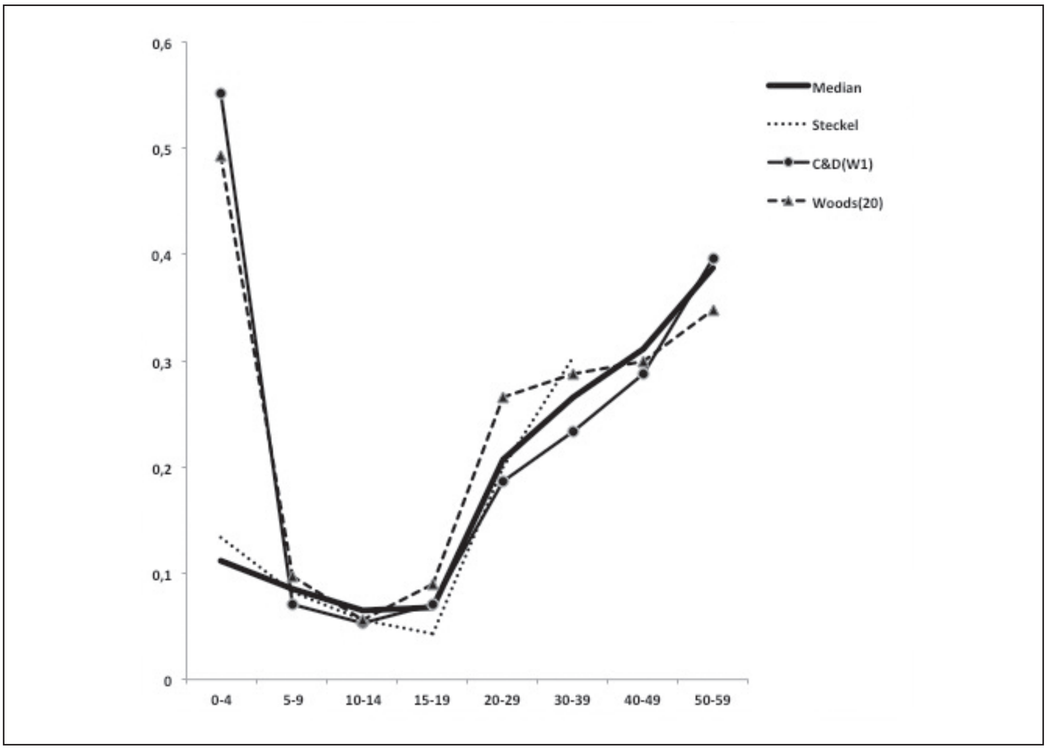
Tab. 2. *Probability of dying constructed from the 75 considered sites using the three procedures described, compared with the probability of dying according to Steckel; Coale and Demeny (Model West 1, e_0=19); Woods (e_0=20); Italy in 1872 (e_0=29.8); Russia in 1896-97 (e_0=29.4)*

	0-4	5-9	10-14	15-19	20-29	30-39	40-49	50-59	60+
Three different procedures applied to the 75 cemeteries									
Mean	0.136	0.091	0.065	0.072	0.228	0.270	0.316	0.381	1.000
Median	0.112	0.085	0.065	0.067	0.207	0.266	0.311	0.387	1.000
Sum	0.134	0.088	0.066	0.066	0.223	0.268	0.314	0.383	1.000
Four life tables compared									
Steckel	0.134	0.082	0.056	0.043	0.199	0.302	---	---	---
C&DW1	0.551	0.070	0.053	0.070	0.186	0.234	0.287	0.396	1.000
$Woods_{20}$	0.493	0.097	0.056	0.090	0.265	0.287	0.300	0.348	1.000
$Italy_{1872}$	0.443	0.063	0.032	0.037	0.103	0.115	0.140	0.219	1.000
$Russia_{1896-97}$	0.453	0.068	0.027	0.027	0.074	0.094	0.131	0.212	1.000
Index number (Median = 100)									
Median	100	100	100	100	100	100	100	100	---
Steckel	120	96	86	64	96	114	---	---	---
$C\&DW_1$	492	82	82	104	90	88	92	102	---
$Woods_{20}$	440	114	86	134	128	108	96	90	---
$Italy_{1872}$	396	74	49	55	50	43	45	57	---
$Russia_{1896-97}$	405	79	41	40	36	35	42	55	

The two standard life tables that represent the highest and lowest levels of mortality allow us to observe (Figure 3 and Table 4) the broad variability of the probability of dying in the 75 investigated sites: $\mathbf{e_5}$ varies from 39.2 years for the first quartile to 29.4 for the third quartile.

3.2. Mortality regime in a specific cemetery. Let us consider the cemetery of Saint-Martin-De-Fontaney – Calvados (France) dated to the 6th century, and previously used in Table 1 to show the procedure of constructing the probability of dying (Figure 4). For each age-class, we compare $\mathbf{q_x}$ with $\mathbf{q_{xMedian}}$ by means of the index number $\mathbf{100 \times q_x/q_{x,Median}}$, as well as consider the index numbers of the first and third quartile (last rows of Table 4). We see that this particular cemetery shows a high mortality between the ages of 5 and 30 (close to the high SLT threshold), a possible overestimation of deaths at age 30-39 (above the interval between the low and high mortality level) and a parallel underestimation of deaths at age 40-49 (below said interval).

Fig. 2. *Probability of dying in the median and in other three life tables*



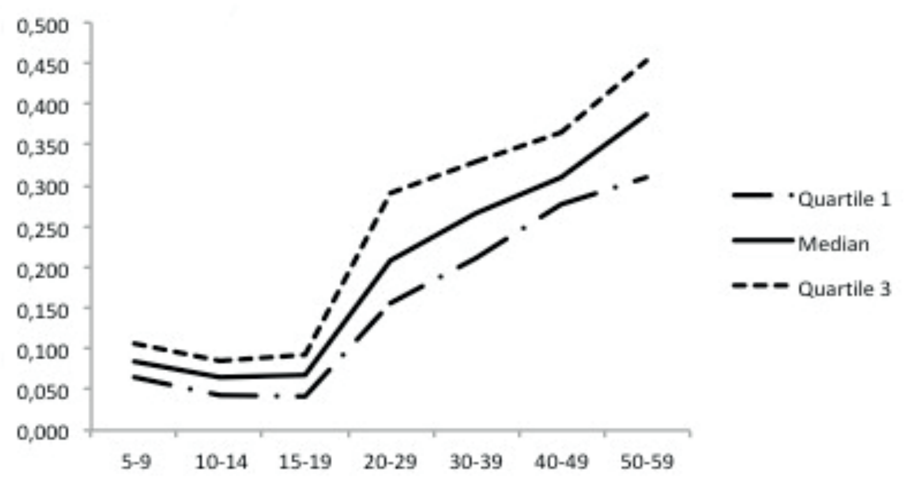
Tab. 3. *Median life table from the fifth birthday on, for the 75 European cemeteries, compared with C&D$_{W1}$ and Woods$_{20}$ for the values of e_x*

	Median of the 75 sites						C&D$_{W1}$	Woods$_{20}$
	$\mathbf{l_x}$	$\mathbf{q_x}$	$\mathbf{d_x}$	$\mathbf{L_x}$	$\mathbf{T_x}$	$\mathbf{e_x}$	$\mathbf{e_x}$	$\mathbf{e_x}$
5	100,000	0.085	8,481	478,797	3,428,475	34.3	36.2	31.2
10	91,519	0.065	5,922	442,790	2,949,677	32.2	33.7	29.9
15	85,597	0.067	5,706	413,720	2,506,887	29.3	30.5	27.3
20	79,891	0.207	16,546	716,175	2,093,167	26.2	27.6	24.2
30	63,344	0.266	16,833	549,277	1,376,992	21.7	22.7	21.8
40	46,511	0.311	14,481	392,707	827,715	17.8	18.1	18.6
50	32,030	0.387	12,387	258,365	435,008	13.6	13.4	14.7
60	19,643	1	19,643	176,643	176,643	9.0	9	9.7

Note: To close the median table, in the last age class, e_{60}=9.0 years, as in C&D$_{W1.}$

We apply the same procedure to a cemetery not included among the 75 analysed here, namely that of Villa Emo in Padua (Italy) dating to the 9-5th century BC, with 152 burials of which only 3 are of unknown age (Gamba, Voltolini 2018). In this necropolis, survival is particularly favourable in the 5-9 and 20-49 age groups.

Fig. 3. *Probability of dying for the first, second (Median), and third quartile in the 75 cemeteries, ages 5-59*



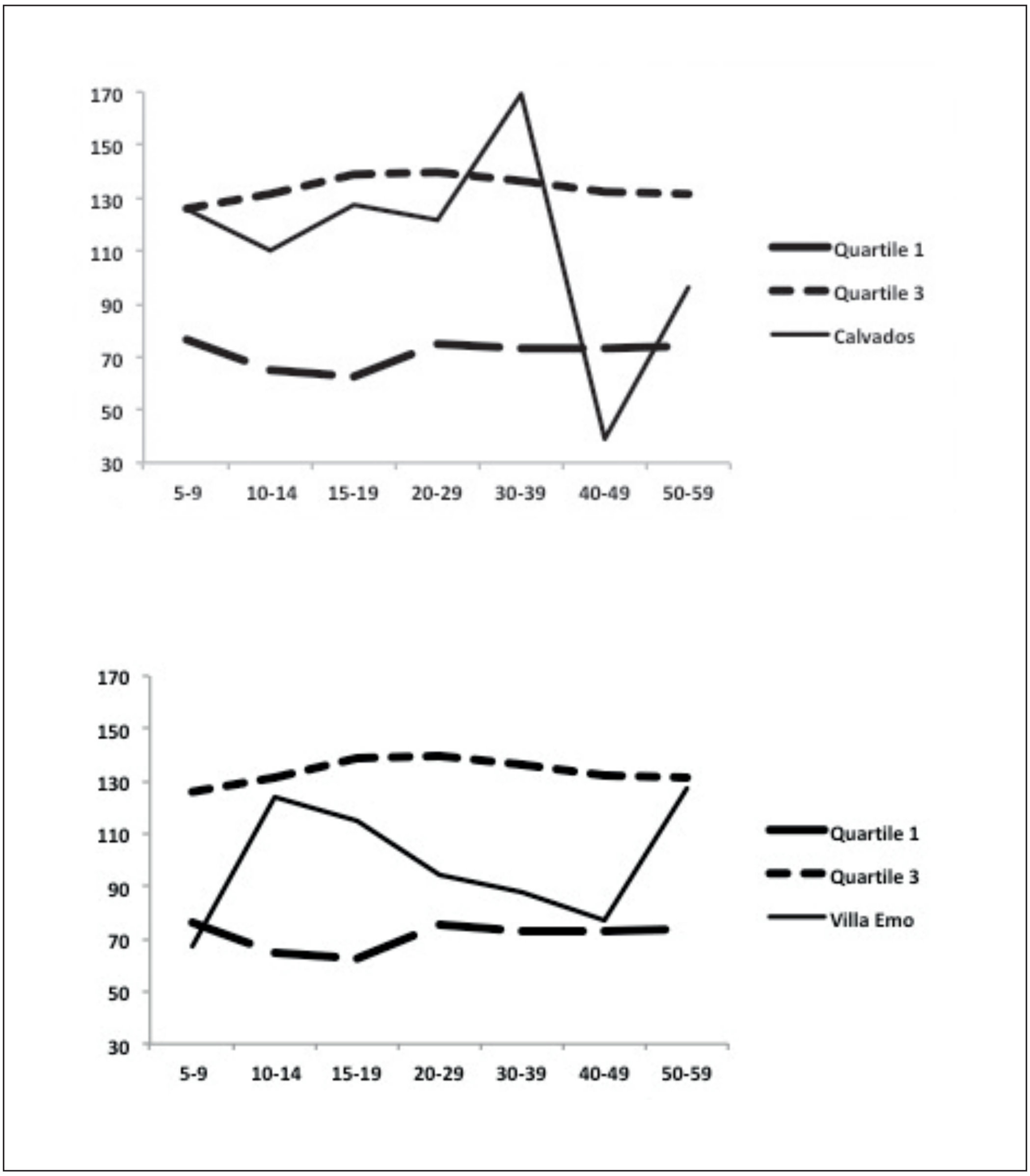
Tab. 4. *Life table for the first, second (Median), and third quartile of the probability of dying in the 75 cemeteries*

	5-9	10-14	15-19	20-29	30-39	40-49	50-59	60+
				q_x				
Quartile 1	0.065	0.042	0.042	0.156	0.210	0.276	0.311	1.000
Median	0.085	0.065	0.067	0.207	0.266	0.311	0.387	1.000
Quartile 3	0.107	0.085	0.092	0.290	0.329	0.365	0.454	1.000
				l_x				
Quartile 1	100,000	93,533	89,608	85,874	72,516	57,293	41,478	28,567
Median	100,000	91,519	85,597	79,891	63,344	46,511	32,030	19,643
Quartile 3	100,000	89,320	81,708	74,154	52,677	35,329	22,435	12,253
				d_x				
Quartile 1	6,467	3,925	3,734	13,358	15,223	15,814	12,912	28,567
Median	8,481	5,922	5,706	16,546	16,833	14,481	12,387	19,643
Quartile 3	10,680	7,612	7,554	21,477	17,348	12,894	10,182	12,253
				e_x				
Quartile 1	39.2	36.8	33.3	29.6	24.1	19.2	14.6	9.0
Median	34.3	32.2	29.3	26.2	21.7	17.8	13.6	9.0
Quartile 3	29.4	27.6	24.9	22.2	19.2	16.2	12.6	9.0

	5-9	10-14	15-19	20-29	30-39	40-49	50-59	60+
				Index number of q_x (Median = 100)				
Quartile 1	76	65	62	75	79	89	80	---
Median	100	100	100	100	100	100	100	---
Quartile 3	126	131	138	140	124	117	117	---

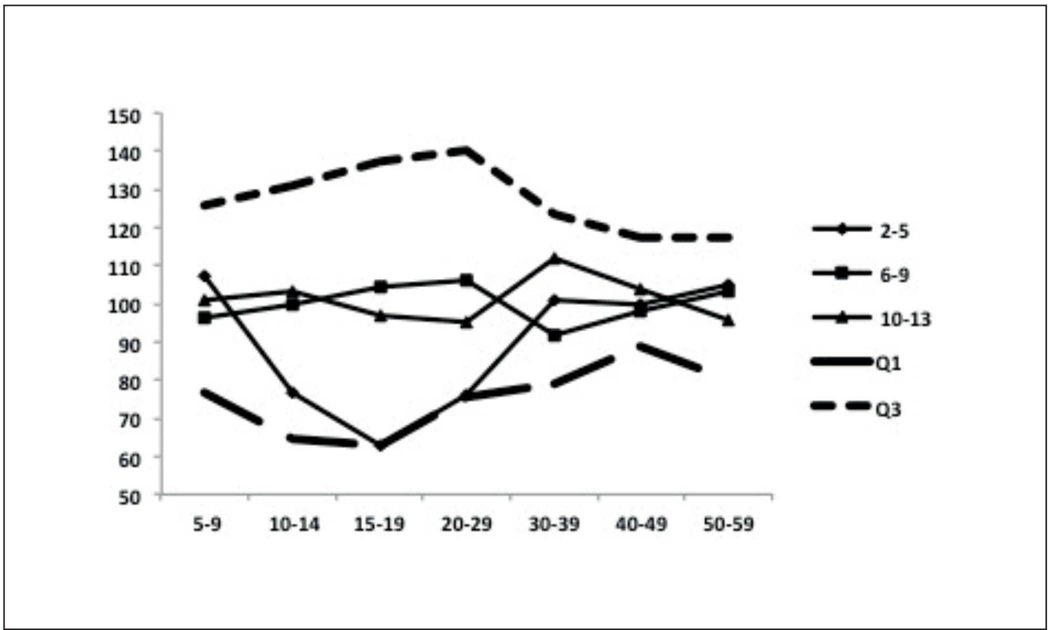
Note: To close the tables, in the last age class, e_{60}=9.0 years, as in $C\&D_{W1.}$

Fig. 4. *Index numbers 100 x qx/qx,Median for the cemeteries of Saint-Martin-De-Fontaney – Calvados (6th century, France) and Padova Emo (7th B.C. Italy)*



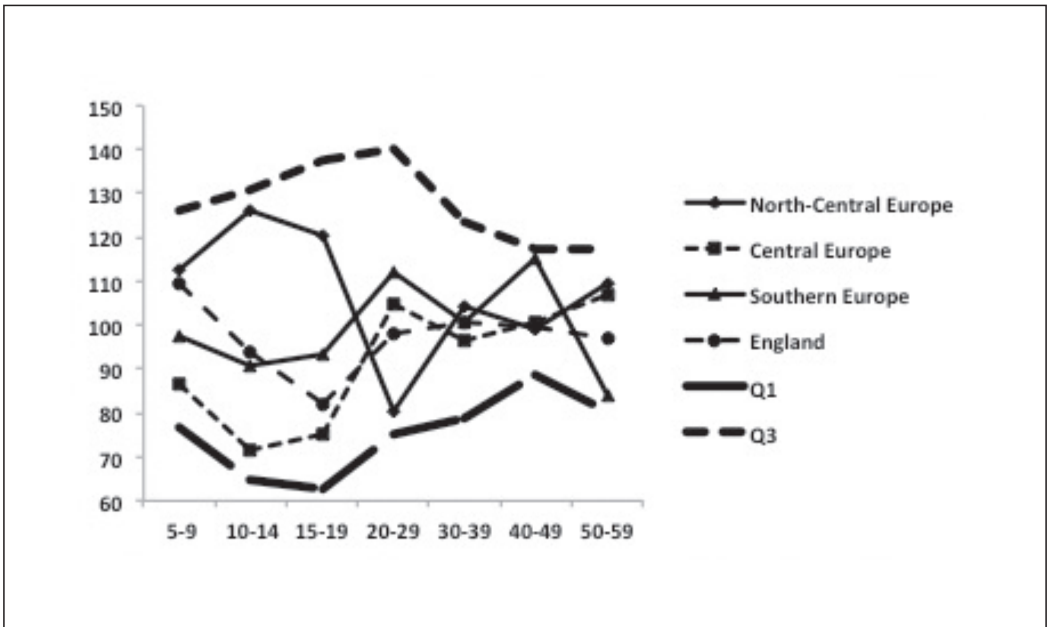
Sources: Saint-Martin-De-Fontaney: Pilet, 1994; Padova Emo: Gamba, Voltolini 2018.

Fig. 5. *Index numbers 100 x qx/qx,Median for the 2nd-5th, 6th-9th, and 10th-13th centuries*



We calculated $\mathbf{q_x}$ as the median of the values of the sites dated to each period. We considered: 9 sites for the 2nd-5th centuries, 47 for the 6th-9th centuries, and 19 for the 10th-13th centuries.

Fig. 6. *Index numbers 100 x qx/qx,Median for the sites located in Central Europe, Northern-Central Europe, Southern Europe and the United Kingdom.*



We calculated $\mathbf{q_x}$ as the median of the values of the sites belonging to an area. We considered: 18 sites in Central Europe, 22 in Northern-Central Europe, 14 in Southern Europe and 12 in the England.

3.3. The variability of the probability of dying over time and space. The 75 considered sites present variations over time and space (Figures 5 and 6). On the one hand, the profile of the probability of dying found in cemeteries dated to the Middle Ages, from the 6th to the 13th centuries, is very close to the **median**. On the other hand, in older sites (from the 2nd to the 5th centuries), the mortality of children (aged 5-9) and of individuals over 30 overlaps with the **median**, while mortality in age 10-29 is lower, resembling the levels found in Stekel et al (see Figure 2).

There is also variation in the probability of dying across the four macro areas, defined relative to the distribution of the sites as portrayed in Figure 1: Central Europe (present-day Hungary, Serbia, eastern Austria and continental Croatia); Northern-Central Europe (Germany and Switzerland); Southern Europe (Italy, Southern France and Dalmatia); and finally the sites in England[6]. Figure 6 shows a higher variability across macro areas than across macro periods: this is possibly partly due to the low number of sites found in certain areas. Mortality by age of adult individuals does not vary substantially in the four considered areas. Striking, however, is the difference in mortality for the age group 5-19 between Central Europe and Northern-Central Europe, being very high in the former and very low in the latter.

4. Discussion

The anthropological literature has highlighted the challenges of using skeletons for studying mortality in the past. Age at death can be difficult to identify in mature and old skeletons, and individuals over the age of 60 are often attributed to younger age groups. Moreover, in ancient cemeteries, the number of deaths under the age of five is underestimated.

In this article, we first suggest a method for making intensive use of the most reliable data available, namely that on the skeletons of individuals aged 5-59, moving from the distribution of deaths by age of a single cemetery to its death probability profile. We do not consider as reliable the estimate for mortality at age 0-4, and impose a fixed rate of deaths at age 60+.

Second, after applying the aforementioned method to 75 European necropolises dating from 2-13 AD, which passed strict selection criteria (at least 40 skeletons, children at age 5-19 classified at five or ten-year age group, less than 30% of skeletons of indefinite age and cemetery used for at least 100 years), we build the profile of the probability of death q_x by five- (5-19) and ten-year (20-59) age groups.

Third, we then calculate the median series of the probability of dying q_x (our "median" life table) and those referring to the first and third quartiles. Using these estimated probabilities of dying, we complete the SLTs. Life expectancy at five years varies from 27.2 (first quartile) to 38.8 (third quartile), with e_5=32.8 for the median table. This last result is very similar to that extrapolated from the cemeteries studied in Steckel et alii (2018), and closely resembles that suggested by Woods (2007) for Southern Europe in the same historical period.

The low level of mortality in age 0-4 in the **median** life table (in comparison with other probabilities of dying) confirms previous observations (Barbiera, Dalla-Zuanna 2009). Specifically, and as we discussed in Section 1.2, the data from cemeteries generally do not allow to precisely estimate mortality before age five. Of the 75 sites, just five have a probability of dying above 300‰ in the 0-4 age class, and only one above 400‰, while it is under 100‰ for 33 of the cemeteries, an implausibly low level for past societies.

While the levels of mortality between the ages of 5 and 60 are much higher than those found in Italy in 1872, they are consistent with the other three tables representing the ancient and medieval period considered here. The results thus confirm previous knowledge of comparatively greater survival in other early modern European contexts preceding the demographic transition; better than that observed in the ancient and medieval period. For instance, in England in 1686, life expectancy at birth was an estimated 34.1 years (Wrigley, Schofield 1989), while in France in 1740 it was just 24.7 years (Henry, Blayo 1975).

Beyond the more marginal differences detailed in Section 3.1, the **median** life table probabilities of dying at the different age classes, between 5 and 59 years of age, closely resemble those in the three tables of Steckel *et al.*, $C\&D_{W1}$, and $Woods_{20}$. These high levels of mortality also align with different population age structures deduced from cadastres and other later medieval written sources (Dalla-Zuanna *et al.* 2012; Herlihy, Klapisch-Zuber 1988).

A satisfactory interpretation has yet, however, to be found to explain the high levels of adolescent and adult mortality registered during antiquity and the Middle Ages, which are significantly higher than those seen in the early modern period (Woods 1993; Saller 1994; Scheidel 2009).

The standard life tables developed here can be used to compare data from single cemeteries or between specific regions. Nonetheless, our method requires careful evaluation of the suitability of the available cemetery documentation: the eventual under- or overestimation of age at death, together with the effectiveness of the hypothesis of stationarity, and the related question of migrations, should be acknowledged.

[1] Compared to our sample, Steckel *et al.* (2018) consider the remains of 15,119 individuals buried in 103 sites dated between 300 and 1900 A.D. covering a geographic area within the present-day borders of: Austria, Cyprus, France, Germany, Greece, Hungary, Latvia, Lithuania, the Netherlands, Poland, Portugal, Spain, Switzerland, the United Kingdom and Ukraine. Differently from our approach, which we describe below, these authors create a single database, combining all the graves, even those excavated in smaller or incomplete cemeteries. Note, in any case, that the objective of their study is neither the demographic mortality analysis nor the construction of SLTs. Rather, they aim to study single individuals in terms of their life standards, nutrition, pathologies, and so on.

[2] The SLTs of C&D (1983) were constructed based on hundreds of mortality tables collected all over the world in the 19th and 20th centuries. According to different curves of the probability of dying, the authors identify four "families" of life tables, for each of which they establish 25 levels, with life expectancy at birth ($\mathbf{e_0}$) for women between 20 and 80 years. There is some doubt of the applicability of these tables for studying mortality for periods prior to the 19th century, as the mortality regimes with $\mathbf{e_0}$ below 30 are constructed by extrapolation. Woods (2007), starting from 11 life tables estimated for populations mainly belonging to ancient and medieval Southern Europe, created six SLTs for $\mathbf{e_0}$ between 20 and 40 years.

[3] https://www.mortality.org/
[4] *Ibidem*.
[5] https://www.lifetable.de/cgi-bin/country.php?code=rus
[6] We excluded from these main clusters several scattered sites that are far from the main groups of cemeteries, such as the one located in Western Austria, or those in northern France and northern Germany, see Figure 1.

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Appendix

Tab. A1. *Death Probability for the 75 cemeteries*

Macro area	Site	Country	Chronology	0-4	5-9	10-14	15-19	20-29	30-39	40-49	50-59
CE	Frauenberg, Leibnitz (Steiermark)	AT	4th-5th c.	0.097	0.105	0.067	0.040	0.176	0.290	0.311	0.387
CE	Leobersdorf	AT	7th-8th c.	0.141	0.082	0.103	0.127	0.171	0.285	0.185	0.486
CE	Munchendorf	AT	7th-8th c.	0.094	0.042	0.087	0.024	0.293	0.241	0.286	0.446
CE	Zwölfaxing	AT	7th-12th c.	0.245	0.089	0.028	0.065	0.169	0.297	0.322	0.371
NN	Schwanenstadt	AT	7th c.	0.112	0.011	0.077	0.093	0.320	0.254	0.405	0.324
NCE	Rottweil	DE	1st-2nd c.	0.033	0.023	0.023	0.041	0.142	0.268	0.309	0.407
NCE	Hemmingen (Stuttgart)	DE	5th-6th c.	0.088	0.038	0.040	0.042	0.391	0.250	0.367	0.368
NCE	Fridingen an der Donau	DE	6th c.	0.044	0.049	0.048	0.018	0.207	0.199	0.311	0.456
NCE	Kösingen (Ostalbkreis)	DE	5th-7th c.	0.138	0.123	0.085	0.092	0.500	0.534	0.204	0.192
NCE	Neresheim (Ostalbkreis)	DE	5th-7th c.	0.077	0.056	0.065	0.088	0.417	0.322	0.355	0.314
NCE	Pleidelsheim	DE	5th-7th c.	0.092	0.085	0.046	0.063	0.277	0.319	0.363	0.308
NCE	Marktoberdorf	DE	5th-7th c.	0.057	0.053	0.043	0.037	0.103	0.121	0.337	0.485
NCE	Schretzheim	DE	5th-7th c.	0.060	0.130	0.075	0.058	0.199	0.164	0.381	0.420
NCE	Unterthürheim	DE	5th- beginning of 8th c.	0.086	0.107	0.070	0.020	0.203	0.204	0.345	0.425
NCE	Eichstetten am Kaiserstuhl	DE	5th-7th c.	0.046	0.058	0.027	0.054	0.114	0.160	0.286	0.499
NCE	Kirchheim am Ries	DE	6th-beginning 8th c.	0.083	0.071	0.053	0.071	0.397	0.388	0.404	0.177
NCE	Weingarten	DE	5th-8th c.	0.050	0.040	0.038	0.041	0.348	0.350	0.269	0.369
NCE	Sontheim an der Brenz	DE	6th-7th c.	0.099	0.085	0.093	0.088	0.435	0.372	0.174	0.422
NCE	Wenigumstadt (Bavaria)	DE	5th-8th c.	0.139	0.077	0.076	0.033	0.218	0.298	0.340	0.352
NCE	Altheim, Horb	DE	6th-8th c.	0.222	0.071	0.031	0.127	0.291	0.335	0.275	0.378

Macro area	Site	Country	Chronology	0-4	5-9	10-14	15-19	20-29	30-39	40-49	50-59
NCE	Donzdorf	DE	7th c.	0.058	0.103	0.027	0.040	0.335	0.235	0.466	0.265
NCE	Merdingen	DE	6th-first half 8th c.	0.040	0.080	0.047	0.063	0.186	0.117	0.293	0.519
NCE	Tafelkreutz, Donaueschingen	DE	7th-8th c.	0.087	0.089	0.090	0.095	0.194	0.237	0.303	0.436
NCE	Donaueschingen, Schwarzwald-Baar-Kreis	DE	end 6th - beginning 8th c.	0.036	0.076	0.037	0.036	0.215	0.229	0.316	0.431
NCE	Espenfeld	DE	11th-12th c.	0.356	0.136	0.099	0.075	0.406	0.335	0.348	0.309
NN	Müngersdorf (Köln)	DE	6th-7th c.	0.023	0.055	0.033	0.051	0.288	0.369	0.278	0.341
NN	Andertein (Hannover)	DE	6th-8th c.	0.107	0.075	0.089	0.248	0.094	0.229	0.380	0.373
NN	Rohnstedt (Erfurt)	DE	8th-9th c.	0.431	0.243	0.101	0.078	0.267	0.243	0.331	0.407
SE	Roissard	FR	5th-7th c.	0.147	0.126	0.039	0.123	0.344	0.268	0.225	0.472
SE	Saint-Paul-Lès-Durance (Cadarche)	FR	5th-7th c.	0.069	0.065	0.059	0.211	0.200	0.266	0.394	0.326
NN	Saint-Martin-De-Fontaney Calvados)	FR	5th-7th c.	0.063	0.107	0.071	0.085	0.252	0.457	0.121	0.372
NN	Thonon, Les Ursules	FR	6th-7th c.	0.147	0.138	0.000	0.120	0.432	0.405	0.302	0.278
NN	Les Rue des Vignes (Cambrai)	FR	6th-8th c.	0.171	0.079	0.086	0.029	0.250	0.299	0.312	0.377
NN	Blussangeaux	FR	6th-8th c.	0.137	0.068	0.073	0.070	0.104	0.171	0.206	0.544
NN	La Chapelle Saint-Simèon (Bourdoux)	FR	7th-8th c.	0.254	0.076	0.057	0.139	0.182	0.191	0.262	0.497
SE	Zadar	HR	3rd-5th c.	0.102	0.087	0.086	0.037	0.158	0.375	0.383	0.222
SE	Privlaka	HR	8th-9th c.	0.077	0.084	0.059	0.056	0.375	0.429	0.368	0.170
SE	Danilo Gornje, Šibenik	HR	9th-11th c.	0.095	0.105	0.176	0.000	0.286	0.368	0.350	0.269

Macro area	Site	Country	Chronology	0-4	5-9	10-14	15-19	20-29	30-39	40-49	50-59
CE	Dakovo 1	HR	11th-13th c.	0.045	0.075	0.082	0.100	0.296	0.350	0.419	0.206
CE	Stenjevec	HR	11st-13th c.	0.222	0.132	0.092	0.076	0.227	0.333	0.422	0.222
CE	Zagreb, Opatovini, St. Francis	HR	13th	0.024	0.067	0.110	0.036	0.106	0.308	0.436	0.232
CE	Kaszás dülő, Raktárrét, Budapest	HU	2nd-4th c.	0.155	0.102	0.193	0.102	0.082	0.191	0.329	0.447
CE	Visegrád-Diós	HU	4th-5th c.	0.164	0.126	0.057	0.067	0.137	0.278	0.288	0.416
CE	Kaposvar	HU	7th-8th c.	0.165	0.089	0.093	0.114	0.212	0.326	0.370	0.294
CE	Gyenesdiás (Balaton)	HU	8th-9th c.	0.347	0.166	0.082	0.119	0.220	0.280	0.304	0.401
CE	Gyöngyöspata-Előmály	HU	8th-9th c.	0.182	0.140	0.068	0.051	0.146	0.161	0.259	0.518
CE	Sopronkőhida	HU	9th c.	0.336	0.151	0.063	0.122	0.092	0.117	0.297	0.517
CE	Kál	HU	10th c.	0.134	0.086	0.057	0.100	0.111	0.206	0.337	0.430
CE	Tiszafüred-Nagykenderföldek	HU	10th c.	0.161	0.170	0.051	0.054	0.129	0.252	0.206	0.495
CE	Halimba-Cseres (Veszprém)	HU	10th-11th c.	0.200	0.085	0.093	0.085	0.175	0.224	0.266	0.473
CE	Zalavár-Kápolna	HU	11th-12th c.	0.000	0.065	0.069	0.093	0.163	0.276	0.322	0.389
SE	Quadrella (Isernia)	IT	1st-4th c.	0.101	0.101	0.050	0.053	0.181	0.163	0.251	0.521
SE	Castellecchio di Reno (Bologna)	IT	2nd-4th c.	0.000	0.048	0.000	0.085	0.111	0.163	0.251	0.521
SE	Centallo (Cuneo)	IT	6th-7th c.	0.206	0.106	0.092	0.058	0.292	0.213	0.464	0.289
SE	S. Vincenzino di Cecina (Livorno)	IT	5th-8th c.	0.092	0.058	0.031	0.143	0.278	0.241	0.414	0.326
SE	Selvicciola (Viterbo)	IT	7th c.	0.191	0.101	0.063	0.067	0.243	0.244	0.388	0.352

Macro area	Site	Country	Chronology	0-4	5-9	10-14	15-19	20-29	30-39	40-49	50-59
SE	Collecchio (Parma)	IT	7th c.	0.398	0.057	0.100	0.133	0.308	0.064	0.136	0.629
SE	Pauciuri, Malvito (Cosenza)	IT	9th-12th c.	0.143	0.063	0.067	0.024	0.220	0.372	0.383	0.226
SE	S. Lorenzo di Aversa (Caserta)	IT	10th-12th c.	0.082	0.022	0.023	0.070	0.125	0.400	0.333	0.250
SE	Trino Vercellese (Vercelli)	IT	10th-13th c.	0.163	0.082	0.041	0.051	0.198	0.278	0.274	0.427
CE	Backo Petrovo Selo	SR	6th-8th c.	0.200	0.139	0.113	0.073	0.127	0.069	0.233	0.580
NCE	Ettenbühl bei Elgg	SW	6th-8th c.	0.059	0.048	0.039	0.029	0.132	0.178	0.284	0.490
NCE	Basel, Kleinhüningen	SW	5th-8th c.	0.053	0.051	0.041	0.047	0.112	0.264	0.190	0.497
ENG	Cannington	ENG	4th-7th c.	0.286	0.091	0.040	0.042	0.370	0.400	0.458	0.077
ENG	Worth Park, Kingsworthy	ENG	end of 5th-middle 7th	0.112	0.115	0.065	0.069	0.179	0.207	0.481	0.271
ENG	Buckland, Dover	ENG	end 5th - beginning 8th c.	0.042	0.088	0.032	0.099	0.413	0.450	0.234	0.289
ENG	Whithorn	ENG	6th-9th c.	0.267	0.208	0.082	0.054	0.151	0.248	0.361	0.376
ENG	York, Minster	ENG	7th-9th c.	0.098	0.068	0.043	0.045	0.222	0.300	0.286	0.400
ENG	Jarrow	ENG	7th - middle of 9th c.	0.189	0.173	0.107	0.076	0.187	0.121	0.310	0.505
ENG	Llandough	ENG	7th-12th c.	0.113	0.061	0.075	0.042	0.173	0.270	0.308	0.406
ENG	York, Swinegate	ENG	9th-11th c.	0.174	0.066	0.070	0.076	0.197	0.260	0.351	0.375
ENG	Barton-on-Humber, St. Peter	ENG	10th-11th c.	0.150	0.086	0.044	0.031	0.153	0.266	0.300	0.416
ENG	Lincoln, St. Mark	ENG	10th-11th c.	0.254	0.128	0.049	0.026	0.237	0.315	0.307	0.368
ENG	Barrow-on-Humber	ENG	10th-12th c.	0.134	0.095	0.066	0.056	0.209	0.226	0.293	0.452
ENG	York, Jewbury	ENG	12th-13th c.	0.127	0.107	0.057	0.075	0.265	0.334	0.323	0.335

Macro area	Site	Country	Chronology	0-4	5-9	10-14	15-19	20-29	30-39	40-49	50-59
			Quartile 1	0.065	0.042	0.042	0.156	0.210	0.276	0.311	
			Median	0.085	0.065	0.067	0.207	0.266	0.311	0.387	
			Quartile 3	0.107	0.085	0.092	0.290	0.329	0.365	0.454	

Attribution to macro areas (see figure 6):
CE = Central Europe
NCE = North–Central Europe
SE = Southern Europe
ENG = England
NN = not attributed

The original data for each necropolis, obtained from volumes and printed articles, are available from the authors.

Tab. *A2. dx function of the life table of Italy in 1872 (l0 = 100,000)*

Age	dx	Age	dx	Age	dx	Age	dx	Age	dx
0	23,340	20	456	40	385	60	565	80	667
1	9,840	21	476	41	398	61	609	81	616
2	5,947	22	525	42	597	62	1,151	82	558
3	3,205	23	539	43	590	63	1,167	83	500
4	2,003	24	545	44	611	64	1,201	84	442
5	1,331	25	513	45	491	65	1,014	85	386
6	883	26	486	46	492	66	1,030	86	333
7	575	27	490	47	595	67	1,241	87	282
8	381	28	474	48	591	68	1,299	88	233
9	313	29	520	49	649	69	1,418	89	189
10	315	30	413	50	407	70	772	90	150
11	344	31	424	51	434	71	749	91	115
12	344	32	541	52	711	72	1,239	92	87
13	340	33	520	53	740	73	1,285	93	63
14	350	34	532	54	794	74	1,326	94	45
15	338	35	479	55	698	75	1,069	95	29
16	345	36	459	56	700	76	987	96	19
17	372	37	517	57	840	77	1,131	97	13
18	384	38	537	58	898	78	987	98	8
19	434	39	602	59	1030	79	930	99+	12

Source: https://www.mortality.org/

Summary

Standard Life Tables for Western and Southern Europe from Antiquity to the Black Death

The purpose of this study is to infer the mortality regimes from human remains found in cemeteries excavated between Antiquity and the Black Death in 1347-49. We suggest a method to (1) move from the age distribution of deaths of a single cemetery to its death probability profile; (2) build Standard Life Tables (SLT) directly deduced from European necropolis, which can be used as terms of comparison with respect to other necropolises or group of necropolises. The SLT are constructed using 75 cemeteries (17,107 individuals), excavated in a vast region of Western and Southern Europe, that guarantee a trustable group of deaths by age. Life expectancy at five years varies from 27.2 (first quartile) to 38.8 (third quartile), with e_5=32.8 for the median table. By comparing our SLT with other tables extrapolated for antiquity, we show that skeletal data can offer trustable information on European mortality from antiquity to the Black Death.

Riassunto

Tavole Tipo di Mortalità per l'Europa Occidentale e Meridionale dall'antichità alla peste nera

Scopo di questo studio è di ricostruire i regimi di mortalità usando i resti umani scavati in una serie di necropoli datate tra l'antichità e la peste nera del 1347-49. In questo lavoro suggeriamo un metodo per (1) passare dalla distribuzione per età dei decessi di una singola necropoli al profilo di probabilità di morte; (2) costruire Tavole Tipo di Mortalità direttamente dedotte dalle necropoli europee, che possono essere utilizzate come termini di confronto rispetto ad altre necropoli o gruppi di necropoli. Le Tavole Tipo sono costruite utilizzando 75 cimiteri (17.107 individui), scavati in una vasta regione dell'Europa occidentale e meridionale, che garantiscono dati affidabili di decessi per età. La speranza di vita a cinque anni varia da 27,2 anni (primo quartile) a 38,8 (terzo quartile), con e_5 = 32,8 per la tavola mediana. Confrontando la nostra Tavola Tipo con altre tavole estrapolate per l'antichità, dimostriamo che i dati scheletrici possono offrire informazioni affidabili sulla mortalità europea dall'antichità alla peste nera.

Keywords

Paleodemography; Mortality; Standard Life Tables; Demographic regimes in Antiquity and the Middle Ages.

Parole chiave

Paleodemografia; Mortalità; Tavole Tipo; Regimi demografici nell'antichità e nel medioevo.