CHAPTER 2

Fifty Shades of Gray Literature: Deconstructing "High" Infant Mortality With New Data Sets in Historic Cemetery Populations

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2.1 INTRODUCTION

Human mortality is a cornerstone in any study describing the lived experience of past populations. It is frequently assumed that mortality—particularly infant mortality—was much higher in ancient cultures than it is today (Caldwell, 1996; Caldwell and Caldwell, 2003; Chamberlain, 2006; Guy et al., 1997; Lewis and Gowland, 2007; Sainz de la Maza Kaufmann, 1997). Unfortunately, prior to the advent of organized record keeping, it is difficult to describe past mortality with confidence (Harding, 1998). Osteological samples from historic cemeteries are one underutilized source that are uniquely suited to analyze whether mortality derived from osteological evidence may be a reliable proxy of the true mortality for the population being studied for two reasons. Firstly, historic cemeteries often have associated burial records, against which osteological estimates of mortality can be compared (Swedlund and Herring, 2003). Secondly, the burial practices utilized are generally understood: namely to preserve the mortal remains of the community for eternity (Cherryson et al., 2012). Theoretically, this results in the creation of a representative population sample, which is also comparatively well preserved.

Although it might seem that the juxtaposition of historical records with excavated cemetery reports would be a well-trodden avenue of inquiry, few studies have attempted to engage with both (Grauer and McNamara, 1995; Lanphear, 1989; Saunders et al., 1995). Though both are very common types of record, they are unusual in that they are often overlooked and rarely perceived as complementary. Historic

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cemetery reports seem homogenous, but are diverse in their presentation, retention, and study (Boyle, 2015). Archival records may be lost to memory, inaccessible, incomplete, or untranslated (Grenham, 2006; Jolly, 2013; Wilkes, 2013). Both have much to offer one another. Among other reasons, cemetery reports are an excellent source of information on infant mortality and archival records contain a bonanza of demographic information (Swedlund and Herring, 2003). Together, they are filled with potential for answering numerous questions about past health and lifeways.

Infant mortality, or the proportion of infants who perish in the first year of life per thousand born, is central to the study of any culture. (Acsadi and Nemeskeri, 1970; Chamberlain, 2006; Lewis and Gowland, 2007). It is one of the best predictors of the overall health of any population (Meckel, 1990). In modern times, it ranges from as little as 0.02% in developed countries to as much as 50% in areas of the developing world (Barbieri, 2001; Department of the Interior, 2012; Kuehn, 2008; Matthews and MacDorman, 2007). Because the current range of existing infant mortalities is quite wide, to say that past infant mortality was "higher than at present" tells us very little without further qualification.

This pattern of wide mortality ranges persists in the numerous studies prior to CE 1900 (Fogel, 1986, 2004; McKeown, 1976; Newman, 1906; Rüttimann and Loesch, 2012; Wrigley and Schofield, 1989). These sources describe the effects of nutrition, hygiene, vaccination, and urbanization on the mortality decline leading up to the modern era. They also have recorded infant mortality percentages from the teens to the mid-1920s in rural England with highs of ~40% in urban areas (Lewis and Gowland, 2007; Newman, 1906; Wrigley and Schofield, 1989). In contrast, estimates as low as 2–3% have been proposed for Colonial America, rising into the teens by the 1900s (Brosco, 1999; Mays, 2004). Variation has been perceived between countries and between localities within a given country, yielding regional ranges from below 10% to over 50% (Newman, 1906; Rüttimann and Loesch, 2012).

Prior to CE 1500, a lack of records causes mortality estimates to become increasingly unreliable, leading archaeologists to look to alternate sources to approximate them. Medically primitive communities are one possible proxy; for example, infant mortality from 12% to 21%

is recorded among the Amish and 20% among the !Kung (Acheson, 1994; Howell, 1979). Studies of ancient demography have also attempted to understand mortality in prehistoric or classical populations using ages derived either from burials or the incomplete textual sources that were available (Acsadi and Nemeskeri, 1970; Bagnall and Frier, 1994; Hassan, 1981; McKechnie, 1999; Russell, 1958; Scheidel, 2001). The ambiguous nature of ancient data coupled with misgivings about sampling have increasingly led researchers to recognize the value of comparing archaeological and textual sources (Lewis, 2002; Lewis and Gowland, 2007; Perry, 2007; Photos-Jones et al., 2008; Swedlund and Herring, 2003). Rare studies have compared mortality from individual historical cemetery samples to burial records (Grauer and McNamara, 1995; Lanphear, 1989; Saunders et al., 1995). These have found agreement between the two mortality estimates, suggesting that cemetery mortality may be an adequate proxy for burial records among juveniles. However, this is only descriptive of specific sites. In order to state more generally whether this is true, many more historic cemetery samples must be compared.

In a survey of infant mortality in excavated medieval cemeteries, Buckberry (2000) was able to demonstrate figures around 30%. While not as low as most modern infant mortality, this is not as high as the estimates of ~35–40% and above which have been postulated by archaeologists and historical demographers (Caldwell, 1996; Coale and Demeny, 1983; Hollingsworth, 1968; Lewis and Gowland, 2007). This study attempts a similar survey of excavated historical cemeteries which employ sufficiently narrow age-at-death categories to consider the differences between infant, child, and adult mortality from the UK and the US with the goal of determining: (1) the range of infant mortalities in excavated historic cemeteries; (2) how this range compares to known historic estimates of infant mortality; and (3) whether the appearance of infant mortality is strongly influenced by factors such as climatic region, urbanization, sample size, and population size/density.

2.2 MATERIALS AND METHODS

Seventy-three reports of excavated historic cemeteries from the US and the UK with sample sizes of ten or more were studied for their inclusion of relevant demographic data derived from osteological sources.

The use of small samples was unavoidable, given the scarcity of larger excavated cemeteries. To mitigate this, samples were aggregated in several ways to improve their representativeness. In addition to the availability of reports, sample size, and a minimum quality of osteological analysis sufficient to yield precise ages at death (see Buikstra and Ubelaker, 1994), two other factors guided sample selection. First, because of potential noise from racial and socioeconomic differences (ie, disruption to family groups during missionization, forced relocation, or slavery) only cemetery samples with large percentages of European ancestry were selected (Chamberlain, 2006). Second, only demographically inclusive samples were used (Chamberlain, 2006). This removes distortion caused by differential age-specific mortality patterns such as would be expected within cemeteries associated with age- and gender-selective establishments (eg, military institutions, poor houses, and hospitals).

The samples used in this study are enumerated in Tables 2.1–2.2. Seventy-three cemeteries had suitable sample size (≥10) and age categories to facilitate the comparison of infants (0–1.9 years), children (2–17.9 years), and adults (18+ years). Two cemeteries with no infants were studied for their child mortality and age-specific mortality. In addition to these general age groups, 19 North American cemeteries and all 23 British cemeteries utilized more precise (ie, age-specific) categories (0–1.9 years, 2–11.9 years, 12–17.9 years, 18–34.9 years, 35–49.9 years, and 50–99.9 years). Although infant mortality is usually defined as occurring in the first year of life only, and although 1-year intervals are typically used in the youngest cohorts for demographic purposes (Chamberlain, 2006), the variable age categories yielded from osteological recording in the cemetery reporting precluded this. In model populations where overall life expectancy is relatively low, the mortality in the youngest age group (0–1.9 years) should still be sufficiently high to enable their comparison with Model West life tables without distorting the effects of infant mortality (Coale and Demeny, 1983; United Nations, 1982). Such tables are experimentally derived mortality profiles for different population types in developing countries. Juxtaposition of osteological mortality against life tables indicates whether the mortality pattern of the sample falls into one of several realistic ranges, or whether it displays abnormal traits (Coale and Demeny, 1983).

Table 2.1 US Cemeteries Used in This Study, Cemeteries With Precise (Numeric) Age Categories Marked With an X

Cemetery	State	n =	Age-Specific	Cemetery	State	n =	Age-Specific
Big Neal Cove Cemetery	AL	68		Filhiol Mound	LA	16	
Becky Wright Cemetery	AR	10		Lane Memorial Hospital	LA	13	
Eddy Cemetery	AR	16		7 Rivers Cemetery	NM	45	X
Alameda Stone Cemetery	AZ	1166	X	Kearny Rd Cemetery	NM	21	X
LA Cemetery	CA	31		St Regis Cemetery	MO	42	
Woodville Cemetery	DE	10		Collings & Watkins Cemetery	OR	10	
Roughton Browne Cemetery	GA	14		Voegtly Cemetery	PA	555	X
Shockley Cemetery	GA	18		Shippenville Cemetery	PA	28	
Fuller Family Cemetery	GA	44		Blanchard Cemetery	RI	11	
Richmond County Cemetery	GA	11		State Institutional Ground	RI	60	X
Pine Ridge Cemetery	GA	14		Hampstead Cemetery	SC	344	X
Dubuque 3rd St	IA	811	X	Son Cemetery	SC	11	
Mitchell Rd Cemetery	IL	15		Mason Cemetery	TN	35	
Vandawerker Burials	IL	11		Read Family Cemetery	TN	27	
Old Irish Cemetery	IL	13		Ridley Cemetery	TN	47	X
Thurston Cemetery	IL	21		Dawson Cemetery	TX	63	X
Grafton Cemetery	IL	163	X	Tucker & Sinclair Cemetery	TX	12	
Bowling Cemetery	IL	199	X	Adam's Family Cemetery	TX	11	
Stellwagen Cemetery	IL	15		Coffey & Boothill Cemetery	TX	15	
Douthitt Cemetery	IN	11		Guinea Rd Cemetery	VA	34	X
Bennett Cemetery	KY	56	X	Wrenn-Hutchinson Cemetery	VA	43	X
Horse Park Cemetery	KY	31	X	Oliver Family Cemetery	VA	10	
Branham Cemetery	KY	24	X	Weir Family Cemetery	VA	24	
Campbell County Cemetery	KY	15		Evans Cemetery	WV	101	X
1st Cemetery of St Peter	LA	29	X	Reynold's Cemetery	WV	32	X

Table 2.2 UK Cemeteries Used in This Study

Cemetery	Location	n =	Cemetery	Location	n =
King's Lynn Quakers	King's Lynn	32	St Peter	Wolverhampton	149
King's Lynn Baptists	King's Lynn	19	St Hilda	South Shields	183
St George	Bloomsbury	113	Chelsea Old Church	London	193
Kingston on Thames Quakers	Kingston on Thames	360	St Luke's Old St	London	891
St Peter Le Bailey	Oxford	172	Spitalfields	London	421
Baptist Chapel, Littlemore	Oxford	29	St Pancras	London	631
Poole Baptist Church	Poole	101	St Bride's, Fleet St	London	443
Sheffield Cathedral	Sheffield	165	New Churchyard, Broadgate	London	143
Carver St Methodists	Sheffield	130	St Benet Sherehog	London	187
St Paul's, Pinstone St	Sheffield	14	City Bunhill Burial Ground	London	239
St Martin in the Bullring	Birmingham	505	Crossbones Burial Ground	London	148
Priory Yard Baptists	Norwich	63			

Where intermediate age categories were used (eg, 10–13 years), or some individuals within the cemetery fell into a nominal class (ie, adult, infant, child), they were divided and apportioned into refined age categories. The number placed in each category using this method was weighted according to standard attritional mortality patterns; generally in historical populations this is a bimodal curve with the highest mortality peak in early infancy and a lesser peak at the point in middle adulthood where increased risk meets declining survivorship (Acsadi and Nemeskeri, 1970; Chamberlain, 2006). While this introduces the potential for slightly skewing the appearance of mortality within a discrete category to seem more demographically typical, it prevents the distortion of mortality across all categories by preserving the size of the sample and the ratios of broad age categories.

Many of the UK cemeteries had sample sizes of ≥100. Because the sample size from US cemeteries was often quite small, they were studied individually and then aggregated into 18 states for comparison with the overall UK trends. Studying both small and aggregated samples is useful as localized population trends can be masked in larger samples, such as censuses (Bagnall and Frier, 1994), yet archaeologists frequently need to understand the composition of the smaller cemeteries they work with. Thus, much can be learned if the mortality demonstrated in the small samples is in accord with that of the larger ones. United States cemeteries with sample sizes of 100 or more were also examined as a group, to ensure that conglomerating samples was not artificially creating the appearance of plausible, yet misleading mortalities. The aggregated states and their sample sizes are presented in Table 2.3. These states were then subdivided into five geographic regions: the Northeast; the Mid-Atlantic; the South; the Southwest; and the Midwest (Table 2.4).

Because of its comparatively small landmass, the UK was considered as a sixth single region. In addition to experimenting with an even larger sample size, this enabled the comparison of mortality by region, a strategy that may influence both attrition and skeletal preservation. Mortality may change by region owing to increased risk posed by epidemic, environmental factors, population density, and social factors

Table 2.3 Samples Aggregated by US State

State	n =	State	n =
Alabama	68	Missouri	42
Arkansas	26	New Mexico	66
Arizona	1166	Pennsylvania	583
California	31	Rhode Island	71
Georgia	101	South Carolina	355
Illinois	437	Tennessee	123
Iowa	811	Texas	101
Kentucky	126	Virginia	111
Louisiana	58	West Virginia	128

Table 2.4 Samples Aggregated by Region

Region	Climate	States	n =	Cemeteries n =
United Kingdom	Temperate Maritime	N/A	5280	23
Northeastern US	Humid Continental	DE, PA, RI	1321	5
Mid-Atlantic US	Humid Continental-Subtropical	KY, VA, WV	355	9
Southern US	Humid Subtropical	AL, AR, GA, LA, SC, TN	718	16
Midwestern US	Humid Continental	IL, IN, MO, IA	1301	10
Southwestern US	Humid Subtropical-Arid	AZ, NM, TX	1258	6

(Acsadi and Nemeskeri, 1970). Taphonomic preservation may alter with seasonal precipitation, soil drainage, and heating/freezing cycles (Buckberry, 2000).

2.3 RESULTS

2.3.1 General Infant Mortality

Infant mortality in the UK cemeteries ranged from 2% to 50% (Fig. 2.1). In the 18 aggregated US states, it ranged from 3% to 46% (Fig. 2.2). More than two-thirds of the UK groups had an infant mortality (0–1.9 years) of 13% or below (Fig. 2.3). The remainder were ~20% and above, with a small group of outliers between 35% and 50%. Child mortality ranged from 6% to 28% with dual modes of 16% and 20%. Though averages for both infant and child mortality were 16%, the majority of samples displayed child mortality of ≥15% and infant mortality of ≤15%.

By contrast, average aggregated US infant mortality was 25%. This closely matched the profile of the nonaggregated cemeteries, showing that sample size was not the prime determinant guiding the appearance of mortality. Three discrete ranges of mortality clusters make a broad distribution from 10% to 25%, a peak at ~30–35% and a few higher

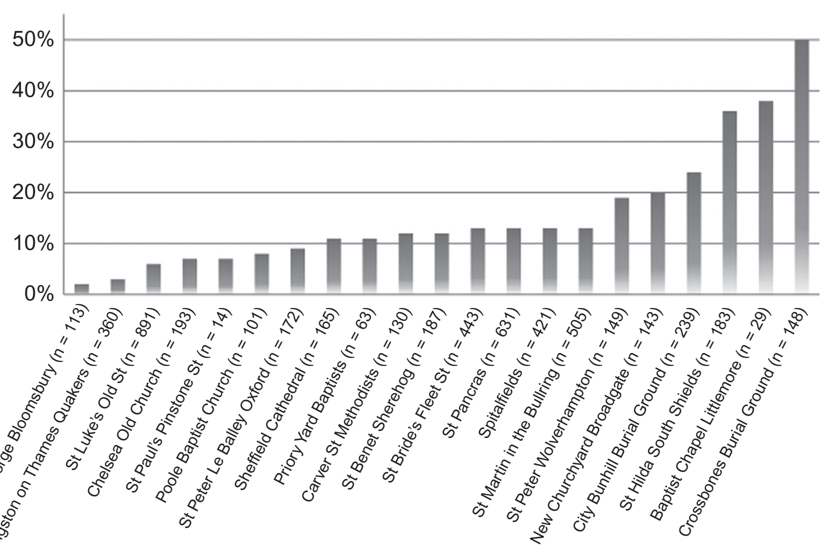

Figure 2.1 Infant (0–1.9 years) mortality in 21 UK cemeteries.

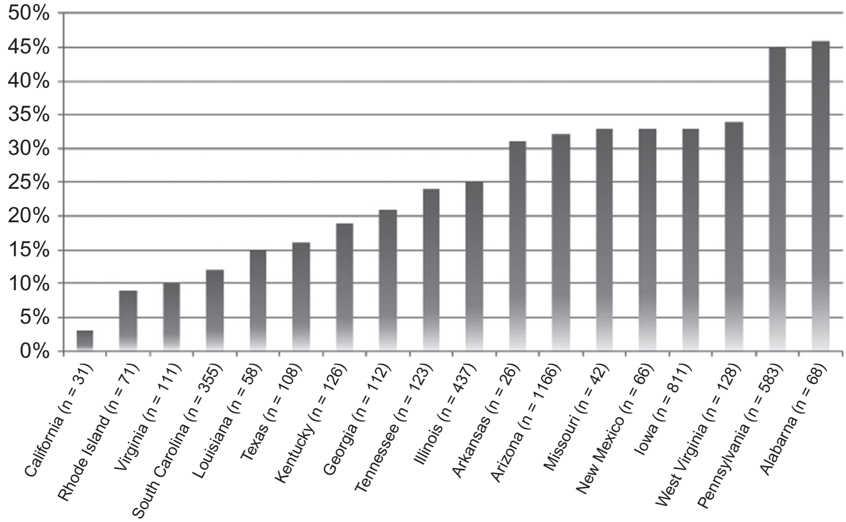

Figure 2.2 Infant (0–1.9 years) mortality in 18 aggregated US States.

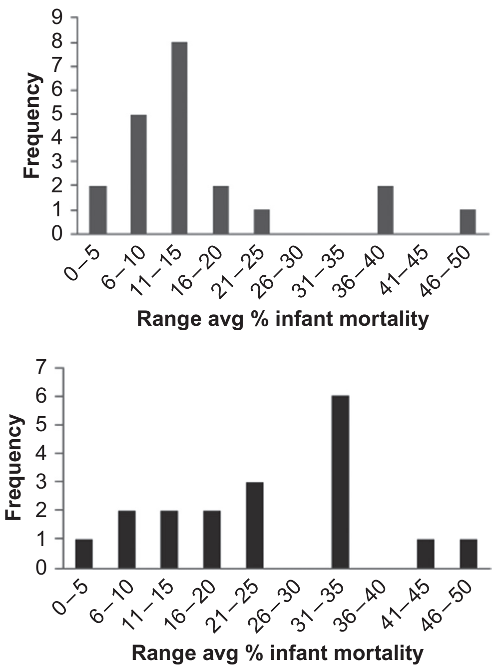

Figure 2.3 Histogram of frequency of average percent infant mortality in the UK (Top) and the US (Bottom).

outliers (Fig. 2.3). This pattern was visible in both the individual and aggregated comparisons. Within the 47 US cemeteries which included children, child mortality ranged from 3% to 53%, with an average of 25%, and dual modes of 19% and 29%. The range of child mortalities was more continuous than infant mortality, with the only slight differentiation being between the ranges of 10–25%, and 30–40%.

2.3.2 Age-Specific Infant Mortality

Forty-two cemeteries were examined for age-specific mortality and compared to expected mortality profiles from Model West life tables. A typical attritional mortality profile in a historic population displays a bimodal curve with the greatest peak during infancy (0–1.9 years), and a smaller peak at the most typical age of death in adulthood (anywhere between 35 and 80 years). Common variations in such profiles include a peak in early childhood (~2–5 years) in tandem with, or in lieu of a peak in infancy. Either infant or early childhood peaks may also be accompanied by a peak in early adulthood (18–30 years).

In comparison with life tables, all but four cemeteries could be fitted to a model with some accuracy. The most common were Levels One, Five, and Nine, with average life expectancy at birth (E0) between 20 and 40 years and annual growth rate (r) of 0.5%. All plausible mortality cemeteries exhibited either peaked infant mortality, peaked child mortality, or a combination of peaked infant/child mortality and peaked early adult mortality. Irregular mortality profiles were linear (ascending). Three examples of the commonly occurring plausible mortality profiles, and an example of an unlikely linear profile, are shown in comparison with a Level Five Model West profile in Fig. 2.4.

A summary of the modality of the different mortality curves for US and UK cemeteries is presented in Table 2.5. Fewer UK cemeteries had strong peaks in infant mortality than in the US. Of the US cemeteries with infant mortality peaks, 37% had corresponding peaks in early adult (18–34.9 years) mortality. In contrast, the UK had more cemeteries exhibiting heightened child mortality (52%), of which 30% also displayed peaks in early adulthood. Only 16% of US cemeteries had high peaks in child mortality, and 5% had corresponding peaks in early adult mortality. The overall percentage of early adult mortality was 10% higher in the US than the UK. The remainder of the cemeteries displayed variable geriatric mortality at 35 years or above.

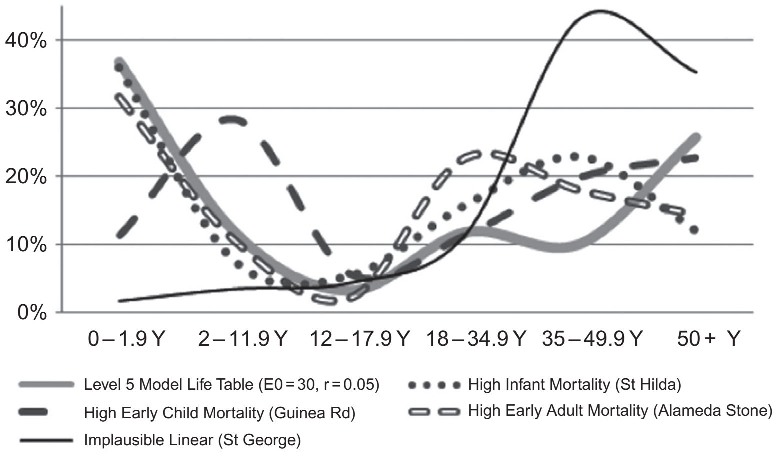

Figure 2.4 Examples of three plausible mortality profiles and one abnormal profile derived from cemeteries studied.

Table 2.5 Percent of the Population Expressing Age-Specific Modality (Peak) Combinations in Cemetery Mortality Profiles

	Infant/ Geriatric (%)	Child/ Geriatric (%)	Infant/ Early Adult (%)	Child/ Early Adult (%)	Infant and Child/Early Adult (%)	Slightly Linear (%)	Strongly Linear (%)
US	37	16	37	5	–	–	5
UK	22	22	4	17	13	9	13

Few cemeteries in either country had abnormally strong ascending linear mortality profiles arising from a veritable exclusion of infants and lesser inclusion of children, along with an incremental increase in the adult age categories. These profiles are suggestive of an underenumeration of the young owing to age-specific burial exclusion or taphonomic loss. The remainder of profiles show mortality peaks in the following periods: (1) death in early infancy (prior to a year); (2) death in late infancy/early childhood (around 2–3 years); (3) most common age(s) of death in adulthood.

In those cemetery reports where more precise aging was used, and comparison with burial records was possible, infant death often occurred before the sixth month. Early child death commonly occurred late in the first year to the middle of the second year. Congenital factors or unsanitary birthing practices are often implicated in deaths within the first 6 months (Acsadi and Nemeskeri, 1970; Kuehn, 2008;

Meckel, 1990; Newman, 1906), and may be primarily responsible for the first of these mortality categories. Between the ages of 6 months and 4 years, unsanitary weaning practices are a common cause of death (Newman, 1906); the second mortality category likely includes many of these. Accident, respiratory ailment, or epidemic is increasingly implicated after the age of 3 or 4 years; however, fewer of these deaths were evident in the cemetery samples. Some of the urbanizing and frontier environments did exhibit such mortality profiles, perhaps suggesting these causes.

2.3.3 Region-Specific Infant Mortality

To explore the possibility that taphonomic factors may strongly influence cemetery preservation (Buckberry, 2000; Djuric et al., 2011), or that mortality patterns may correlate with climatic conditions which alter the spread of epidemics (Acsadi and Nemeskeri, 1970; Newman, 1906), infant mortality was studied by region. The US was divided into five geoclimatic regions, and compared to the UK as a whole. Average infant and child mortality by region is presented in Fig. 2.5.

The range of infant mortalities (0–1.9 years) was similar in all areas apart from the Southwest US, which began at a higher percentage and was around half the range of every other region. Maximum infant mortality was similar in all areas. The range of child mortalities

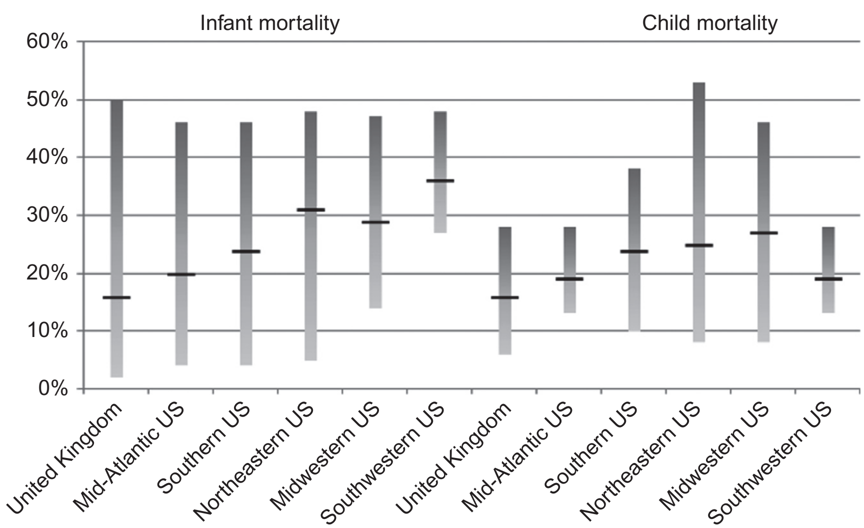

Figure 2.5 Range of infant and child mortality and their averages by region.

(2–17.9 years) was consistent in its minimum across all regions, but varied over 20% at its maximum between regions. Typically, the range of child mortality was narrower than the corresponding region's infant mortality. Both average infant and child mortality were lowest in the United Kingdom, however its range was greatest and highest in this area.

Average infant mortality was highest in the Southwest United States. Average infant and child mortality were similar to one another within the UK, the Midwest, and the Southern US. In other regions, infant mortality differed from child mortality. No two regions shared the same average infant mortality.

There was no obvious correlation between region and the appearance of infant or child mortality. For infant mortality, the coldest regions (UK and the Northeast) had similar ranges, but drastically different averages. This range was also similar to the much hotter Southern US, and the transitional Mid-Atlantic. The hottest regions (Southern and Southwest US) had dissimilar ranges and averages.

2.4 DISCUSSION

Average infant mortality for the US was 25% and 16% for the UK. The range of infant mortalities observed was almost identical between the UK (2–50%) and the aggregated samples from the US (3–46%). Figures on the lower end of this spectrum are somewhat unlikely given what is known about birth rates and living conditions in pre-Jennerian populations, that is, those prior to the widespread use of inoculation (Barbieri, 2001; Monnier, 2001). Despite this, the most commonly occurring infant mortalities (~10–35%) are on average lower than the "high" estimates previously believed. The outlying high mortalities (above ~35%) are still realistic, but may represent more catastrophic circumstances (Acsadi and Nemeskeri, 1970; Meckel, 1990; Newman, 1906). It is likely that some loss occurs to cemeteries through taphonomy and partial sampling, meaning that even plausible observed mortalities are not a perfect representation of the buried group (Buckberry, 2000; Murphy, forthcoming). Furthermore, this shows that a variety of possible mortalities may be witnessed at different sites.

Typically a 10–15% difference between at least two distinct ranges of infant mortalities was seen in intercemetery comparisons.

Sixty-seven percent of the UK samples had an infant mortality of ≥10%, with 48% of all samples falling between 10% and 20% infant mortality. A second cluster of three samples had comparatively high mortalities (35–50%). The remaining 30% of samples fell just under 10%, suggesting underenumerated infants. The US was split more clearly into two distinct ranges, with a small quantity of samples in a third, high mortality group. Thirty-nine percent of aggregated US samples had an infant mortality of 30–35%, while 33% demonstrated an infant mortality of 10–20%.

These wide ranges and apparent mortality clusters suggest that separate mortality profiles exist within different geographically proximal groups and perhaps within individual population types. The specific cause of these varying profiles is not clear. One possibility is cemetery composition. In a small family cemetery, one might expect to find a disproportionate number of the very young and the very old as those of reproductive age migrate away, and perhaps migrate back for burial in their later years (Chamberlain, 2006). In a newly expanding city, an increased number of the unmarried may skew the composition of the population to early adulthood. Different environments may affect mortality in unpredictable ways: in urban settings, crowding and pollution may be combatted to some extent by access to work and modern amenities, whereas in frontier towns, lack of infrastructure, lawlessness, and lack of medical attention may negate the benefits of living space (Meckel, 1990; Newman, 1906). Additionally, within any community, the economic status of those buried may affect their mortality either through deficiency diseases, professional hazards, epidemics, or diseases of excess (Acsadi and Nemeskeri, 1970).

These statements are borne out to some extent by the examination of more detailed age-specific mortality profiles within cemeteries. Closer examination yielded peaks in mortality at different ages, which could often be understood in terms of lifestyle factors described in the associated reports. These include the presence of certain epidemics, pressures from urbanization, cemetery use-duration, and interpersonal violence. A variety of disparate yet plausible age-specific mortalities were thus observed in samples of different sizes. The mortality shifts most commonly witnessed were threefold. First, mortality was observed to vary in early childhood between neonatal, later infant, and early childhood mortality. This is likely owing to congenital disease and birthing practices in the first group, weaning hazards in the second, and risk of accident and epidemic in the third case (see Acsadi and Nemeskeri, 1970; Meckel, 1990; Rüttimann and Loesch, 2012). Secondly, in many samples, mortality rose prematurely in early adulthood. This may correspond with violence, dangerous professions, or parturition risks to women (Acsadi and Nemeskeri, 1970; Heilen and Gray, 2010). Finally, the average age of the geriatric differed somewhat across all samples.

Of the 19 US cemeteries with age-specific mortalities, only three (5%) had moderately "abnormal" mortality profiles. These cemeteries display almost linear increases in mortality, typical of age-preferential burial inclusion. The fact that they are geographically distant from one another, with other "regular mortality" cemeteries closer by, argues against purely taphonomic explanations. Twenty-two percent of UK samples demonstrated atypical mortality profiles, however only two of these (9%) were strongly linear. This pattern also correlates with Baptist and Quaker burial practices rather than with preservation influences. In the UK, average early childhood mortality was slightly higher than in infancy. Across the US, death in infancy was more common. In both countries, there appears to be a minor correlation between infant/child death and death in early adulthood, perhaps suggesting a link between loss of caregiver or contagion as a cause of early life mortality.

There was a minor positive correlation between sample size and higher infant mortality in the US. Most US cemeteries with an individual sample size of ≥100, as well as aggregated states, had an infant mortality of 30% or greater. However this trend was not linear; the largest cemeteries did not demonstrate the highest mortalities, nor did all large cemeteries display high mortality. Despite larger UK sample sizes, no corresponding correlation was observed. Though infant mortality ranged from 2% to 50%, four of the largest samples shared an infant mortality of only 13%. This suggests that factors like population growth and social-environmental conditions may correlate with heightened infant mortality, rather than increased mortality being an artifact of sample size. For example, although derived from a more populous city than remote Santa Fe or industrializing Pittsburgh, London samples in this study often demonstrated lower mortality.

No strong link could be found between climatic region and infant mortality. As previously noted, a wide range of infant and child mortalities was observed across both countries. This was also true across geographic areas. The wider range and generally lower averages of infant mortalities in long-settled areas, compared to the frontiers of the Midwest and the Southwest may suggest that perhaps settlement patterns are a greater indicator of mortality risk than climate itself. The western communities were rapidly expanding cities on the outskirts of "civilization," while more easterly regions may have had greater infrastructure. Likewise, the higher early life mortality in the US as compared to the UK may have arisen from the more recent industrialization and changing migration patterns of the US.

2.5 CONCLUSIONS

In the past, it has been common to assume that infant mortality observed in an isolated excavated cemetery is either higher or lower than the "true" mortality of the buried population. The comparison of these similar, yet "disparate" datasets has clarified the complexity behind populations displaying identical mortalities with different causes, and identical environments that display opposite mortalities. Average infant and child mortalities in historic cemetery samples are 25% in the US and 16% in the UK. A variety of realistic mortality profiles exist within the large range of these groups, with characteristic variations occurring between infant, child, and early adult mortality peaks. Infant mortality figures of <10% are less likely. However figures of around 10–35% may be typical of the period; this corresponds with the findings of historical demographers (Newman, 1906; Rüttimann and Loesch, 2012; Wrigley and Schofield, 1989). No apparent correlation exists between climatic region and the appearance of infant mortality. Together, these factors imply that taphonomic factors may not have the strong negative effect on infant preservation once thought, and that climatic factors are not the primary determinant of infant mortality. There is a minor association between larger urban samples and infant mortality. Coupled with the heightened mortality in newer, expanding communities, this may suggest that settlement patterns, man-made environmental factors, and population growth are the biggest predictors of infant mortality.

In an attempt to reduce the variables present in this study, only cemeteries with high percentages of European ancestry, and so-called "normal" populations were included. It would be worthwhile to extend this study to see whether the appearance of mortality differs dramatically in other types of populations. While numerous factors may influence the appearance of mortality within a cemetery, most are dependent on too many variables to confidently state causality in this study (Chamberlain, 2006). The most prominent of these are probably prior cemetery disturbance and differential skeletal preservation, which both have the potential to impact the question, yet are difficult to quantify (Buckberry, 2000; Djuric et al., 2011; Lewis and Gowland, 2007). It was beyond the purview of this project to thoroughly assess the different environmental and socioeconomic circumstances of each cemetery group. It would be useful to compare these cemeteries to censuses and historical records for a more thorough understanding of the dynamics that may be responsible for different mortality profiles. Finally, taphonomic factors play an important role in the preservation of cemetery samples and the data that can be gleaned from them (Buckberry, 2000; Djuric et al., 2011; Lewis and Gowland, 2007). More in-depth study of the effect that preservation has upon the appearance of mortality is necessary to be confident that cemetery mortalities are reliable.

This study clearly shows that historic cemetery reports and archival records are rich sources of data for addressing questions about past cultures. With a relatively small sample, it was possible to explore mortality by age, region, climate, sample size, and social structure. These are only a few areas of inquiry that can be addressed with these "disparate datasets." Historically, such sources have been overlooked, or have not been combined. This is because researchers are constrained by the perception that only certain datasets fall within their specialization, or they become preoccupied with cultivating new methods and projects in search of "new data." Datasets need not be novel or radical to be profoundly useful; often reopening "long-resolved" debates using a fresh perspective and overlooked sources is sufficient.

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