Historical relationships between socio-economic status and mortality remain poorly understood. This is particularly the case in England, due to a lack of status indicators in available sources especially before c. 1850. This study uses the paternal occupational descriptors routinely recorded in Anglican baptism registers from 1813–37 to compare infant and early childhood mortality by social status. The sample consists of eight of the Cambridge Group family reconstitution parishes, which make it possible to investigate the contributions of environment as well as household characteristics. The main variable of interest was an individual-level continuous measure of wealth based on ranking paternal occupations by the propensity for their movable wealth to be inventoried upon death. The findings show that wealth conferred no clear survival advantage in infancy, once differences in average mortality levels between parishes were adjusted for. However, wealth was associated with higher survival rates in early childhood, especially in the second year of life, and this pattern persisted after adjustment for parish-level effects. The striking exception to this pattern was labourers, who were among the poorest of fathers but whose children enjoyed relatively low mortality. Thus socio-economic differentials in mortality were present in early nineteenth-century England; however, they were small, age-specific, and non-linear.

Socio-economic gradients in health and mortality are ubiquitous in modern populations. Today life expectancy is generally positively correlated with individual or ecological measures of income, educational attainment, and status within national populations. Moreover, these patterns may have been present for at least a century in now-developed countries, despite the huge changes that have occurred in these populations in terms of longevity, causes of death,
welfare and public health systems, and medical interventions. However, in stark contrast to these modern patterns, there is little evidence for such pervasive advantages of wealth to survival in historical populations before the nineteenth century. This is surprising, because one might expect that wealth would have been even more important to survival in historical societies where malnutrition and under-nutrition were presumably common, where clothing and heating were expensive, and where poor housing and overcrowding contributed to the spread of infectious diseases. Nevertheless, against these apparent advantages of wealth may be set several possible historical disadvantages, such as the pursuit of dangerous activities by the rich (for example, dangerous sports, over-eating, or medieval warfare), dangerous fashions in infant feeding (such as wet-nursing or hand-feeding), or the tendency for the wealthy to spend more time in cities, where the disease environment was more dangerous. Indeed, even superior access to medical attention may have been injurious in many situations, including childbirth and where bloodletting was prescribed. Alternatively or additionally, it may be the case that the types of diseases that dominated mortality before the nineteenth century were mainly those against which good nutritional status conferred no advantage, such as plague, cholera, typhus, typhoid, malaria, smallpox, and yellow fever, and therefore the advantages of wealth to health were not evident with respect to mortality.

Recently a broad consensus has been reached that socio-economic gradients in survival emerged in the course of the ‘epidemiological transition’, and several theorists locate their emergence in the late eighteenth century. However, the empirical basis for this assertion is rather slim, because we have very little evidence for the eighteenth and early nineteenth centuries (see section I). Here we test whether a socio-economic gradient in child survival was already present in early nineteenth-century England using individual-level data on infant and child mortality for eight parishes. Our findings confirm the existence of such a gradient; however, it was relatively small, age-specific, and non-linear. In the sample as a whole we find a U-shaped relationship between paternal social status and survival, with the children of poor labourers or wealthier fathers enjoying relatively high survival chances. In infancy this pattern was mediated by the geographical composition of the sample, because labourers and farmers were more likely to live in rural parishes with low mortality. However, in early childhood this U-shaped pattern persisted after adjustment for parish-level effects. These results are considered in the context of debates regarding the emergence of socio-economic differentials in survival and the relative importance of ‘place versus class’ (section I). Section II describes our dataset which, very unusually in the English context, provides information on both wealth and maternal literacy for a range of settlement types, and allows us to explore the influences of resources, place of residence, and maternal characteristics. Section III describes our analytical approach, in particular the use of male occupations as indicators of status and wealth. Analyses are presented in section IV and section V concludes.
Evidence of a lack of socio-economic gradients in survival, and even survival disadvantages to wealth in the past, has provoked several theoretical explanations for the evolution of twentieth-century patterns. In a much-cited article in 1967, Antonovsky reviewed a range of evidence for social class differentials in mortality in historical populations and concluded that differences were smallest or non-existent where mortality was very high. However, as mortality fell due to improvements in sanitation or medical technologies then these improvements became available first to the wealthy and spread only gradually to the poor. That is, one would expect a sequence from no mortality differentials by wealth to marked differentials, followed by a closing of the gap as mortality reached low levels. Mainly on the basis of Hollingsworth’s comparison of trends in aristocratic life expectancies with those of the general population of England, Antonovky suggested that a marked advantage to wealth emerged in the eighteenth century. He also argued that the emergence of socio-economic differentials would occur with similar timing across the age range.

Kunitz, in a short article on the historical relationship between adult height and mortality, concurred with Antonovsky that the eighteenth century was a turning point. He argued that although wealth may always have conferred health advantages, including superior adult stature, these advantages did not necessarily translate into a survival advantage before the nineteenth century. According to Kunitz this was because before the nineteenth century mortality patterns were strongly affected by diseases that were relatively insensitive to nutritional status. Only once the most lethal diseases such as plague and smallpox were controlled could the protective effects of good nutritional status against milder diseases such as pneumonia, tuberculosis, and diarrhoeal diseases become evident.

Link and Phelan initially argued in a series of influential papers that while the proximate causes of socio-economic differentials in mortality varied by disease and over time, these patterns were driven by ‘fundamental causes’ that were not contingent on historical or societal circumstances. More recently, however, they and colleagues have adapted their ‘fundamental causes’ model to incorporate the possibility that these causes operated with varying force under different historical conditions. Without citing Antonovsky they proposed a similar model with four stages, the timing of each stage being disease-specific. The first stage they termed ‘natural mortality’, when there is little knowledge about or control of the disease, and mortality may be invariant among social groups, or may even show a positive relationship to wealth. In the second stage the advent of knowledge about the disease is only accessible to or can only be acted upon by some groups with superior resources, giving rise to health and mortality inequalities. In the third stage knowledge becomes more widely diffused and socio-economic differentials narrow, until the fourth stage when morbidity or mortality from the disease is almost eliminated and access to treatment or avoidance strategies becomes universal.

The theories of both Antonovsky and Link and Phelan emphasized the importance of access to knowledge and to medical technologies. Kunitz, on the
other hand, assumed an enduring connection between wealth and nutritional status and disease resistance, but one that was obscured before the nineteenth century by high rates of mortality from nutrition-insensitive diseases. It seems likely, however, that the relative importance of nutrition and medical or sanitary knowledge, for instance, varied by disease environment and also by age group.7

Our understanding of the relationships between socio-economic status, health, and mortality in the past is very weak in the English case because very few historical demographic sources provide systematic information on wealth or occupation before the twentieth century. The Registrar-General reported mortality for various male occupational groups in the second half of the nineteenth century, but for young children the first clear evidence we have of a linear social gradient derives from the 1911 census. According to the Registrar-General's social class classification based on paternal occupation, class 1 (upper and middle classes) had the lowest infant mortality rate in 1911, at 76.4 (per 1,000 live births), and mortality increased progressively with social class ranking, with the highest rate of 152.5 experienced by unskilled workers (class V).8 The real exception to this gradient were agricultural labourers who had an infant mortality rate of 96.9 per 1,000 live births, which was much closer to upper and middle classes than to other lower social status groups.9 There were justifiable concerns about the crudeness of the 1911 social class classification, which ‘assign[ed] the head of a tinplate works to the same social class as his labourers’.10 Nevertheless, the refined occupational classifications of the 1921 and 1931 censuses suggested much the same patterns of social inequality in infant mortality.11

The anomalously low mortality of infants of agricultural labourers presents a puzzle, because agricultural labourers were one of the poorest occupational groups. Did agricultural labourers and their families have distinctive habits that favoured infant survival, or did their decidedly rural residential distribution shield them from the diseases encountered by infants in more urban settings? Despite higher average wealth and wages, urban populations experienced a very severe mortality penalty relative to rural populations in early modern England, and although this penalty diminished very substantially over the late eighteenth and nineteenth centuries, it did not disappear until the 1930s.

To address the question of whether residential patterns or household characteristics were the main determinants of the social gradient in infant survival, Reid and colleagues analysed an anonymized sample of the 1911 census records.12 Reid concluded that environment, or ‘place’, had the biggest effect on infant mortality in the late nineteenth and early twentieth centuries, with social class effects operating primarily through the residential environment. That is, higher social classes were more likely to live in more salubrious, low mortality environments.13 However, it was also the case that the effects of class or social

7 Kunitz and Engerman, ‘Ranks of death’; Woods and Williams, ‘Must the gap widen?’.
8 Titmuss, Birth, poverty and wealth, p. 23; Woods, Demography, p. 264.
9 In addition to the five social classes the Registrar-General created an additional three (sub-)classes for specific occupational groups: textile workers (class VI), miners (VII), and agricultural labourers (VIII).
10 Titmuss, Birth, poverty and wealth, p. 24.
11 Ibid.
12 Garrett, Reid, Schürer, and Szreter, Changing family size.
13 Reid, ‘Locality or class?’.
status were not consistent across different environments. For example, within agricultural environments, all five of the Registrar-General’s social classes had very similar infant mortality rates. Yet in ‘professional’ or mostly urban environments children born to upper and middle class families still had notably better chances of survival in the first year of life than the other groups.\(^\text{14}\) An ecological study of infant mortality rates in Sheffield in the 1860s produced a similar finding, that both social class and environment were important influences on infants, with residence near the river associated with higher mortality for all social classes, in conjunction with a persistent social gradient in each area of the town.\(^\text{15}\)

We have very little information on mortality by social status in England before the mid-nineteenth century.\(^\text{16}\) Antonovsky’s supposition that socio-economic differentials in mortality emerged in the eighteenth century rested on Hollingsworth’s analysis of life expectancies for the English peerage. However, reanalysis of Hollingsworth’s peerage data by Smith and Oeppen using event history techniques indicated that married female peers enjoyed no advantage and married male peers actually suffered a disadvantage relative to married adults in the general population, until the early nineteenth century.\(^\text{17}\) Smith and Oeppen speculated that the lack of any elite advantage in the eighteenth century may have been related to the more urban habits of adult aristocrats and hence their higher exposure to infectious diseases.

If differences in exposure to urban environments operated to reduce the observed survival advantages of wealth, then such survival advantages should be evident in studies of communities residing within the same disease environment. However, within London, socio-economic gradients in mortality still appear to have been muted, at least for infants. Razzell and Spence found little evidence of a social gradient in infant mortality between 1550 to 1850 in a small sample drawn from two parishes.\(^\text{18}\) Both Newton and Finlay concluded that the apparently lower infant mortality of wealthy inner London parishes compared with poorer suburban parishes in the sixteenth and seventeenth centuries was an artefact of the selective export of infants of wealthier families for rural wet-nursing.\(^\text{19}\) Davenport concluded that wet-nursing and artificial feeding of infants resulted in higher infant mortality in wealthier families compared with other groups in mid-eighteenth-century Westminster. However, even once breastfeeding habits of the wealthy converged to those of the rest of the population, the advantages of wealth were slight.\(^\text{20}\) Similarly, Landers estimated that London Quakers, despite being relatively wealthy compared to the general population, had an infant mortality rate similar to rates estimated from the London bills of mortality for the population of London as a whole.\(^\text{21}\) Landers attributed this approximate equality in infant

\(^\text{14}\) Ibid., pp. 147–9.
\(^\text{15}\) Williams, ‘Death in its season’.
\(^\text{16}\) Boberg-Fazlic, Sharp, and Weisdorf, ‘Survival of the richest?’, reported differences in net survival by social status using the same datasets employed in the present study. However, they did not measure mortality rates. Their analysis relied on data on social status from the sixteenth to the nineteenth centuries, despite the absence of occupational information for most men in the sample before 1813.
\(^\text{17}\) Hollingsworth, ‘Mortality in the British peerage’; Smith and Oeppen, ‘Place and status’.
\(^\text{18}\) Razzell and Spence, ‘History’.
\(^\text{19}\) Finlay, Population and metropolis; Newton, ‘Infant mortality variations’.
\(^\text{20}\) Davenport, ‘Infant feeding practices’.
\(^\text{21}\) Landers, ‘Mortality and metropolis’.
mortality to the absence or short duration of maternal breastfeeding among Quakers. The apparent importance of breastfeeding habits in London raised the question of whether class variations in infant feeding practices were confined to metropolitan or urban populations where cultures of wet-nursing and hand-feeding were well established, or could be expected to operate also in other types of communities.\footnote{Davenport, ‘Infant feeding practices’, p. 197; Woods and Williams, ‘Must the gap widen?’.}

Previous research across Europe has also failed to find consistent evidence for social gradients in mortality before the mid-nineteenth century. Studies focusing on different regions in Sweden revealed no clear socio-economic inequalities in infant, child, or adult mortality in the pre-industrial period.\footnote{Bengtsson and Dribe, ‘Family frailty effect’; idem, ‘Late emergence’; Edvinsson, ‘Social differences’; Edvinsson and Lindkvist, ‘Wealth and health’.; Lee and Marschalck, ‘Bremen’.} Social gradients in child mortality (between ages one and 15) in Sweden emerged only in the second half of the nineteenth century and in adult mortality after the Second World War. In Bremen, social gradients in infant survival were absent (or inverse, for immigrants) in the mid-nineteenth century, but had emerged in marked form by 1901–10.\footnote{Lee and Marschalck, ‘Bremen’.} In contrast, in the Netherlands, van Poppel et al. found a clear social gradient in adult mortality already present in the early nineteenth century but over time there was a strong convergence in social class mortality.\footnote{van Poppel, Jennissen, and Mandemakers, ‘Time trends’.} Based on their findings, they also argued that where one lived had much more effect on survival chances than the social class to which one belonged, consistent with the ‘place versus class’ argument suggested to operate in England. More recently, Ekamper and van Poppel used geo-located individual-level data to demonstrate that religion and neighbourhood were closely associated with infant mortality in Amsterdam in the mid-nineteenth century, but paternal occupation was not.\footnote{Ekamper and van Poppel, ‘Amsterdam’. See also Connor, ‘Poverty’, for a very elegant multi-level analysis of under-fives’ mortality in early twentieth-century Dublin that demonstrates large effects of religion and neighbourhood characteristics, in addition to paternal occupation.} In Geneva, socio-economic differences in infant and childhood mortality were evident from the beginning of the seventeenth century to the end of the nineteenth. However, these survival advantages were limited to a small group at the top of the social ladder (peers) and mortality rates among other social strata were much more homogeneous.\footnote{Schumacher and Oris, ‘Long-term changes’.}

Empirical work comparing historical mortality patterns over 200 years in a set of locations in Europe and Asia found that social status and economic conditions were important dominant determinants of mortality only in childhood, and social differentials were generally absent in infancy. Poorer families had increased risk of dying during childhood in Italy (both in the village of Casalguidi and the city of Venice) and in Belgium (Tilleur and Sart) in the nineteenth century.\footnote{Bengtsson et al., Life under pressure.} These findings raise the possibility that social gradients emerged at different periods in different age groups.\footnote{As suggested by Woods and Williams, ‘Must the gap widen?’.}
The main data source for this study is the 26 family reconstitutions created by the Cambridge Group for the History of Population and Social Structure. This dataset was used to reconstruct the demographic history of England from 1550 to 1837. However, the geographical patterns within the dataset have remained largely unexplored, as have potential interactions between place or local environment and socio-economic status.

Table 1. The characteristics of the eight reconstitution parishes

| Parish       | County         | Character             | Population (1801) | Acres (1831) |
|--------------|----------------|-----------------------|-------------------|--------------|
| Ash          | Kent           | Rural                 | 1,575             | 6,940        |
| Banbury      | Oxfordshire    | Market town           | 3,810             | 3,150        |
| Bottesford   | Leicestershire | Mixed economy         | 804               | 5,010        |
| Dawlish      | Devon          | Market town           | 1,424             | 4,710        |
| Gedling      | Nottinghamshire| Industrializing village| 1,530             | 4,490        |
| Morchard Bishop | Devon     | Rural                 | 1,698             | 6,910        |
| Odiham       | Hampshire      | Mixed economy         | 1,485             | 7,550        |
| Shepshed     | Leicestershire | Industrializing village| 2,627             | 5,280        |

Source: Wrigley et al., *English population history*, pp. 22–3, 41–5.

In this article we analyse the influences on mortality of infants and young children in the period 1813 to 1837. The start date for our study is determined by the availability of comprehensive information about paternal occupation after the introduction of Rose’s Act in 1813. This Act required incumbents to record the ‘Quality, Trade or Profession’ of the father in Anglican baptism registers, and supplied regulation printed forms for this purpose. Before 1813 it was the norm for occupation or status to be recorded only in notable circumstances; for example, when the father was a vicar, a gentleman, or a vagrant. The introduction of near-universal recording of paternal occupation meant that from 1813 onwards we were able to examine the relationship between demographic behaviour and status across the whole social spectrum, rather than having to focus only on small subgroups such as peers, as has very often been the case in previous research. The end date of our study, 1837, coincides with the introduction of civil registration of vital events, and a decline in the reliability of some of the available parish registers.

Family reconstitutions were available for eight parishes in this period: Ash, Banbury, Bottesford, Dawlish, Gedling, Morchard Bishop, Odiham, and Shepshed (table 1). Although the parishes are situated across six different counties in England, the sample has an unmistakably southern bias (figure 1). The sample does not include any very large towns but the parishes were nevertheless substantial. The average parish population in England was approximately 860 people in 1801, but only one of the eight parishes had an 1801 population below 1,400. In their original work, Wrigley et al. also grouped the parishes according to their economic ‘character’ using data from the 1831 census, which noted the number

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30 Officially known as 52 Geo. III, c.146, ‘An Act for the better regulating and preserving Parish and other Registers of Births, Baptisms, Marriages, and Burials, in England’, it came into force in Jan. 1813.

31 See Wrigley, Davies, Oeppen, and Schofield, *English population history*, chs. 2–4, for extensive discussion of the reliability and representativeness of the sample.
Figure 1. Location of 26 Cambridge Group reconstitution parishes and the eight parishes used in this study

Note: Boundaries are ancient county boundaries.

of households mainly engaged in agriculture, trade, and manufacturing. Based on this characterization, the eight parishes were relatively diverse. Two parishes were predominantly rural, two were industrializing villages with substantial textile industries, two were market towns with a substantial dose of services, and the remaining two were a mix of the primary, secondary, and tertiary sectors in what was described as a ‘mixed economy’.

Ibid., pp. 41–51.

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Table 2. Number of observations, deaths, and mortality rates in infant and early childhood mortality by parish, 1813–37

| Parish          | Births | Deaths | IMR  | Alive at age 1 | Deaths | ECMR |
|-----------------|--------|--------|------|----------------|--------|------|
| Ash             | 1,655  | 143    | 87.0 | 1,486          | 98     | 70.1 |
| Banbury         | 3,494  | 480    | 140.8| 2,885          | 272    | 107.5|
| Bottesford      | 772    | 88     | 115.2| 668            | 50     | 81.5 |
| Dawlish         | 1,091  | 99     | 92.4 | 976            | 84     | 96.1 |
| Gedling         | 1,514  | 185    | 124.3| 1,293          | 109    | 93.2 |
| Morchard Bishop | 1,362  | 107    | 79.3 | 1,231          | 73     | 62.1 |
| Odiham          | 1,728  | 140    | 81.7 | 1,558          | 89     | 60.4 |
| Shepshed        | 2,107  | 243    | 117.7| 1,811          | 145    | 85.2 |
| Total           | 13,723 | 1,485  | 110.0| 11,908         | 920    | 84.0 |

Notes: Mortality rates are expressed as the probability of dying before age 1, or between ages 1 and 5 years, per 1,000 at risk, and were calculated using survival analysis (that is, product-limit life tables).

Source: Wrigley et al., ‘26 English parish family reconstitutions’.

Wrigley et al. demonstrated marked differences in levels of infant mortality by parish in the larger sample of 26 parishes when considered in the longue durée. In general, more rural and isolated parishes experienced lower mortality rates in infancy and childhood compared with better-connected parishes, especially those with market towns. These patterns were also evident in our sample in the period 1813–37 (table 2). The rural parishes of Ash and Morchard Bishop and the small mixed-economy parish of Odiham had the lowest infant and child mortality rates in our period. The market town of Banbury recorded the highest rates of mortality in infancy (141 deaths per 1,000 births, nearly double that of Morchard Bishop) as well as in early childhood (an 11 per cent probability of dying—108/1,000—between the first and fifth birthdays, compared with 6 per cent in Odiham). The framework knitting parishes of Gedling and Shepshed were also notable for their high mortality rates in infancy and early childhood.

Despite somewhat limited numbers, the varied nature and economic character of these eight parishes made it possible to explore in more detail the relationship between place of residence (local environment) and individual characteristics such as social status in determining mortality risks in the early phases of life in the nineteenth-century context.

III

Contemporary studies of socio-economic status and child health emphasize the importance of both income and maternal education to infant and child survival. Mosley and Chen’s commonly used model of socio-economic and proximate determinants provides an analytical framework for understanding how concepts like access to resources and social position affect health and mortality via more direct factors such as nutrition, sanitation, avoidance of overcrowding, and access...
to medical care. Their framework proposes that income or wealth can affect infant and child mortality in a variety of ways. These include access to and quality of food and water; housing, clothing, and bedding; essential fuel for warmth and cooking; transportation; and medical care. Infants and young children are particularly vulnerable to hypothermia, making adequate fuel, bedding, and clothing for warmth an important factor in infant survival. Damp and overcrowded housing increases the risk of tuberculosis and other respiratory and airborne infections. When combined with limited ability to do laundry, overcrowding also increases the risk of infections like typhus. Finances therefore have the potential to affect infant and child mortality in a wide range of ways. Maternal education is also routinely identified as a key variable that operates independently or in synergy with income. The effects of maternal education are proposed to operate via lower fertility, via knowledge of officially recommended healthcare practices, and via greater empowerment to seek medical treatment for both mother and children.

It is also likely that the factors identified by Mosley and Chen would operate with varying intensity across infancy and childhood, because exposure and resistance to infectious disease and other hazards vary with age. Young infants are protected to some extent against many infectious diseases by maternal antibodies acquired in utero, if their mother has immunity to these diseases. However, this immunity wanes over the first six to nine months of life, and therefore late infancy and early childhood can be particularly dangerous periods. Infants that are exclusively breastfed also enjoy substantial protection against respiratory and gastrointestinal pathogens because of the immunological properties of breast milk, as well as optimal nutrition. The buffering of infants against the external disease environment by these mechanisms means that where breastfeeding is prolonged then mortality may be higher in early childhood than in infancy, a pattern that was particularly evident in urban areas of England and Wales in the mid-nineteenth century. Therefore, as the historical evidence reviewed in the previous section suggests, maternal, household, and wider environmental characteristics may exert greater influence at some ages than others, and may be modulated by infant feeding practices.

The Cambridge Group family reconstitutions provide a substantial amount of individual-level information and detail about the child, the parents, and the household in which they were born. Importantly for this study, the datasets provide information about paternal occupation and parental literacy for the period 1813–37. However, they provide no direct measures of household wealth or income, nor of parental education. We took three approaches to create rankings of paternal occupations, discussed below.

Previous studies on socio-economic differences in mortality in historical contexts have used a number of different social stratification schemes based on ranking historic occupations. The two most commonly used schemes are based on the

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34 Mosley and Chen, ‘Analytic framework’.
Scalone and Samoggia, ‘Neonatal mortality’.
36 Mosley and Chen, ‘Analytic framework’; Cleland and van Ginneken, ‘Maternal education’; Gakidou, Cowling, Lozano, and Murray, ‘Educational attainment’.
37 Nicoara, Zäch, Trachsel, Germann, and Matter, ‘Decay’.
38 Jaadla and Reid, ‘Childhood mortality’; Knodel and Kintner, ‘Breast feeding patterns’; Woods, ‘Historical relationship’.

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Electronic copy available at: https://ssrn.com/abstract=3712339
Historical International Standard Classification of Occupations (HISCO), and are HISCLASS, a measure of social class, and HISCAM, a score of social interaction.\(^39\) Both classifications are based on social stratification scales that were developed in the mid-to-late twentieth century to analyse contemporary employment and then reworked backwards to create similar schemes for historic occupations. However, they were conceptualized and constructed on different principles. HISCLASS relied on experts’ assessments of the requisite skill and level of responsibility required for each occupation, and is generally used as a five- or 12-category classification. In this study, we used the HISCLASS scheme based on five social classes. These are category 1: elite; category 2: lower middle class—clerks, merchants, and dealers; category 3: skilled workers—different makers, smiths, and weavers; category 4: farmers and yeomen; and category 5: unskilled workers—agricultural and general labourers. In contrast, HISCAM was constructed using a ‘social interaction distance’ approach and is a continuous measure. This approach assumes that people chose spouses who were socially and culturally similar to themselves, a practice known as homogamy. HISCAM was therefore based on the combinations of occupations recorded in marriage registers. If a doctor married the daughter of a solicitor, the two occupations would be judged to have low social distance and would be similarly ranked in HISCAM scores. HISCAM scores for occupations in reconstitution parishes range from 39.9 to 99 where higher scores mean higher social status. The latter include clergy, surgeons, attorneys, and military sergeants, while the lowest status on this scale is set for servants.

HISCLASS and HISCAM provide rankings of male occupations within occupational or social hierarchies, rather than according to income. This poses a problem for their use in the present context, since it is not clear how measures like social distance or skills would influence infant and child mortality. A second potential problem with using HISCLASS or HISCAM to study socio-economic differentials in mortality in early nineteenth-century England is the extent to which these schemes captured differences in wealth or status specifically in English society. We used the early HISCAM scale (1800–c.1890), because it was closest to our sample in period. However, even in this scheme there were elements of the rankings that were obviously discordant with respect to English society in this period. For example, the HISCAM score for farmers is very close to that for agricultural labourers, whereas all military-related occupations (for example, captains, lieutenants, and sergeants) have the highest score in the scheme (see figure 2).

In order to capture more closely differences in household wealth in our sample we also used a measure of average wealth devised by Keibek that has not previously been used in studying socio-economic differences in mortality.\(^40\) Keibek did not set out to produce a measure of wealth. Instead, he used parish registers and probate inventories to estimate occupational structure in the absence of nationally comprehensive occupational data. Probate records provide a large sample of occupational data points (numbering in the millions) covering much of England, but are strongly biased towards the wealthy and to decedents working in

\(^{39}\) Lambert, Zijdeman, van Leeuwen, Maas, and Prandy, ‘HISCAM’; van Leeuwen and Maas, HISCLASS; van Leeuwen, Maas, and Miles, HISCO.

\(^{40}\) Keibek, ‘Correcting the probate record’; idem, ‘Male occupational structure’.

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capital-intensive industries. The main approach was to use areas with both probate records and parish registers with comprehensive occupational data to understand how probate inventories needed to be adjusted or ‘calibrated’ to provide an unbiased representation of the male occupational structure in areas where probate records were the only available source of occupational data. The result of this effort was a calibration factor which was calculated for every occupation in two stages. In the first stage, the frequency of an occupation appearing in probate inventories was compared to its frequency in baptism registers covering the same area, creating a ratio for each occupation. In the next stage, these occupation-specific ratios were indexed against the ratio for farmers, meaning the calibration factor for farmers is always 1. Calibration factors less than 1 indicate that men in a particular occupation were more likely to leave a probate inventory, and were therefore wealthier, on average, than farmers. Calibration factors greater than 1 (far more common) indicate occupations with a lower propensity to be probated. A calibration factor of 14.1 for servants, for example, suggests a farmer was 14.1 times more likely to leave a will, probate inventory, or other probate document than a male servant.41

The proportion of men of a given occupation who were probated is not in itself a direct indication of relative wealth. However, the probability of being probated was also strongly correlated with the median value of probated estates by occupation, as can be demonstrated for men who left a probate inventory.42 Therefore Keibek’s occupational calibration factors could be used as a continuous measure of the relative wealth of an occupation. The value of occupational calibration factors in our sample ranged from 0.29 for esquires and gentlemen to 38.4 for labourers, the occupational group least likely to be probated. For simplicity of interpretation in the models, our variable of interest, described as relative wealth, is inversed and log-transformed. Log transformations are standard for income or wealth data, which tend to be strongly right-skewed, and using the reciprocal of the calibration factor reverses the relationship so that the measure increases as wealth increases.

Figure 2 demonstrates how the three measures of socio-economic status relate to each other in the eight reconstitution parishes. HISCAM scores and Keibek’s relative wealth measure are plotted against each other, and HISCLASS categories 1 to 5 are indicated by shade. The size of the circles reflects the number of paternal occupations associated with a baptism in each parish sample. If HISCAM scores and relative wealth measures were highly correlated then we would expect the distribution of different occupations on these dimensions to follow a diagonal line. However, this is not the case. The range of scores according to our wealth measure is considerably wider than that based on HISCAM values, where the majority of the occupations represented in our dataset are clustered at relatively low values (note the inverted axis for HISCAM scores). Farmers stand out as a particularly anomalous group, being considered as close to the upper end of the scale in our relative wealth measure, but ranked among the lower status groups on the HISCAM and HISCLASS scales (with a social status almost comparable to labourers). This discrepancy reflects the capitalist nature of farming in the southern and midlands

41 The propensity to be probated also varied regionally for specific occupations, and over time. Keibek constructed county- and chronologically-specific calibration factors, and we used calibration factors for the counties in our sample for the period 1807–27; Keibek, ‘Male occupational structure’, app. A.

42 Ibid., p. 93.
counties in our sample compared with most European societies in this period, and the very wide gulf between farmers and the labourers they employed. As expected, Banbury parish, containing the market town of Banbury, had the most diverse occupational structure in the early nineteenth century. Conversely, the two textile parishes, Gedling and Shepshed, had large proportions of fathers involved in framework knitting (relative wealth score 7.95). One important pattern that emerges from figure 2 is that all eight parishes had a rather large proportion of labourers (the large circle in the upper-left corner for every parish).

The distribution of the top five occupations in each parish is shown in table 3. Labourers constituted a very high proportion of all fathers in the parishes that were characterized as agricultural or mixed, and a majority (56.8 per cent) in Ash. This contrasted with Banbury, where labourers comprised only 27.8 per cent of fathers, and the industrial parishes of Gedling (22.2 per cent) and Shepshed (14.5 per cent). In these latter two parishes the most common paternal occupation was framework knitting. In absolute terms, labourers were strongly clustered in parishes with better-than-average mortality. Almost half of the labourers in the dataset lived in the parishes with the greatest survival rates to age five (Odiham, Morchard Bishop, and Ash). As these three parishes accounted for just 33 per cent of all
### Table 3. The five most common paternal occupations (%) recorded at baptism in reconstituted families, 1813–37, by parish

| Parish         | Labourer | Farmer | Carpenter | Tailor | Shoemaker | Total |
|---------------|----------|--------|-----------|--------|-----------|-------|
| Ash           | (61)     | (10)   | (4)       | (3)    | (3)       | 1,655 |
| Banbury       | (30)     | (7)    | (4)       | (4)    | (3)       | 3,494 |
| Bottesford    | (49)     | (11)   | (9)       | (2)    | (2)       | 772   |
| Dawlish       | (49)     | (11)   | (9)       | (2)    | (2)       | 1,091 |
| Gedling       | (52)     | (21)   | (8)       | (3)    | (3)       | 1,514 |
| Morchard Bishop | (52)   | (13)   | (4)       | (4)    | (4)       | 1,362 |
| Odiham        | (53)     | (4)    | (4)       | (3)    | (3)       | 1,728 |
| Shepshed      | (64)     | (12)   | (3)       | (3)    | (2)       | 2,107 |

**Notes:** The data refer to baptisms, not fathers. Figures given in brackets are percentages of the total observations. **Source:** Wrigley et al., ‘26 English parish family reconstitutions’.

In our sample, the labourers were notably over-represented in the ‘healthy’ parishes.44 The large share and unequal distribution of labourers in our sample is important to consider because the existing literature suggests that even where a social gradient existed in the late nineteenth or early twentieth century, agricultural labourers tended to be a notable exception.45 This phenomenon of the healthy agricultural labourer raises the possibility of a historical social gradient of mortality that had something approaching an inverted U-shape, being low among elite groups and increasing progressively with falling levels of wealth or status, but then reversing abruptly in the poorest group. Anomalously low mortality among the children of agricultural labourers therefore had the potential to hide a more general social gradient. Unfortunately, parish register entries in our period did not routinely distinguish between agricultural labourers and other types of labourer. Thirty-five per cent of the fathers in our sample baptizing children in the period 1813–37 were labourers. However, just less than 1 per cent of labourers were specifically described as ‘agricultural labourer’, despite the inclusion of highly agricultural parishes like Ash, where most labourers were probably agricultural.

The lack of information about agricultural versus non-agricultural labourer poses a complication for mortality analysis done in the aggregate, because it might be expected that families of general labourers lived under different conditions from those of agricultural labourers, and did not necessarily share the same mortality patterns. We can gauge the extent of this problem in 1851 because the census enumerators distinguished labourers by type (table 4). As expected, agricultural

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44 A key question is whether males tended to change occupation. We used the paternal occupation given at baptism in each case; however, we found that occupational stability was high, as reported previously by Kitson, *Family formation*, ch. 4.

45 Woods, *Demography*, pp. 264–7; Woods, Watterson, and Woodward, ‘Causes’.

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labourers predominated in the more rural parishes. General labourers, on other hand, were largely involved in construction and in hauling and similar activities associated with transport. They formed a higher proportion of labourers in the industrial villages, and a majority of all labourers in the two towns. Therefore general labourers were concentrated in those parishes where infant and child mortality rates were higher.

In addition to the influences of paternal occupation, we could also measure the contribution of maternal education to child survival, as indicated by the ability to sign the marriage register. Obviously the ability to sign one's name is an incomplete proxy for literacy or education. In early nineteenth-century England literacy was acquired through a variety of channels that included formal schools, workhouses, Sunday schools, charities, informal networks, and autodidacticism, and some of these venues taught reading but not writing. Where writing was taught it was usually taught at an older age than reading, and therefore the ability to sign may have been rarer than the ability to read, although it did not necessarily connote fluency in either reading or writing. Nonetheless, the capacity to sign the marriage register was the only available non-demographic indicator of maternal capital in the dataset, and was in fact a fairly stringent bar. Of women with marriage records in the dataset only 41 per cent signed instead of marking. Moreover, the capacity of brides to sign was not unambiguously associated with their husband’s occupational ranking or literacy. Some 21 per cent of women who could sign were married to men who marked the register, and this may reflect the variety of means by which this skill could be acquired, in addition to familial capital. In this study we used female capacity to sign rather than male, because the latter was more closely associated with occupational ranking, and because it is female education that has been identified as closely associated with child survival in contemporary studies. A key limitation of this variable, in addition to those already discussed, was that some 35 per cent of couples married outside the parishes in our sample, and therefore we lacked any information regarding their capacity to sign.

Reay, ‘Context and meaning’; Schofield, ‘Dimensions of illiteracy’.

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Table 4. The distribution of agricultural and general labourers (aged 20 and over) in 1851, by parish

| Parish       | Character | Agricultural | General | All    | Labourers % of all males aged 20 and above | General labourers % of all labourers |
|--------------|-----------|--------------|---------|--------|-------------------------------------------|-------------------------------------|
| Ash          | Rural     | 51           | 1       | 52     | 2                                         | 100%                                 |
| Banbury      | Town      | 6            | 10      | 16     | 63                                        | 100%                                 |
| Bottesford   | Mixed     | 39           | 1       | 40     | 3                                         | 100%                                 |
| Dawlish      | Town      | 10           | 18      | 28     | 64                                        | 100%                                 |
| Gedling      | Industrializing | 13    | 2       | 15     | 13                                        | 100%                                 |
| Morechard Bishop | Rural     | 50           | 0       | 50     | 0                                         | 100%                                 |
| Odham        | Mixed     | 22           | 21      | 43     | 49                                        | 100%                                 |
| Shepshed     | Industrializing | 12  | 2       | 14     | 14                                        | 100%                                 |

Source: Schürer and Higgs, ‘Integrated census microdata’.
IV

Did child survival vary by paternal occupation in early nineteenth-century England? Table 5 reports mortality rates for five HISCLASS groups and by quartile of relative wealth estimated from paternal occupation. Neither ranking provided evidence of a linear social gradient in mortality. The HISCLASS classification provided some evidence for social status differentials in infancy and in early childhood, but not a clear gradient. Farmers, who were accorded relatively low status in HISCLASS, had the lowest rates of infant and early childhood mortality, and the elite did not display a significant mortality advantage. The relative wealth measure suggested the possibility of a U-shaped pattern of survival with respect to wealth. Labourers (quartile 1) had the lowest infant mortality of any group. In early childhood, quartiles 1 (labourers) and 4 (highest relative wealth) had lower mortality than quartiles 2 and 3.

Table 5. Infant (IMR) and early childhood (ECMR) mortality by HISCLASS and by relative wealth quartiles, 1813–37

| HISCLASS                  | No. of births | IMR   | ECMR  |
|---------------------------|---------------|-------|-------|
| Unskilled workers         | 5,491         | 101.0 | 79.9  |
| Farmers and yeomen        | 802           | 90.2  | 55.6  |
| Skilled workers           | 6,442         | 118.4 | 94.5  |
| Lower middle class        | 676           | 126.2 | 59.9  |
| Elite                     | 312           | 112.2 | 73.7  |
| Relative wealth           |               |       |       |
| Quartile 1 (labourers)    | 5,006         | 102.2 | 79.1  |
| Quartile 2                | 3,636         | 123.5 | 95.0  |
| Quartile 3                | 2,576         | 106.4 | 92.4  |
| Quartile 4                | 2,505         | 109.9 | 69.9  |
| Total                     | 13,723        | 110.0 | 84.0  |

Notes: Relative wealth implied by paternal occupation. Relative wealth groups were not strictly quartiles, because of the large size of the labourer and framework knitter occupational groups. All rates were calculated using product-limit life tables.

Source: Wrigley et al., '26 English parish family reconstitutions'.

To investigate these patterns further we used survival analysis where survival time was measured from baptism or birth, with the date of birth preferred if available. We adopted this approach because survival analyses take into account the exit of children from the sample population at risk due to death or other reasons (i.e. 'censoring'), which other approaches do not.
labourer’ effect. To control for the effects of ‘place’ (the differing average levels of mortality in parishes) we included an indicator variable (‘Parish’) for each parish, in adjusted models. All models clustered individual observations by family. Our basic estimation equation took the form:

\[ h_i(t) = \lambda_0(t) + \exp(\beta_1 x_{i1} + \beta_2 x_{i2} + \cdots + \beta_k x_{ik}) \]

where \( h_i(t) \) is the hazard for an individual \( i \) at time \( t \), \( \lambda_0(t) \) is the baseline hazard function at time \( t \), and \( \beta_1 x_{i1} \ldots \beta_k x_{ik} \) are fixed covariates. The proportional hazards assumption of the models was confirmed using Schoenfeld’s residuals.\(^{48}\) Analyses were conducted using STATA 15 software.\(^{49}\)

Table 6 presents model results using HISCAM scores and HISCLASS social class variables. Model 1 included only the log-transformed HISCAM measure, for infancy and early childhood. Hazard ratios below one indicated that, as expected, an increase in HISCAM scores (that is, higher social status) was associated with lower mortality risks. However, none of the models were statistically significant at the 5 per cent level. When we included dummy variables for individual parishes (model 2), to test whether the absence of a socio-economic gradient was due to variations in mortality levels and occupational composition between parishes in our sample, then the relationship between social status and mortality became stronger at both ages, but remained statistically insignificant. When we added a labourer dummy variable (model 3), the effect of social status on mortality again became stronger but remained statistically insignificant.

The HISCLASS models (models 4 and 5 in table 6) compared mortality in other social classes with the reference group 3, skilled workers. Hazard ratios below one indicated lower mortality than the reference group. As in table 5, there was evidence for social status differentials in infancy and in early childhood, but no evidence for a gradient. Infants of farmers and unskilled workers (mainly labourers) experienced lower mortality risks compared to skilled workers, but this advantage disappeared once controls were included for variations in mortality levels between parishes (model 5, table 6). In early childhood, children of farmers and lower-middle-class fathers experienced lower mortality, and this advantage persisted after adjustment for parish-level effects (model 5, table 6). Parish-level effects were fairly similar in all multivariate models reported here, and the market town of Banbury and the industrializing parishes of Gedling and Shepshed were associated with higher mortality in all age groups.

These results are difficult to interpret with respect to socio-economic gradients in mortality, and are consistent with the suggestion made earlier that HISCLASS and HISCAM did not adequately capture socio-economic differentials in our sample. For example, the skilled workers in our sample were predominantly framework knitters, a relatively disadvantaged group by the second quarter of the nineteenth century, and of lower economic and social status than farmers.

\(^{48}\) In some models the inclusion of control variables for individual parishes caused the models to violate the proportionality assumption, because of differences in the age patterns of survival between parishes (online app. fig. S1). However, when models were stratified by parish (which resolved the proportionality problem) then the results of the models were almost identical.

\(^{49}\) StataCorp, Stata.
Table 6. Hazard ratios for infant and childhood death by HISCAM and HISCLASS variables (Cox proportional hazard models), 1813–37

|                     | (1)     | (2)     | (3)     | (4)     | (5)     |
|---------------------|---------|---------|---------|---------|---------|
| 0–364 days (infancy)|         |         |         |         |         |
| Log(HISCAM)         | 0.908   | 0.728   | 0.647   |         |         |
|                     | (0.249) | (0.210) | (0.215) |         |         |
| HISCLASS:           |         |         |         |         |         |
| Elite               | 0.940   | 1.087   |         |         |         |
|                     | (0.199) | (0.229) |         |         |         |
| Lower middle class  | 1.042   | 0.974   |         |         |         |
|                     | (0.162) | (0.152) |         |         |         |
| Skilled workers     | (ref.)  | (ref.)  |         |         |         |
| Farmers and yeomen  | 0.749*  | 0.861   |         |         |         |
|                     | (0.110) | (0.127) |         |         |         |
| Unskilled workers   | 0.837** | 0.927   |         |         |         |
|                     | (0.053) | (0.065) |         |         |         |
| Labourers           | 0.942   |         |         |         |         |
|                     | (0.072) |         |         |         |         |
| Parish              | X       | X       | X       |         |         |
| 365–1,824 days (early childhood) |   |         |         |         |         |
| Log(HISCAM)         | 0.801   | 0.619   | 0.534   |         |         |
|                     | (0.299) | (0.253) | (0.258) |         |         |
| HISCLASS:           |         |         |         |         |         |
| Elite               | 0.765   | 0.843   |         |         |         |
|                     | (0.227) | (0.249) |         |         |         |
| Lower middle class  | 0.609** | 0.560** |         |         |         |
|                     | (0.117) | (0.110) |         |         |         |
| Skilled workers     | (ref.)  | (ref.)  |         |         |         |
| Farmers and yeomen  | 0.580***| 0.653** |         |         |         |
|                     | (0.098) | (0.113) |         |         |         |
| Unskilled workers   | 0.842** | 0.911   |         |         |         |
|                     | (0.062) | (0.073) |         |         |         |
| Labourers           | 0.932   |         |         |         |         |
|                     | (0.085) |         |         |         |         |
| Parish              | X       | X       | X       |         |         |

Notes: Models are clustered by family. Proportional hazards assumption checked using Schoenfeld residuals. ‘X’ indicates that the variable was included in the model. Figures in parentheses are robust standard errors. *p ≤ 0.05, **p ≤ 0.01, ***p ≤ 0.001. Parish-level effects are reported in full in the online app. tabs. S1 and S2. Source: Wrigley et al., ‘26 English parish family reconstitutions’.

In order to overcome this issue, in table 7 we replace HISCAM and HISCLASS with Keibek’s measure of relative wealth. Hazard ratios below one indicate that an increase in wealth was associated with a reduction in mortality. Across the full age range from birth to age five (0 to 1,824 days) there was some indication of a social gradient in mortality. However, this was only true after accounting for the seemingly confounding influence of labourers. In model 1, which included only the log-transformed multiplier (as a continuous measure), there was no advantage or disadvantage to having wealthy parents. 50 A social gradient only became apparent

50 We used a continuous rather than an ordered categorical measure for statistical analyses because the distribution of occupations was ‘lumpy’ and therefore categorical measures, as used in tab. 5, did not capture the distances between occupational groups in terms of wealth or status. Results of models using a four-category measure of relative wealth are presented in online app. tab. S3. These models demonstrate the same gradients detected using a continuous wealth measure, but the results are not statistically significant at the 5% level.
Table 7. **Hazard ratios for occupational differences for different age ranges in infant and child mortality (Cox proportional hazard models), 1813–37**

| Age Range               | Variable       | (1)     | (2)   | (3)   | (4)   | (5)   |
|-------------------------|----------------|---------|-------|-------|-------|-------|
| 0–1,824 days            | Relative wealth| 1.008   | 0.904**| 0.982 | 0.934† | 0.939 |
|                         |                | (0.019) | (0.034) | (0.020) | (0.035) | (0.037) |
|                         | Labourer       | 0.725***| 0.859 | 0.876 |       |       |
|                         |                | (0.065) |        |       |       |       |
|                         | Maternal literacy|       |       |       |       |       |
|                         | Signed         | 1.042   |       |       |       |       |
|                         |                | (0.065) |       |       |       |       |
|                         | Missing        | 0.935   |       |       |       |       |
|                         |                | (0.052) |       |       |       |       |
| 0–364 days (infancy)    | Parish         | X       | X     |       |       |       |
|                         | Relative wealth| 1.024   | 0.942 | 0.999 | 0.977 | 0.981 |
|                         |                | (0.025) | (0.046) | (0.026) | (0.048) | (0.049) |
|                         | Labourer       | 0.775**| 0.935 | 0.962 |       |       |
|                         |                | (0.120) |        |       |       |       |
|                         | Maternal literacy|       |       |       |       |       |
|                         | Signed         | 1.103   |       |       |       |       |
|                         |                | (0.089) |       |       |       |       |
|                         | Missing        | 0.932   |       |       |       |       |
|                         |                | (0.067) |       |       |       |       |
| 365–1,824 days (early childhood) | Parish | X       | X     |       |       |       |
|                         | Relative wealth| 0.983   | 0.837**| 0.956 | 0.856**| 0.863**|
|                         |                | (0.026) | (0.043) | (0.027) | (0.045) | (0.047) |
|                         | Labourer       | 0.629***| 0.720**| 0.724**|       |       |
|                         |                | (0.080) |        |        |       |       |
|                         | Maternal literacy|       |       |       |       |       |
|                         | Signed         | 0.949   |       |       |       |       |
|                         |                | (0.086) |       |       |       |       |
|                         | Missing        | 0.939   |       |       |       |       |
|                         |                | (0.081) |       |       |       |       |

**Notes:** Relative wealth implied by paternal occupation. Models are clustered by family. Proportional hazards assumption checked using Schoenfeld residuals. ‘X’ indicates that the variable was included in the model. Figures in parentheses are robust standard errors. †p ≤ 0.10, ‡p ≤ 0.05, **p ≤ 0.01, ***p ≤ 0.001. Parish-level effects are reported in full in online app. tab. S4.

**Source:** Wrigley et al., '26 English parish family reconstitutions'.

when a dummy variable for labourer was included in the model (models 2 and 4). However, at least some of this pattern was caused by the uneven distribution of occupations into parishes of differing average mortality. Once parish-level effects were adjusted for then the social gradient was reduced, and the advantage to labourers’ children disappeared (model 4, table 7, ages 0–1,824 days).

The more striking finding is that the effect of wealth on survival was age-dependent. Relative wealth had essentially no effect in infancy even when the labourer dummy was included in the model. Infants of labourers appeared to enjoy lower mortality (model 2, table 7). However, this effect was mainly attributable to the greater propensity of labourers compared with non-labourers to live in healthier parishes, and disappeared once parish-level effects were adjusted for (model 4). In contrast, in early childhood both relative wealth and having a labourer father conferred a considerable survival advantage, although
the advantages of wealth were only evident once the advantage to labourers was taken into account. These advantages persisted after adjustment for parish-level effects (model 4). An increase of one unit in (logged) relative wealth was associated with a 14 per cent lower risk of death in early childhood, in adjusted models (models 4 and 5). In terms of occupations, this meant the difference between being born into the family of a butcher or a surgeon; or a shoemaker versus a schoolmaster.

Maternal literacy was apparently unrelated to infant or childhood mortality. Whether included separately or in combination with paternal occupational measures, the capacity to sign the marriage register neither increased nor decreased the risk of infant or child death (model 5, table 7). If correct, this finding is unsurprising. Maternal education is usually argued to benefit children through reduced family size, greater access to medical information, and greater maternal agency in procuring treatment or services. These benefits were less likely to be relevant in the context of our study. In the early nineteenth century fertility was relatively high, and may not have varied substantially between occupational groups. Much of the advice available in print regarding infant care was of dubious value, and with the exception of skilled midwifery and services such as bone-setting, medical services may have been largely unhelpful or even dangerous, and in some cases (such as hospital care) unavailable to children. The key exception to this was smallpox vaccination, which was of indisputable value. However, whether vaccination was more accessible to or more highly sought by the literate is unclear. Many parishes offered gratuitous vaccination (or its forerunner, inoculation) to the poor. More generally, it may be the case that the most useful information regarding childcare practices was spread by word of mouth and via parochial institutions, and that literacy was unnecessary in this respect.

To understand better how the advantages of wealth and of a labouring father operated to improve survival we conducted a finer analysis of mortality by age (table 8). Deaths in infancy could be divided into two major components: those determined largely by maternal health, gestational conditions, and accidents of birth, which dominate mortality in the first month of life; and those caused by infectious diseases, which reach their greatest force later in the first year of life. However, despite these large differences in causes of death by age, our results indicate that mortality in both the neonatal (0–27 days) and post-neonatal (28–364 days) periods was relatively insensitive to the effects of paternal occupation (and maternal literacy) (table 8, all models adjusted for parish-level effects). In early childhood, where we found strong effects of both wealth and labourer status in previous models, closer analysis of age patterns indicated that the main effects of these variables operated in the second year of life (that is, on one-year-olds). This is the age group where infectious disease mortality appears to have been most intense, and when weaning usually occurred. Therefore familial factors affecting exposure and resistance to childhood and gastrointestinal diseases may have been most important in the second year of life. These could include vaccination or inoculation against smallpox, number of siblings, nutritional status,

51 Wrigley et al., *English population history*, pp. 427–9, but see also Boberg-Fazlic et al., ‘Survival of the richest?’.
52 Bourgeois-Pichat, ‘Infant mortality’.
53 See n. 57.
Table 8.  *Hazard ratios for occupational differences for different age ranges in infant and child mortality (Cox proportional hazard models), 1813–37*

|                           | (1) 0–1,824 days | (2) 0–27 days | (3) 28–364 days | (4) 365–730 days | (5) 731–1,824 days |
|---------------------------|------------------|--------------|-----------------|-----------------|-------------------|
| Relative wealth           | 0.939 (0.037)    | 0.845† (0.079) | 1.042 (0.060)   | 0.847† (0.064)  | 0.885 (0.067)     |
| Labourers                 | 0.873 (0.085)    | 0.823 (0.179) | 1.021 (0.149)   | 0.872† (0.123)  | 0.878 (0.157)     |
| Maternal literacy: Signed | 1.043 (0.065)    | 1.210 (0.172) | 1.058 (0.973)   | 0.905 (0.114)   | 1.001 (0.129)     |
| Maternal literacy: Missing| 0.935 (0.053)    | 1.102 (0.139) | 0.865† (0.072)  | 0.874 (0.101)   | 1.003 (0.120)     |
| Parish                    | X                | X            | X               | X               | X                 |
| Sex                       | X                | X            | X               | X               | X                 |
| No. of observations       | 13,723           | 13,723       | 13,156          | 11,908          | 10,828            |
| No. of deaths             | 2,405            | 457          | 1,028           | 475             | 445               |

Notes: Relative wealth implied by paternal occupation. Models are clustered by family. Proportional hazards assumption checked using Schoenfeld residuals. Figures in parentheses are robust standard errors. †p ≤ 0.10, *p ≤ 0.05, **p ≤ 0.01.

Source: Wrigley et al., ‘26 English parish family reconstitutions’.

age at weaning, and practices regarding food preparation, weaning foods, or water supply. Interestingly, the size of the wealth and labourer effects were similar, but not statistically significant, at ages two to four years compared with age one. Therefore these effects may have continued to operate at older ages, but were too small to detect with our sample size.

The models presented here are very simple, and any apparent effects of paternal occupation or wealth could reflect differences in maternal age or parity, for instance, rather than a direct effect of familial wealth. However, a series of sensitivity tests confirmed that the observed wealth advantage in early childhood mortality held even when including an additional set of control variables (results of these models are available in online appendix table S5). These models were all estimated on a smaller subset of births in the reconstitution data, for which we had information on mother’s birth date (baptism date), length of current marriage (marriage date), birth order (information on full birth histories), and whether the birth was part of a twinset.

The results presented so far are notable for two reasons. First, they suggest that the wealthy could and did buy a mortality advantage for their children in early nineteenth-century English society, albeit one that labourers also enjoyed. But second, it also suggests that this advantage did not operate in infancy.

A key question was whether these patterns were present in all parishes in the sample. In our full models we adjusted for compositional effects such as the higher concentration of labourers in healthier parishes (tables 7 and 8). However, it was still possible that the aggregate results were driven by strong or contrary patterns in a few parishes. To test whether the socio-economic patterns in mortality that we observed operated within individual parishes, we performed the same analyses on our sample disaggregated by parish (table 9). Here we found considerable heterogeneity in infancy, although the small numbers involved in some cases make
Table 9. Hazard ratios for occupational differences in infant and child mortality by parish (Cox proportional hazard models), 1813–37

|          | Ash         | Banbury    | Bottesford | Dawlish   | Gedling    | Morchard Bishop | Odiham    | Shepshed |
|----------|-------------|------------|------------|-----------|------------|-----------------|-----------|----------|
| Infant mortality (0–364 days) |             |            |            |           |            |                 |           |          |
| Relative wealth | 1.331       | 0.999      | 1.416      | 1.008     | 0.917      | 0.859           | 0.667*    | 0.644*   |
|            | (0.233)     | (0.081)    | (0.327)    | (0.121)   | (0.121)    | (0.154)         | (0.131)   | (0.115)  |
| Labourers  | 1.611       | 1.054      | 1.952      | 0.989     | 0.680      | 0.571           | 0.687     | 0.554    |
|            | (0.861)     | (0.220)    | (1.291)    | (0.424)   | (0.217)    | (0.236)         | (0.293)   | (0.219)  |
| Early childhood mortality (365–1,824 days) |             |            |            |           |            |                 |           |          |
| Relative wealth | 0.829       | 0.787**    | 0.958      | 0.741†    | 1.093      | 0.645*          | 1.158     | 1.010    |
|            | (0.149)     | (0.071)    | (0.280)    | (0.125)   | (0.149)    | (0.118)         | (0.176)   | (0.193)  |
| Labourers  | 0.675       | 0.664*     | 0.874      | 0.534     | 0.669      | 0.358**         | 1.786     | 1.242    |
|            | (0.357)     | (0.140)    | (0.723)    | (0.220)   | (0.274)    | (0.159)         | (0.733)   | (0.556)  |

Notes: Relative wealth implied by paternal occupation. Models are clustered by family and include controls for maternal literacy and sex of the child. Figures in parentheses are robust standard errors. †p ≤ 0.10, ‡p ≤ 0.05, §p ≤ 0.01, ¶p ≤ 0.001.

Source: Wrigley et al., ‘26 English parish family reconstitutions’.

it unwise to compare results where t-scores were low.54 Two parishes, Odiham and Shepshed, displayed marked advantages to wealth (and, with less statistical claim, to labourers) in infancy, and not in early childhood. In early childhood the strong advantages of wealth and a labourer as a father evident in the aggregated sample were clearest in the two parishes in the sample with the highest and the second-lowest mortality rates respectively: Banbury and Morchard Bishop. This was surprising, since Banbury was a market town and Morchard Bishop a remote rural parish, and suggested that this pattern, of a survival advantage to wealth and to labourers, was fairly widespread. Indeed the pattern of lower mortality among children of labourers and of wealthier men was evident in five of the eight parishes, and was notably absent only in Odiham and Shepshed, where the pattern was instead present in infancy, and in Gedling.55 This analysis indicated that socio-economic gradients were present in most parishes, at least in early childhood. It also confirmed that being a labourer carried an advantage to one’s children even at parish level. Below we investigate why labourers were apparently the exception to socio-economic gradients of survival in early childhood.

Labourers were some of the poorest men in our sample. Many would have experienced seasonal unemployment as well as low wages when employed. Against these disadvantages, however, must be set the potential benefits of rural residence, at least for agricultural labourers. These benefits may have operated even within relatively small units such as parishes, if labourers were more likely to live outside the main settlement, in hamlets or in isolated cottages.

We could investigate the effects of place of residence on mortality within parishes only in the case of Banbury. Banbury comprised two distinct settlements, Banbury town and the large ‘hamlet’ of Neithrop, as well as a number of much smaller

54 Small sample sizes for some parishes also forced us to restrict this analysis to the broader age groups of infants and children aged 1–4 years.
55 It was notable that neither of the ‘industrializing’ framework knitting parishes, Gedling and Shepshed, displayed a socio-economic gradient in early childhood survival, despite the economic decline of framework knitting in our period. Further work on northern and industrializing parishes is required to determine whether there were geographical or economic patterns in the occurrence of socio-economic differentials in mortality.
hamlets, and address information in the baptism register made it possible to allocate fathers to one of these three settlement types. Labourers were over-represented in hamlets, comprising 55 per cent of fathers in hamlets, but only 20 per cent in Banbury town, and 36 per cent in Neithrop. We modelled the effect of residence as an interaction with a dummy variable for labourers (figure 3). Relative to non-labourers living in Banbury town, there was a marked survival disadvantage to living in Neithrop in infancy, and this was especially large for non-labourers (a relative risk of 1.364, \( p = 0.039 \)). Conversely, in early childhood, where the survival advantage to labourers was most notable in the sample as a whole, there was a very considerable advantage to labourers living in hamlets (a risk of 0.283 relative to non-labourers in Banbury town, \( p = 0.000 \)). However, the advantages of hamlet dwelling were apparently limited to labourers. Infants and children of non-labourers living outside Banbury town and Neithrop were not at significantly lower risk. Therefore these results did not support the proposition that living in more remote locations conferred a survival advantage on children of agricultural labourers. Rather, since labourers living in hamlets enjoyed an advantage relative both to other hamlet dwellers and to labourers living in the town or Neithrop, it seemed likely that there was something distinctive about this group of labourers. In particular, it was probable that the majority of labourers living in hamlets were agricultural labourers, whereas those living in Banbury town or Neithrop probably included a higher proportion of general labourers. We could not, however, preclude the possibility that mortality was unusually high among non-labourers in the hamlets. It was possible that agricultural labourers were ‘positively selected’ into hamlets on account of work, whereas other hamlet dwellers were generally ‘negatively selected’ into hamlets by poverty.

56 The relatively poor living conditions of Neithrop were highlighted in the 1850s in a Board of Health report: Rammell, Report, pp. 17–25.
A second possible difference between labouring families and other occupational groups was breastfeeding practices. As noted in section I, the duration of maternal breastfeeding was a major determinant of infant survival in historical populations, and one that appears to have varied markedly by social status. However, records of infant feeding practices are very rare, and restricted mainly to anecdotal accounts written by elite women, in our period. Attempts to estimate breastfeeding practices have therefore generally relied on the indirect evidence of observed birth intervals. The interval between successive births is affected by a variety of factors, but in the English population in the eighteenth and early nineteenth centuries the major determinant of variations in interval length appears to have been the duration of breastfeeding. Where breastfeeding was of sufficient intensity then it prevented ovulation and conception, a phenomenon termed ‘lactational infecundability’. The length of breastfeeding varied between women and between births to the same woman, but the average duration in the English population in this period is estimated to have been around 18 months, except in towns, where practices such as early weaning or wet-nursing could result in much shorter intervals (although these behaviours seem to have declined by 1800). There is anecdotal evidence that the connection between breastfeeding and conception was understood, and that maternal breastfeeding was limited or avoided in order to increase fertility in some wealthy families.

In order to explore whether the protective effect of having a labourer father reflected differences in breastfeeding practices, we compared the distributions of birth intervals in labouring and other families. We restricted our analyses to single births of birth order 3–9 (since birth intervals were fairly uniform in this range), and to birth intervals where the child whose birth opened the interval was known to have survived to age one. This last restriction was designed to include only births where breastfeeding was not truncated by the death of the breastfed infant, and so the length of breastfeeding could be considered to reflect maternal preference. We display the complete distributions of birth intervals because the very skewed nature of the distributions means that summary parametric statistics are not an accurate representation of differences in the distributions.

Figure 4 indicates that in families where the father was described as a labourer birth intervals were longer than in other types of family, and the difference in the distributions for the aggregated sample was significant according to the non-parametric Kolmogorov–Smirnov test ($p = 0.000$). To test whether this difference in birth intervals translated into a survival advantage, we included an interaction between labourer status and birth interval in our models. The birth interval variable distinguished between short (less than 24 months) and longer birth intervals (24 months or longer). Intervals of less than 24 months (or 730 days) were below

57 Davenport, ‘Infant feeding practices’; Fildes, *Breasts*, pp. 87–91; Landers, ‘Fertility decline’; Wilson, ‘Proximate determinants’; Wrigley et al., *English population history*, pp. 430–49.
58 Fildes, *Breasts*, pp. 108–9; McLaren, ‘Marital fertility’; Trumbach, *Egalitarian family*, p. 70. See also Cinnirella, Kemp, and Weisdorf, ‘Malthus in the bedroom’; Clark and Cummins, ‘Randomness in the bedroom’.
59 Wrigley et al., *English population history*, pp. 101–6.
60 This difference was not due to lower fecundity among labourer couples. The interval from marriage to first baptism or birth (a commonly used measure of fecundity) was the same for labourers and non-labourers, excluding births occurring within nine months of marriage and more than four years from marriage (data not shown).
the median of c. 800 days for the sample (where the previous child survived the first year of life). Figure 5 presents the risk of dying by age group, relative to non-labourers with long (≥ 24 month) birth intervals (the reference group). The findings in figure 5 indicate that, relative to non-labourers with long birth intervals, being a non-labourer and having short birth intervals was associated with a clear mortality disadvantage in all age groups. Conversely, being a labourer and having a long birth interval almost halved the mortality risk in early childhood (ages one to four years, a relative risk of 0.55). These results indicated, first, that long birth intervals were associated with higher survival chances, and therefore that some of the advantage to labourers’ children was probably a function of maternal breastfeeding practices, and second, that there was a persistent and substantial advantage to being a labourer over and above the advantage of longer birth intervals. Consistent with this, children of labourers who were born after a short birth interval were at no higher risk than the reference group (non-labourers with long birth intervals).

Taken together these results regarding the survival advantage of labourers present a puzzle. Labourers’ wives may have breastfed their children for longer than other

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**Figure 4. Birth interval distributions for labourers and non-labourers, by parish**

Notes: Kolmogorov–Smirnov test p-values for each parish: Ash 0.004; Banbury 0.000; Bottesford 0.002; Dawlish 0.000; Gedling 0.010; Morchard Bishop 0.002; Odiham 0.000; Shepshed 0.567. 
Source: Wrigley et al., '26 English parish family reconstitutions'.
groups, and this conferred some survival advantage. Labourers were also more likely to live outside the main settlements, at least in Banbury; however, this was not in itself an advantage, in this case. Besides these factors, there remained some additional survival advantage that we could not identify in this study. The (indirect) evidence of longer breastfeeding among labourers’ wives points to other possible differences in the management of weaning, which could include avoidance of dangerous seasons for weaning, and protracted breastfeeding after the introduction of other foods. Other possibilities include more maternal time spent in the home or in childcare, and greater kin support. Labourers’ wives may have had relatively little employment outside the home except during the harvest (although such seasonal employment coincided with the most dangerous time of the year for weaning, the summer). The collapse of spinning as a domestic employment for married women may have increased the time available to devote to childcare, especially in labouring households. However, the potential trade-offs between reduced household income and greater maternal care are unknown. With respect to kin, labourers were more likely than non-labourers to marry within their parish of married residence. Since it was customary to marry in the bride’s parish, married labourers may have been more likely to live in the same parish as the bride’s family, and therefore to have enjoyed a greater availability of kin and associated informal support. Nonetheless, marriage in the parish was not associated with increased survival chances (the models are not shown). Labourers may also have been more eligible than other groups for parish-based relief. However, this is unlikely to have conferred the absolute survival advantage evident here with respect to other occupational groups (table 5).

The advantages of longer birth intervals may have included effects of smaller sibship size, as well as direct effects of later weaning.

With respect to smallpox, where parish-sponsored free vaccination and inoculation may have conferred an advantage on the poor, there is evidence that free immunization was extended to individuals and families not
Were socio-economic differentials in mortality present in the English population by the early nineteenth century, as suggested by Antonovsky and Kunitz? Our results provide a qualified yes. We did detect differentials in child survival by paternal or household wealth in the first five years of life in early nineteenth-century England. However, the effects of wealth were muted, and non-linear. Socio-economic differentials emerged only after the first year of life (when mortality rates were highest), and were strongest at age one. Summed over the first five years of life, though the advantages of wealth were marginal. A difference in wealth equivalent to the difference between a farmer and a saddler or between an innkeeper and a cooper was associated with a 7 per cent difference in survival to age five, with marginal statistical significance (table 7, model 4, 0–1,824 days, \( p = 0.073 \)).

Second, the advantages of wealth were only observed once the anomalously low mortality of labourers’ children was taken into account.

To the extent that wealth did confer a survival advantage, did this effect operate through access to information, or to material resources? There was no evidence in our study that literacy was important to child survival. However, our results did suggest that cultural practices in relation to weaning may have been key. This was indicated by the peculiar age pattern of the socio-economic gradient to survival, which was strongest in the second year of life, the year in which most children were weaned. We also found a marked survival advantage of longer birth intervals post-infancy, and this advantage accrued particularly to labourers’ children, because their mothers had longer-than-average birth intervals.

Our findings point to the importance of breastfeeding patterns in modulating the influences of socio-economic status on infant and child survival. Breastfeeding practices varied enormously in historical populations, both geographically and by social status. These variations, over time and space, together with the differential sorting of social groups into relatively healthy or unhealthy environments, probably explain why it is so difficult to pinpoint the emergence of socio-economic gradients in survival, especially in infancy.

The most obvious way in which material circumstances might have contributed to socio-economic differentials in survival is via differences in access to adequate nutrition. However, nutritional status of either mother or child seems to have played a minor role, if any, in driving the patterns reported here. There was little wealth gradient to survival in the first month of life, when maternal nutrition and infection during pregnancy exerted their greatest effects. This pattern is consistent with the apparent convergence of endogenous (early life) mortality rates in towns and rural areas by the early-to-mid-nineteenth century, and the relatively small differences in mortality between legitimate and illegitimate infants in this age range, suggesting that neither environment nor socio-economic status exerted a major influence on early life mortality by this period. With respect to child nutritional status, it is otherwise considered eligible for parish support, because of the threat posed by unvaccinated children to the community as a whole. See Davenport, ‘Cultures of contagion’.

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64 Thorvaldsen, 'European breastfeeding pattern'.

65 There was some hint of a wealth gradient to survival in the first month of life (tab. 8, col. 2). However, infants of labourers were also at lower risk.

66 Smith and Oeppen, 'Place and status', pp. 61–3.
hard to see why any effects of under- or malnutrition on survival would manifest mainly in the second year of life. They might rather be expected to persist, and possibly to accumulate, with age. If this was indeed the case then such effects were too small to detect in our sample.

What are the implications of our findings for the ‘place versus class’ debate regarding the drivers of socio-economic differentials in mortality in historical populations? As might be expected, our results provide evidence for the contribution of both environment and household or familial factors. In infancy, mortality varied between parishes; however, the environmental hazards associated with industrializing or urban settlements appear to have operated fairly equally on households of differing socio-economic status. It is likely that most infants in our sample were breastfed throughout the first year of life, and this probably conferred a ubiquitous advantage that overwhelmed other material differences in household conditions (including warmth, cleanliness, levels of crowding, water quality, and maternal nutrition). This finding accords with national patterns of infant mortality in late nineteenth-century England.67

For ages 1–4 years we were able to demonstrate that the advantages of wealth and of a labouring father operated even at the level of individual parishes. That is, these advantages were not simply a function of the sorting of classes or occupations into different environments. These findings therefore implicate differences in household practices and conditions in the survival of children in our sample. This was clearest in the case of labourers. Labourers’ children enjoyed higher survival rates than predicted by household wealth, and this was associated with longer birth intervals (consistent with longer breastfeeding), as well as other factors that we could not identify, but which were probably not a function of rural isolation within parishes. Why labouring households should have differed in these ways remains unexplained.

Our study had a number of limitations. Our measures of wealth and maternal education were indirect. Moreover, our measures of wealth or status did not reflect the individual characteristics of fathers but rather average values associated with their occupations. More broadly, our research also highlighted the trade-offs between constructing meaningful, historically-specific rankings of socio-economic status, and comparability across studies. The effects of socio-economic status on mortality were clearest in our study when we used a measure based on wealth, rather than relative status, and one drawn from the same population as our sample. This also suggests that socio-economic gradients in survival may be overlooked if inappropriate occupational categorization schemes are used.

We also lacked potentially important demographic variables for most women, such as age and parity of births, although our sensitivity analyses suggested that these did not bias our results (see online appendix table S5). The short window of observation (1813–37) precluded examination of mortality at older ages, and it is possible that the advantages of better heating and clothing, greater supervision, and different work and educational opportunities became more marked in later childhood, when accidents and respiratory tuberculosis may have contributed more to mortality.

Our study explored high quality data on a variety of rural communities and small towns in the south and midlands of England. Additional evidence on large

67 Reid, ‘Locality or class’.

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towns and on northern England is needed to examine how generally our findings apply. Nonetheless, similar results have been reported for London, where wealth also conferred no advantage in infancy in the late eighteenth and early nineteenth centuries. Our results support the argument that socio-economic differentials in survival emerged at different times in different age groups. The apparent absence of a clear socio-economic gradient in infant survival in our sample also implies that the traditional focus on infant mortality as a key indicator of environmental or socio-economic conditions may be misplaced, at least in historical studies.

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68 Davenport, ‘Infant feeding practices’. © 2020 The Authors. The Economic History Review published by John Wiley & Sons Ltd on behalf of Economic History Society.
Supporting information

Additional supporting information may be found online in the Supporting Information section at the end of the article.

Table S1. Hazard ratios for infant and childhood death by HISCAM (Cox proportional hazard models), 1813–37
Table S2. Hazard ratios for infant and childhood death by HISCLASS (Cox proportional hazard models), 1813–37
Table S3. Hazard ratios for occupational differences (relative wealth quartiles) in infant and child mortality (Cox proportional hazard models), 1813–37
Table S4. Hazard ratios for occupational differences in infant and child mortality (Cox proportional hazard models), 1813–37
Table S5. Hazard ratios for occupational differences in early childhood mortality (365–1,824 days) controlling for maternal and family characteristics (Cox Proportional hazard models), 1813–37
Figure S1. Probability of surviving by age and parish, 1813–37 (ages 0–1,824 days)