Infant Mortality in England, 1538-2000: Decline in the Twentieth Century*

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Abstract

This paper, the fourth of four, discusses infant mortality during the twentieth century. It charts the changes and major influences on infant mortality over the course of the century. The paper also includes examples of how research into this important topic can be carried out and it ends with suggestions for future research.

Introduction

The twentieth century witnessed a remarkable improvement in infant health as the infant mortality rate (hereafter IMR) declined almost continually from 151 per 1,000 live births in 1901 to under 6 by the end of the century.[2] Over the long term the reasons for this 96 per cent decline are obvious and relate to the significant improvements in education, living standards and medicine that greatly enhanced the

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1 Chris Galley: chrisgalley77@gmail.com. This paper is the fourth of a set of four papers dealing with the history of infant mortality in England. The previous three papers are: C. Galley, 'Infant mortality in England, 1538-2000: trends, sources and methods', *Local Population Studies*, 102 (2019), pp. 21-52, https://doi.org/10.35488/lps102.2019.21; C. Galley, 'Infant mortality in England, 1538-2000: the parish register period, 1538-1837', *Local Population Studies*, 103 (2019), pp. 103-204, https://doi.org/10.35488/lps103.2019.103; C. Galley, 'Infant mortality in England, 1538-2000: stability and the beginnings of change, 1837-1910', *Local Population Studies*, 106 (2021), pp. 98-209, https://doi.org/10.35488/lps106.2021.98.

2 1901—A. Macfarlane and M. Mugford (eds) *Birth Counts: Statistics of Pregnancy and Childbirth,* Vol. 2 (London, 2000), pp. 2-4; 2000—Office of National Statistics, *Review of the Registrar General on Deaths in England and Wales, 2000, Childhood, Infant and Perinatal Mortality Statistics,* Series DH3 no. 33 (London, 2002), p. 113. During the twenty-first century the decline in infant mortality has stalled with the infant mortality rate in 2019 being 4 per 1,000 live births (Office of National Statistics, *Deaths Registered in England and Wales: 2019* [2020] https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/bulletins/deathsregistrationsummarytables/2019#stillbirth-rates-and neonatal-and- infant-mortality-rates [accessed April 2021].

health of the vast majority of the population throughout the century.[3] However, less is known about the precise effects of socio-economic variables such as infant feeding and care, place, class, housing and municipal health initiatives on changes in infant mortality, as is also the case with the impact of specific events, most notably the two world wars. In the first instance this paper will seek to chart the broad outlines of change in infant mortality from *c.*1910 until the end of the twentieth century. It will then examine the main influences on infant mortality and identify topics where further research can be readily undertaken, in part by carrying out small-scale studies using a variety of sources. It will end with suggestions for further research.

As was the case with the nineteenth century, the main sources for the student of infant mortality in England and Wales in the twentieth century are the various returns published by the General Register Office (GRO) and its successor the Office of National Statistics (ONS).[4] These can be supplemented for the earlier part of the century by a multitude of studies such as Arthur Newsholme's special reports to the Local Government Board (LGB) and offshoots of work undertaken by Medical Officers of Health (MOHs).[5] For the later part of the century there are major surveys carried out by organisations such as The National Birthday Trust Fund and the 1946 Birth Cohort Study.[6] Finally, there are many individual research projects that have

3 This resulted in life expectancy at birth increasing from about 50 years in 1901 to 78 years in 2001 (Office of National Statistics, *How Has Life Expectancy Changed over Time'* [2015] https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/lifeexpectancies/articles/howhaslifeexpectancychangedovertime/2015-09-09 [accessed April 2021].

4 See Galley, 'Infant mortality in England, 1538-2000: stability and the beginnings of change', pp. 100-9 for a discussion of the strengths and weaknesses of these sources. By the twentieth century the national returns of births, marriages and deaths can be considered accurate.

5 For Newsholme's special reports, see A. Newsholme, *Supplement to the Thirty-Ninth Annual Report of the Local Government Board 1909-10 Containing a Report by the Medical Officer on Infant and Child Mortality* (London, 1910); A. Newsholme, *Supplement to the Forty-Second Annual Report of the Local Government Board 1912-13 Containing a Second Report by the Medical Officer on Infant and Child Mortality* (London, 1913); A. Newsholme, *Supplement to the Forty-Third Annual Report of the Local Government Board 1913-14 Containing a Third Report by the Medical Officer on Infant and Child Mortality Dealing with Infant Mortality in Lancashire* (London, 1914); A. Newsholme, *Supplement to the Forty-Fourth Annual Report of the Local Government Board Containing a Report on Maternal Mortality in Connection with Childbearing and its Relation to Infant Mortality* (London, 1915); A. Newsholme, *Supplement to the Forty-Fifth Annual Report of the Local Government Board Containing a Report on Child Mortality at Ages 0-5, in England and Wales* (London, 1916). Perhaps the most famous example of work undertaken by a Medical Officer of Health (MOH) is G. Newman, *Infant Mortality, a Social Problem* (London, 1906), which was written whilst Newman was MOH for the London Borough of Finsbury.

6 On the National Birthday Trust Fund's work, see N.R. Butler and D.G. Bonham, *Perinatal Mortality: the First Report of the 1958 British Perinatal Survey under the Auspices of The National Birthday Trust Fund* (Edinburgh, 1963). For the 1946 Birth Cohort Study, see Joint Committee of the Royal College of Obstetricians and Gynaecologists and the Population Investigation Committee, *Maternity in Great Britain* (Oxford, 1948); M. Wadsworth, D. Kuh, M. Richards and R. Hardy, 'Cohort profile: the 1946 National Birth Cohort (MRC National Survey of Health

sought to understand how infant mortality might be reduced.[7] Obtaining individual data remains difficult because restrictions remain on accessing large numbers of birth and death records and, even when this is possible, a 100-year rule is often applied to ensure confidentiality. Moreover, even after privileged access has been allowed, very large datasets are often created and their analysis requires sophisticated statistical and computing expertise which is sometimes beyond the means of a single unsupported researcher.[8] Alice Reid's use of rare Derbyshire notification of birth registers is a notable exception which allowed her to make an extensive study of infant and child

and Development), *International Journal of Epidemiology* 35 (2006), pp. 49–54, https://doi.org/10.1093/ije/dyi201

7 Two notable studies published as part of a series of papers are: J.R. Gibson and T. McKeown, 'Observations on all births (23,970) in Birmingham, 1947: III. Survival', *British Journal of Social Medicine* 5 (1951), pp. 177-83, https://doi.org/10.1136/jech.5.3.177; and J.R. Gibson and T. McKeown, 'Observations on all births (23,970) in Birmingham, 1947: VII. Effect of changing family size on infant mortality', *British Journal of Social Medicine* 6 (1952), pp. 183-7, https://doi.org/10.1136/jech.6.3.183. For another series of papers see J.N. Morris and J.A. Heady, 'Social and biological factors in infant mortality: I. Objects and methods', *The Lancet* 265 (6,859) (1955), pp. 343-9, https://doi.org/10.1016/S0140-6736(55)90078-7; J.A. Heady, C. Daly and J.N. Morris, 'Social and biological factors in infant mortality: II. Variation of mortality with mother's age and parity', *The Lancet* 265 (6,860) (1955), pp. 395-7, https://doi.org./10.1016/S0140-6736(55)91290-3; C. Daly, J.A. Heady and J.N. Morris, 'Social and biological factors in infant mortality: III. The effects of mother's age and parity on social-class differences in infant mortality', *The Lancet* 265 (6,861), pp. 445-8, https://doi.org/10.1016/S0140-6736(55)90229-4; J.A. Heady, C.F. Stevens, C. Daly and J.N. Morris, 'Social and biological factors in infant mortality: IV. The independent effects of social class, region, the mother's age and her parity', *The Lancet*, 265 (6,862) (1955), pp. 499-503, https://doi.org/10.1016/S0140-6736(55)90284-1; J.N. Morris and J.A. Heady, 'Social and biological factors in infant mortality: V. Mortality in relation to the father's occupation 1911-1950', *The Lancet* 265 (6,863) (1955), pp. 554-9, https://doi.org/10.1016/S0140-6736(55)91237-X; J.A. Heady and J.N. Morris, 'Social and biological factors in infant mortality: VI. Mothers who have their babies in hospitals and nursing homes', *British Journal of Preventive and Social Medicine* 10 (1956), pp. 97–106; J.A. Heady and J.N. Morris, 'Social and biological factors in infant mortality: VII. Variation of mortality with mother's age and parity', *Journal of Obstetrics and Gynaecology of the British Empire* 66 (1959), pp. 577-91; S.L. Morrison, J.A. Heady and J.N. Morris, 'Social and biological factors in infant mortality: VIII. Mortality in the post-neonatal period', *Archives of Diseases in Childhood* 34 (174) (1959), pp. 101-14, https://doi.org./10.1136/adc.34.174.101. See also J.A. Heady and M.A. Heasman, *Studies on Medical and Population Subjects no. 15. Social and Biological Factors in Infant Mortality* (London, 1959).

8 For example, the Integrated Census Microdata (I-CeM) Project 'produced a standardised, integrated dataset of most of the censuses of Great Britain for the period 1851 to 1911' from raw data given by its commercial partner FindMyPast. The resulting dataset comprised '35 million household observations and over 200 million observations of individuals, and is one of the largest historical datasets in the world'. While some data are freely available via their website, the main files can only be accessed by 'accredited researchers in higher education institutions'. See University of Essex, *Integrated Census Microdata (I-CeM): Unlocking our Past* [n.d.] https://www1.essex.ac.uk/history/research/ICeM/default.htm [accessed April 2021].

mortality during the period from 1917 to 1922.[9] These sources were compiled following the 1915 Notification of Births (extension) Act which required all births to be notified to the local MOH within 36 hours, thereby enabling more effective health visiting to be provided.[10] Alongside information relating to the infant, they included details of the doctor or midwife who delivered the infant, the number of rooms in the house where the infant resided and details of the mother's childrearing history.[11] These sources allowed Reid to write a detailed and nuanced analysis of infant and childhood mortality at the end of the First World War.[12]

One of the main problems with undertaking research into infant mortality during the twentieth century is the sheer mass of data that is available in both primary and secondary form. Much research was undertaken by contemporaries whose aim was to understand the determinants of infant mortality with a view to recommending policies that would force down the rate. This research often accessed confidential data that cannot be readily re-examined, although for the recent past, at least, the main influences on infant mortality and the course of change have been determined with relative certainty.[13] As medicine progressed significantly during the second half of the century many of the causes of infant death began to be fully understood and, moreover, increasingly they became treatable. At the same time inequalities in infant mortality persisted. For example, in 2000 the IMR in class I (professional) was 3.6 per 1,000 live births while in class 5 (unskilled) it was over twice as high at 7.9.[14] While the causes of health inequalities are well known, a lack of political resolve to

9 See A. Reid, 'Neonatal mortality and stillbirths in early twentieth century Derbyshire, England', *Population Studies* 55 (2001), pp. 213-32, https://doi.org/10.1080/00324720127696.

10 The 1915 Act extended the 1907 Notification of Births Act to areas where it had not been previously adopted, see W. Lawson, 'Infant mortality and the Notification of Births Acts, 1907, 1915', *Journal of the Statistical and Social Inquiry Society of Ireland* 97 (1917), pp. 479-97.

11 Reid, 'Neonatal mortality and stillbirths', p. 214.

12 A. Reid, 'Health visitors and child health: did health visitors have an impact?', *Annales de Démographie Historique*, (2001), pp. 117-37; A. Reid, 'Infant feeding and post-neonatal mortality in Derbyshire, England, in the twentieth century', *Population Studies* 56 (2002), pp. 151-66, https://doi.org/10.1080/00324720215926; A. Reid, 'The effects of the 1918-1919 influenza pandemic on infant and child health in Derbyshire', *Medical History* 49 (2005), pp. 29-54, https://doi.org/10.1017/S0025727300008279; A. Reid, 'The influences on the health and mortality of illegitimate children in Derbyshire, 1917-1922', in A. Levene, T. Nutt and S. Williams (eds), *Illegitimacy in Britain, 1700-1920* (Basingstoke, 2005), pp. 168-89; A. Reid, 'Health visitors and "enlightened motherhood" ', in E. Garrett, C. Galley, N. Shelton and R. Woods (eds) *Infant Mortality: a Continuing Social Problem* (London, 2006), pp. 191-210; A. Reid, 'Infant feeding and child health and survival in Derbyshire in the early twentieth century', *Women's Studies International Forum* 60 (2017), pp. 111-9, https://doi.org/10.1016/j.wsif.2016.10.011.

13 D. Taylor-Robinson, E.T.C. Lai, S. Wickham, T. Rose, P. Norman, C. Bambra, M. Whitehead and B. Barr, 'Assessing the impact of rising child poverty on the unprecedented rise in infant mortality in England, 2000–2017: time trend analysis', *BMJOpen* 9 (2019), e029424, https://doi.org/10.1136/bmjopen-2019-029424.

14 Office for National Statistics, *Review of the Registrar General on Deaths in England and Wales, 2000*, Series DH1 no. 33 (London, 2002), pp. xxiv, 61.

address the relevant issues during the 2010s has meant that unfortunately inequalities still persist.[15] Given the difficulties in accessing data from the recent past it seems that, for the foreseeable future at least, most students of the history of infant mortality in the twentieth century will focus their attention on the first half of that century.

Decline during the twentieth century

In 1901 there were 551,585 deaths in England and Wales, of which 25.5 per cent (140,648) were infants; by 2000 the total number of deaths was similar, 535,664, but only 3,377 of these were infants (0.6 per cent).[16] Between 1901 and 2000 the population increased from about 33 million to over 52 million, birth and death rates declined substantially causing the age structure of deaths to change significantly so that by 2000 the vast majority of deaths were of older people.[17] Thus, by the end of the century, while concerns about reducing infant mortality remained, the health services, not surprisingly, focused much of their efforts on reducing mortality within the adult population.

The steady decline in infant mortality can be seen in Figure 1. During the first half of the century there were considerable annual fluctuations, but from the late 1940s these disappeared and the rate then declined almost continuously. In terms of years of special significance, the peaks of 1904, 1911 and 1940-1941 stand out, but if someone who knew little about the history of the twentieth century was asked to use this graph to identify when two world wars, a major economic depression and an influenza pandemic had occurred, they would be hard pushed to do so correctly.[18] It could be that these events had little impact on infant health or—perhaps counter-intuitively—they may even have been beneficial, or that other factors may have mitigated the negative effects of these national crises. Such events nevertheless

15 P. Townsend and N. Davidson, *Inequalities in Health: the Black Report*, Penguin edn (London, 1992) examines general health inequalities with pp. 27, 43-5, 62-3, 74, 115-7, 140-2, 175 discussing infant mortality. See J. Maher and A. Macfarlane, 'Inequalities in infant mortality: trends by social class, registration status, mother's age and birthweight, England and Wales, 1976-2000', *Health Statistics Quarterly* 22 (2004), pp. 14-22, https://doi.org/ for a discussion of recent inequalities.

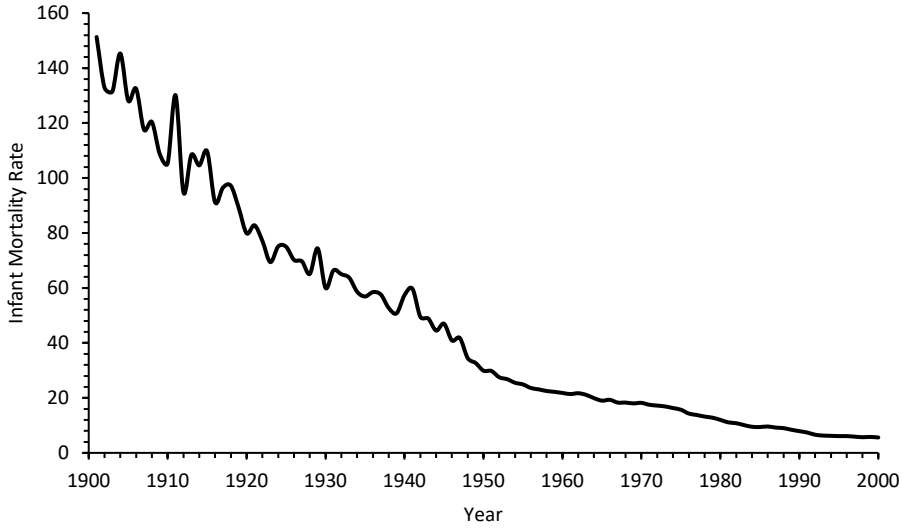
16 Registrar General, *Sixty-Fourth Annual Report of the Registrar General* (London, 1903), pp. 2, 136-7; Office of National Statistics, *Review of the Registrar General on Deaths in England and Wales, 2000*, pp. xv, 1.

17 J. Hicks and G. Allen, 'A century of change: trends in UK statistics since 1900', *House of Commons Library Research Paper* 99/111 (1999), pp. 1-34, here at p. 6.

18 C. Griffiths and A. Brock, 'Twentieth century mortality trends in England and Wales', *Health Statistics Quarterly* 18 (2003), pp. 5-17, here at p. 7, give a short account of this trend. W. Taylor, 'The changing pattern of mortality in England and Wales: I. Infant mortality', *British Journal of Preventive and Social Medicine* 8 (1954), pp. 1-9, here at p. 5, https://doi.org/10.1136/jech.8.1.1 discusses the complicated and sometime contradictory factors associated with the trend between 1901 and 1950.

warrant further investigation and some will be examined as case studies later in this paper with the aim of showing how local studies can enhance our understanding of national trends.

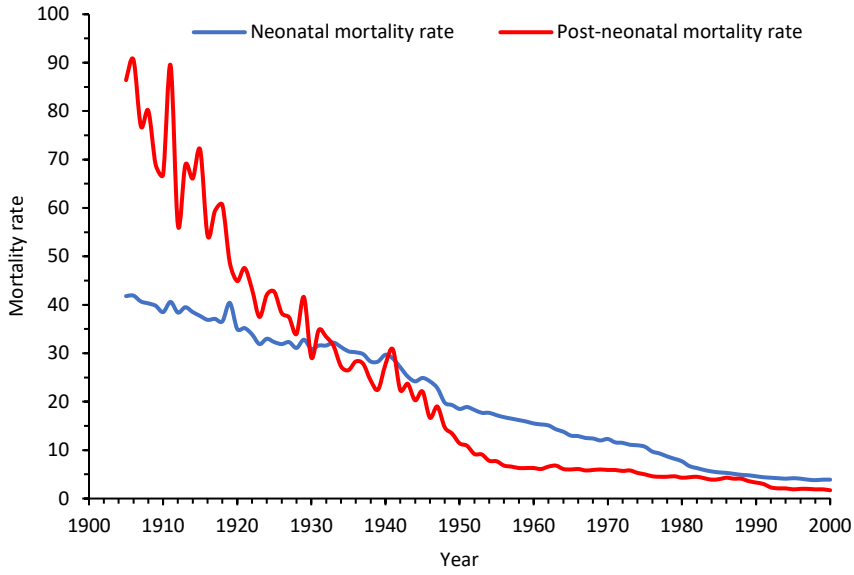
Figure 1 Infant mortality rates in England and Wales, 1901-2000



Source: 1901-1970, A. Macfarlane and M. Mugford (eds), *Birth Counts: Statistics of Pregnancy and Childbirth,* Vol. 2 (London, 2000), pp. 2-4; 1971-2000, Office of National Statistics, *Review of the Registrar General on Deaths in England and Wales, 2000, Childhood, Infant and Perinatal Mortality Statistics,* Series DH3 no. 33 (London, 2002), p. 113.

Figure 2 seeks to examine infant mortality decline in more detail by breaking the overall rate up into its neonatal and post-neonatal components. It is immediately apparent that the two lines follow very different paths. Neonatal mortality declined steadily throughout the twentieth century, with only a small upward kink in 1919. In contrast, most of the decline in overall infant mortality during the first half of the century, and nearly all the annual variations, occurred within the post-neonatal component. Indeed, while post-neonatal mortality was more than double neonatal mortality in 1905 (86.4 per 1,000 live births compared with 41.8), by 1930 it was lower and from 1933 it remained so apart from in 1941. By the early 1950s post-

Figure 2 **Neonatal and post-neonatal mortality rates, England and Wales, 1905-2000**



Note: The Registrar General's annual reports only provided an age breakdown of infant deaths from 1905.

Sources: 1901-1970, A. Macfarlane and M. Mugford (eds), *Birth Counts: Statistics of Pregnancy and Childbirth,* Vol. 2 (London, 2000), pp. 29-30; 1971-2000, Office of National Statistics, *Review of the Registrar General on Deaths in England and Wales, 2000, Childhood, Infant and Perinatal Mortality Statistics,* Series DH3 no. 33 (London, 2002), p. 113.

neonatal rates were already under 10 per 1,000 live births and most of the subsequent decline in overall infant mortality occurred within the neonatal component. After 1950 both neonatal and post-neonatal mortality continued to decline, and in 2000 neonatal mortality was more than double post-neonatal mortality (3.9 compared with 1.7). These two distinct patterns suggest that several different factors must have been responsible for the overall decline in infant mortality.

The decline in post-neonatal mortality is relatively easy to explain and was led by a sustained reduction in deaths from infectious diseases. Interpreting early twentieth century causes of death is fraught with difficulties due to changes in how some 'causes' were used and classified over time.[19] The adoption of the International

19 Writing in 1906 George Newman noted, 'that more accurate medical diagnosis, and therefore more accurate certification of the cause of death, has been secured in recent years, with the obvious result that there has been a tendency to a transference of deaths from indefinite to definite causes', see Newman, *Infant Mortality*. For similar problems with nineteenth-century

Table 1 Infant mortality rates by significant causes of death, 1911 compared with 1951

	Infant mortality rate (deaths per 1,000 live births)		
	1911	1951	Change
Overall	130.1	29.7	-100.4
Post-neonatal	89.5	10.9	-78.6
Neonatal	40.6	18.8	-21.8
Causes of death			
Infectious			
Diarrhoeal diseases	36.2	1.2	-35.0
Respiratory diseases	19.1	6.0	-13.1
Measles/whooping cough/diphtheria	7.6	0.5	-7.1
Tuberculosis	3.8	0.1	-3.7
Total infectious	**66.7**	**7.8**	**-58.9**
Ill-defined			
Premature birth	20.1	5.7	-14.4
Congenital debility and sclerema	15.0	0.0	-15.0
Convulsions	9.7	0.1	-9.6
Total ill-defined	**44.8**	**5.8**	**-39.0**

Notes: Diarrhoea was reported as 'diarrhoea and enteritis' in 1911 and 'gastroenteritis' in 1951; respiratory diseases are 'bronchitis', 'pneumonia', 'influenza' and 'other respiratory diseases' in both 1911 and 1951; tuberculosis is 'tuberculosis of the nervous system', 'tuberculosis of intestines and peritoneum' and 'other tuberculosis diseases' in 1911 and 'tuberculosis of meninges and central nervous system' and 'other tuberculosis diseases' in 1951; premature birth is reported as 'immaturity' in 1951. 'Sclerema' is a hardening of the skin that occurs in neonatal infants and is often associated with sepsis, congenital heart disease, respiratory problems or severe dehydration.

Sources: 1911, Registrar General, *Registrar General's Statistical Review for 1921. Tables, Part I Medical* (London, 1923), p. 42; 1951, Registrar General, *Registrar General's Statistical Review for 1955* (London, 1956), p. 61.

cause of death data, including the interpretation of multiple causes, see Galley, 'Infant mortality in England, 1538-2000: stability and the beginnings of change', pp. 127-34.

Classification of Causes of Death (ICD) system in 1911, and its regular updating, meant that 'causes' such as 'premature birth' and 'convulsions' were increasingly abandoned in favour of more precise, 'scientific' ones.[20] Moreover, as medicine developed a better understanding of the reasons why infants died, a greater number of causes began to be employed. Consequently, before a comprehensive analysis of causes of death during the twentieth century can be given, considerable time and effort is needed to ensure that causes are classified in such a way that like is always being compared with like.[21] For our purposes however, it can be demonstrated relatively easily that the decline in post-neonatal mortality during the first half of the twentieth century was driven by a reduction in deaths from infectious diseases. Table 1 compares IMRs from the principal causes of death in 1911 with the same or similar causes in 1951.[22] Four causes, or groups of causes, representing the most important infectious diseases, have been selected: diarrhoeal diseases, respiratory diseases, the most common diseases of childhood (measles, whooping cough and diphtheria) and tuberculosis. In each case mainly post-neonatal infants were affected and we can be reasonably confident that these diseases were relatively easy to identify and their classification did not change too much over time.[23] Between 1911 and 1951 mortality from these causes decreased by 58.9 per 1,000 live births whilst the total post-neonatal mortality rate declined by 78.6 which suggests that controlling infections explains much of the decline in post-neonatal mortality. While further detailed work

20 The ICD was developed by the French statistician Jacques Bertillon and adopted by the International Statistical Institute in 1893 as a means by which causes of death could be standardised and compared between different countries. As medicine advanced frequent revisions were made to the system and, from its creation in 1948, the World Health Organization assumed responsibility for the ICD, see I.M. Moriyama, R.M. Loy, and A.H.T. Robb-Smith, *History of the Statistical Classification of Diseases and Causes of Death* (Washington, 2011), pp. 9-21.

21 See Office for National Statistics, *The 20th Century Mortality File, 1901-2000* [2013], https://data.gov.uk/dataset/2548e46b-873e-4668-968c-25d6c155dd73/the-20th-century-mortality-files [accessed April 2021] which provides detailed cause of death data by age. Deaths were classified according to the following revisions: 1901-1910, ICD-1; 1911-1920, ICD-2; 1921-1930, ICD-3; 1931-1939, ICD-4; 1940-49, ICD-5; 1950-1957, ICD-6; 1958-1967, ICD-7; 1968-1978, ICD-8; 1979-1984, ICD-9a; 1985-1993, ICD-9b and 1994-2000, ICD-9c.

22 It should be noted that 1911 was an exceptional year because the hot summer caused a substantial increase in diarrhoeal deaths (Figure 1), although a significant epidemic of measles also occurred. Had another year been chosen, the same pattern would have been evident, although perhaps to a lesser degree.

23 For instance, in 1921 the neonatal mortality rate from these four diseases combined was 2.7 while the corresponding post-neonatal rate was 31.6 (11.7 times higher), see Registrar General, *Registrar General's Statistical Review for 1921: Tables, Part I Medical* (London, 1923), pp. 44-5. During the early part of the twentieth century the Registrar General repeatedly exhorted doctors not to give diarrhoea as a cause of death and instead use gastro-enteritis. Since diarrhoea is a symptom rather than a cause it is possible that some deaths that would have been ascribed to diarrhoea in 1911 would have been given another cause in 1951; however the scale of the decline reported in Table 1 is sufficient to demonstrate that there must have been a substantial reduction in these types of infectious deaths by 1951.

on all causes of death is required to confirm this conclusion, other infectious causes, which had been responsible for many infant deaths during the nineteenth century, such as scarlet fever and syphilis, had virtually ceased to affect infants by 1951.[24] The decline in infectious diseases can also be seen in Figure 3 which shows annual IMRs from diarrhoea, respiratory diseases, tuberculosis, measles and whooping cough. The downward trend is evident in each series. In the case of diarrhoea, pronounced peaks occurred in 1904, 1906 and especially 1911 (see below for a discussion of this year) and, while infants died from diarrhoea at all times of the year, deaths were particularly high during hot, dry summers. Between 1901 and 1950 diarrhoea mortality declined gradually and the peaks reduced significantly, the last major one being associated with the drought year of 1921.[25] In the case of respiratory diseases decline was less pronounced, peaks still appeared and by 1950 this group of diseases was responsible for about a half of all post-neonatal deaths. These patterns, albeit to a lesser extent, also occurred with whooping cough and measles and, while both these diseases mainly affected children over the age of one year, they still made important contributions to the overall decline in infant mortality. By contrast, tuberculosis deaths were not epidemic in nature, although a gradual reduction is still evident. Figure 3 shows that infectious disease control was the main cause of the decline in post-neonatal mortality and this suggests that medical officials must have had increasing success both in reducing exposure to these diseases and in mitigating their effects.

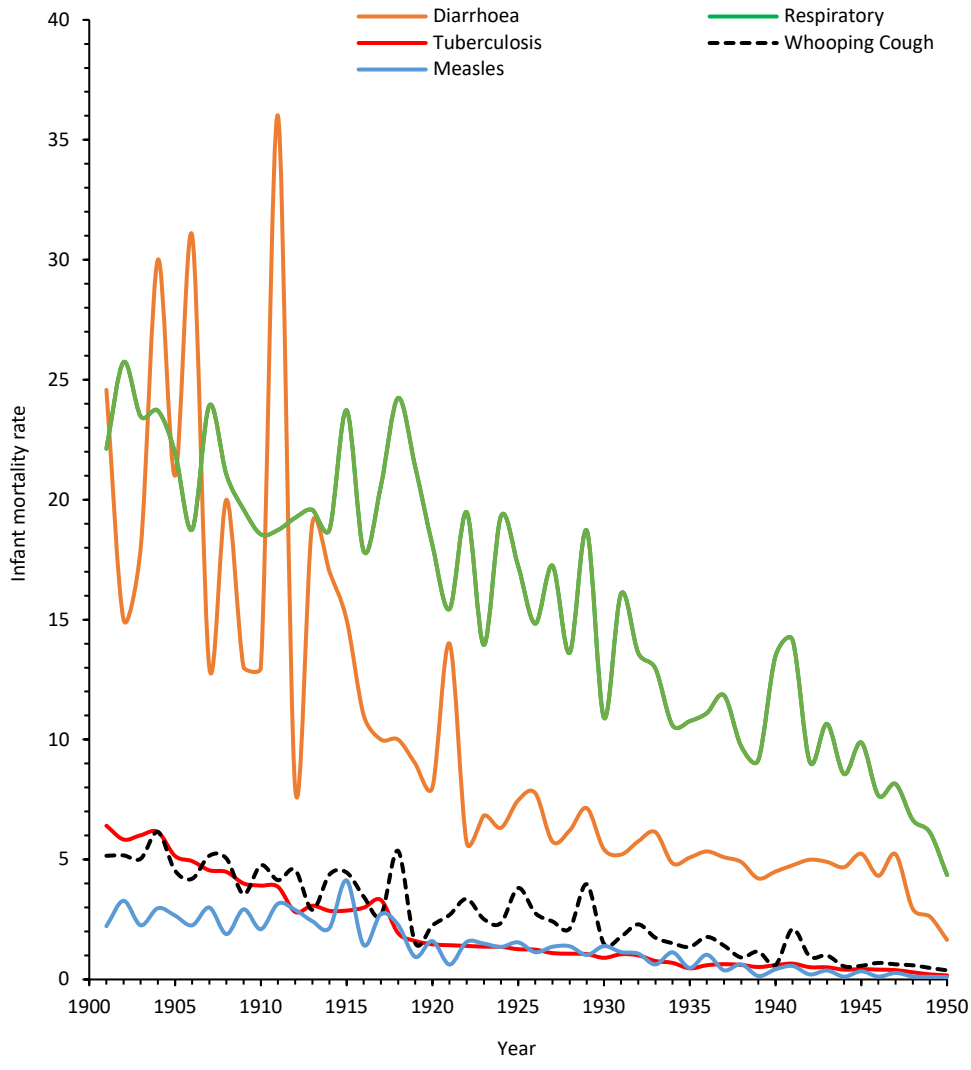
Explaining change using causes of death is complicated by the prominence in 1911 of three ill-defined causes: 'premature birth', 'congenital debility and schlerema' and 'convulsions'. These 'causes' appear to have declined substantially during the period, although the reasons for this are mainly due to changes in nosology rather than in their incidence and possible changes in reporting practices. 'Premature birth' was essentially a neonatal cause of death while 'congenital debility' and 'convulsions' deaths were divided almost equally between neonates and post-neonates.[26] While neonatal mortality decreased by 21.8 per 1,000 live births between 1911 and 1951, the apparent decline in these three ill-defined 'causes' was 39 which suggests that many deaths ascribed to these causes in 1911 would have been classified in other

24 Only 19 congenital syphilis deaths were recorded in 1951 while scarlet fever, that scourge of Victorian Britain, did not appear in the table of the most common causes of infant death, see Registrar General, *Registrar General's Statistical Review for 1955* (London, 1956), p. 61.

25 L.J. Barker, J. Hannaford, S. Parry, K.A. Smith, M. Tanguy and |C. Prudhomme, 'Historic hydrological droughts 1891–2015: systematic characterisation for a diverse set of catchments across the UK', *Hydrology and Earth System Science* 23 (2019), pp. 4,583–602, https://doi.org/10.5194/hess-23-4583-2019.

26 Registrar General, *Statistical Review for 1921*, p. 46 shows that about 90 per cent of 'premature birth' deaths were neonatal ones.

Figure 3 **Infant mortality rates from diarrhoea, respiratory diseases, tuberculosis, whooping cough and measles, England and Wales, 1901-1951**



Source: Office for National Statistics, *The 20th Century Mortality File, 1901-2000* [2013], https://data.gov.uk/dataset/2548e46b-873e-4668-968c-25d6c155dd73/the-20th-century-mortality-files [accessed April 2021].

causes had they occurred in 1951.[27] Indeed, some mortality rates from causes that almost exclusively affected neonates, such as atelectasis (lung collapse) and birth injury, even increased between 1911 and 1951.[28] Determining the cause of death of some very young babies is difficult and a combination of factors was probably responsible for the decline in neonatal mortality, a conclusion that appears confirmed when neonatal mortality rates are broken down into different age groups.

Figure 4 shows early age mortality rates between 1921 and 2000 together with stillbirth rates from 1928.[29] The neonatal and stillbirth rates are fairly close to each other. Initially the stillbirth rate is higher than the neonatal mortality rate with the small initial rise probably reflecting better registration as the new system was introduced. The stillbirth rate then declined significantly until 1950 when it stalled for nearly a decade. Afterwards it continued to decline rapidly so that by the mid-1970s neonatal and stillbirth rate were nearly identical. The increase from 1993 reflects a change in how stillbirths were defined (from 28 to 24 weeks gestation). When neonatal deaths are broken down into their different components a more complicated picture emerges. Both first day and first week mortality appear to follow a similar, but not identical, trend that shows steady decline throughout the period with the downward trend being halted during the 1950s and early 1960s in first day deaths, but not in infants aged from one day to one week. Deaths of neonates aged over one week follow a slightly different path with more variation and a significant decline during the late 1940s. It should be remembered that all these age divisions are arbitrary and do not necessarily reflect development processes within the infant. Nevertheless, with substantial decline being evident in all five series, it is likely that some common factors were responsible for these trends, although other, more individual factors, such as improvements in maternal health and midwifery practices, were more likely to have affected stillbirth rates and first day mortality.

The balance of factors responsible for causing these differing, age-specific trends remains as yet unresolved in part because relatively little effort has been devoted to addressing this topic. This is mainly due to the fact that, rather than concentrating on explaining these subtle age-specific variations, most research has focused on the effects of particular sets of socio-economic variables on infant mortality.[30]

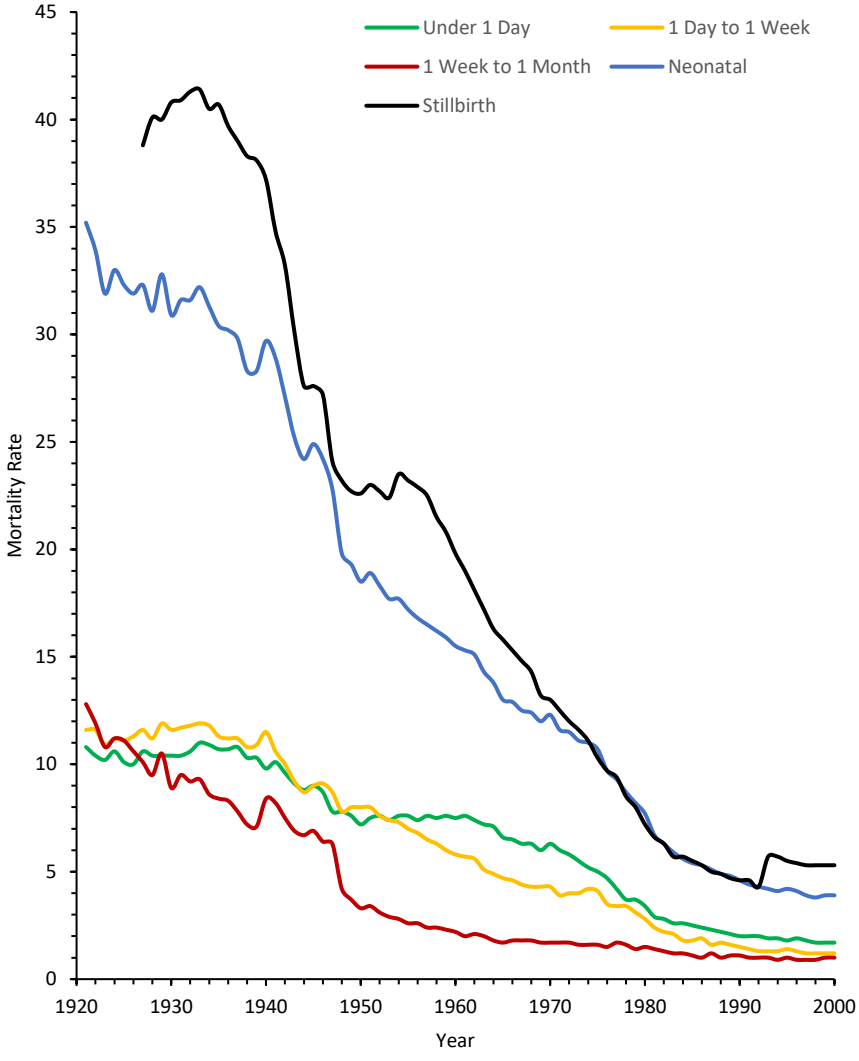
27 These include 'spina bifida and meningocele' (caused by the imperfect development of the spine) and 'hemolytic disease of the newborn' (a blood disorder that occurs when the infant's blood type is incompatible with that of its mother) which appear in 1951, but not in 1911.

28 In 1911 the IMR for atelectasis was 1.69 per 1,000 live births and for birth injury 1.03. Comparable IMRs in 1951 were 3.58 (post-natal asphyxia and atelectasis) and 2.87 respectively, Registrar General, *Statistical Review for 1921*, p. 42; Registrar General, *Statistical Review for 1955*, p. 61.

29 Compulsory stillbirth registration started in England and Wales on 1 July 1927 so 1928 was the first year when annual stillbirth rates can be calculated.

30 See for example R.A. Cage and J. Foster, 'Overcrowding and infant mortality: a tale of two cities', *Scottish Journal of Political Economy* 49 (2002), pp. 129-49, https://doi.org/10.1111/1467-9485.00225; D. Dorling, 'Infant mortality and social progress in Britain, 1905-2005', in Garrett *et al.*, *Infant Mortality: a Continuing Social Problem*, pp. 213-28.

Figure 4 **Early age mortality and stillbirth rates, England and Wales, 1921-2000**



Note: From 1928 to 1992 stillbirths relate to fetal deaths at or over 28 weeks gestation, and from 1993 at or over 24 weeks gestation.

Source: Office of National Statistics, *Review of the Registrar General on Deaths in England and Wales, 2000, Childhood, Infant and Perinatal Mortality Statistics,* Series DH3 no. 33 (London, 2002), pp. 112-3.

In order to make progress towards understanding why these variations in infant mortality trends occurred, four types of explanations seem worthy of further investigation. The first relates to the extent to which direct medical interventions, such as better midwifery practices, the introduction of antibiotics from the 1930s, mass vaccination and surgical advances, even on fetuses, improved infant health. The second concerns general improvements in infant welfare education and includes improvements in infant feeding, greater hygiene and isolating infants from infectious disease. The third requires disentangling the precise contribution that various socio-economic improvements, such as increasing prosperity, better housing and a cleaner living environment, made towards decreasing IMRs. Finally, the twentieth century witnessed a dramatic decline in fertility and it is important to investigate how this phenomenon impacted on infant health. The fact that steady improvements occurred in all these areas means that teasing out the exact contribution that each interlocking variable made to overall infant mortality decline remains difficult if not impossible.[31] As a first step towards exploring some of these issues, assessments will be made of the state of contemporary knowledge about the causes of infant mortality during the early twentieth century, the 1950s and in 2000. We begin by examining the work of George Newman and Arthur Newsholme, the two most important pioneers in infant welfare working in the early twentieth century.

Understanding infant mortality during the early twentieth century

George Newman's landmark publication, *Infant Mortality, a Social Problem*, published in 1906, was the first book length treatment of the subject.[32] In 356 pages of plain, easy to understand text Newman surveyed national and local patterns of infant mortality, examined the fatal diseases of infancy (with special emphasis being placed on epidemic diarrhoea), discussed how social factors such as women's work, domestic conditions and infant management affected infant survival and proposed a series of preventive measures relating to the mother, her infant and the environment that should have brought about a decline in infant mortality. Newman (1870-1948) was born into a prominent Quaker family and his lifelong faith fueled his desire to serve as a 'medical missionary'.[33] Following a series of part-time appointments in public health he became MOH for Bedfordshire (1897) and then for the London Borough of Finsbury (1900); he went on to become Chief Medical Officer to the

31 Writing about population studies more widely, E.A. Wrigley, 'The interplay of demographic, economic, and social history', *Journal of Interdisciplinary History* 50 (2020), pp. 495–515, here at p. 495, https://doi.org/10.1162/jinh_a_01483, argues that, 'although *description* may be feasible, *explanation* often presents problems. It is normally the case that a number of factors are involved, and determining their relative importance often presents severe difficulties'. In many studies single causes for what are inevitably complicated ones are often investigated.

32 Newman, *Infant Mortality*.

33 Newman's career is discussed in C. Galley, 'George Newman – a life in public health', in Garrett *et al.*, *Infant Mortality: a Continuing Social Problem*, pp. 17-31.

Board of Education (1907) and Chief Medical Officer to the newly created Ministry of Health (1919). These last two appointments, held concurrently, were key public positions that helped him to shape post-war public health policy. Newman wrote *Infant Mortality* as a consequence of his work as MOH:

> During the last five years my work in Finsbury has necessitated a careful study of the problem of infant mortality. This book is part of the outcome. It is an attempt to state in a plain way the chief facts concerning a question which is not without national importance.[34]

Newman did not offer a new approach to tackling high IMRs, instead he provided an extensive survey of what others had written on the subject and, using his considerable experience as someone whose daily work entailed a constant fight to improve infant health, proposed a number of simple practical measures which he believed would bring about a reduction in infant mortality. As the title of the book implies, Newman believed that high infant mortality was essentially a *social* rather than a *medical* problem with the mother being placed centrally as the single most important influence on her infant's survival:

> The problem of infant mortality is not one of sanitation alone, or housing, or indeed of poverty as such, *but is mainly a question of motherhood.* No doubt external conditions as those named are influencing maternity, but they are, in the main, affecting the mother, and not the child. They exert their influence upon the infant indirectly through the mother. Improved sanitation, better housing, cheap and good food, domestic education, a healthy life of body and mind—these are the conditions which lead to efficient motherhood from the point of view of child-bearing. They exert but an indirect effect on the child itself, who depends for its life in the first twelve months, not upon the State or the municipality, nor yet upon this or that system of *crèche* or milk-feeding, but upon the health, the intelligence, the devotion and maternal instinct of the mother.[35]

Such a conclusion has proved controversial since some researchers have argued that Newman sought to blame mothers, or more specifically working-class mothers, for high IMRs.[36] However, Newman's argument is more subtle than this. Writing about

34 Newman, *Infant Mortality*, p. v.

35 Newman, *Infant Mortality*, pp. 257-8.

36 For examples see, A. Davin, 'Imperialism and motherhood', *History Workshop* 5 (1978), pp. 9-65, here at pp. 12-4, 24-8, https://doi.org/10.1093/hwj/5.1.9; C. Dyhouse, 'Working-class mothers and infant mortality in England, 1895-1914', *Journal of Social History* 12 (1978), pp. 248-67, here at pp. 257-9, https://doi.org/10.1353/jsh/12.2.248; J. Lewis, *The Politics of Motherhood: Child and Maternal Welfare in England, 1900-1939* (London, 1980), pp. 61-88; D.

public health more generally he argued that while the causes of high mortality were well understood by public health officials, 'the people perish for lack of knowledge' and '[m]uch remains to be done in England in the direction of educational life in public health'.[37] Newman remained consistent on this point, writing in 1931 that 'the State cannot itself save the child*, but it can help the mother to save it*'.[38] Later in 1941, when commenting on the substantial decline in infant mortality that had by then occurred, he firmly ascribed this success to the mothers:

> There has been nothing comparable in the history of Preventive Medicine in England with this great triumph. The State and the doctors have no doubt done their part, but this is the achievement of the mothers of England themselves, aided by a zealous army of devoted and skilled helpers.[39]

Thus, Newman believed that raising maternal enlightenment was the key to reducing infant mortality and his stress on the social causes of infant mortality, the various direct and indirect factors responsible for causing infant deaths, resonates with those seeking to understanding the secular decline and persistent inequalities in infant mortality that occurred throughout the twentieth century.[40] Newman's work still remains relevant since, as well as providing an extensive analysis of infant mortality in Edwardian Britain, the final chapters can serve as a model by which explanations of infant mortality decline can be investigated and evaluated.

Newman's book is divided into 11 chapters. The first two provide an overview of the incidence and distribution of infant mortality. They note that adult and childhood mortality, along with fertility, had declined in the years before 1906, but infant mortality had not done likewise. They show that high infant mortality was associated with towns, especially industrial ones, poverty, illegitimacy and that the risks infants faced decreased considerably with age. International and spatial variations are also examined and New Zealand, the country with the lowest IMR,

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Dwork, *War is Good for Babies and Other Young Children* (London, 1987), pp. 226-30; E. Ross, *Love and Toil: Motherhood in Outcast London, 1870-1918* (Oxford, 1993), p. 201.

37 G. Newman, *The Health of the State* (London, 1907), pp. 177, 194.

38 G. Newman, *Health and Social Evolution* (London, 1931), p. 131.

39 G. Newman, *English Social Services* (London, 1941), pp. 19-20. Eric Pritchard, a leading figure in the infant welfare movement, also stressed the importance of motherhood: '[t]he moment we began to concentrate on the mother, to educate her, and to equip her with a special knowledge, special resources, the special expedients, and the special instruments necessary for protecting her baby from the dangers of its immediate environment, from that moment the Infant Mortality rate began to fall', E. Pritchard, 'Infant mortality and the welfare movement', *Contemporary Review* 120 (1921), pp. 76- 82, here at p. 80.

40 See the discussion in R. Woods, 'Newman's *Infant Mortality* as an agenda for research', in Garrett *et al.*, *Infant Mortality: a Continuing Social Problem*, pp. 33-49. Woods also examines the sources that Newman used.

was shown to have attained the 'ideal' IMR of 71 in 1904.[41] Chapters 3 and 4 discuss the fatal diseases of infancy (see Table 1 above). The differences between town and countryside are again highlighted and Newman also examines in detail those deaths that have an ante-natal cause. Here, in an important conclusion, he suggests that the, 'poor physique and ill-nutrition of the mother exerts, in a considerable percentage of cases, an injurious effect upon the infant'.[42] The next chapter deals with the industrial occupation of women. It notes a broad correlation between districts that employ a large proportion of women and high IMRs and it details how the employment of women close to giving birth and an immediate return to work thereafter is detrimental to infant health. Newman is less successful in demonstrating that the industrial employment of women is a direct cause of high infant mortality and he is forced to concede that, '[s]tatistical returns do not entirely support the assertion that factory employment of women is the main cause of high infant mortality'.[43] Chapter 6 concerns epidemic diarrhoea, arguing that it is essentially a 'filth' disease particularly associated with the working-class populations of towns and consequently, because of the large differences in rates between places and classes, it could be remedied by preventive action.[44] Chapter 7 examines domestic and social influences, and shows how poverty, upbringing, education, food, housing and overcrowding create

41 Newman, *Infant Mortality*, p. 10. See also G. Newman, *On the State of the Public Health: Annual Report of the Chief Medical Officer of the Ministry of Health for the Year 1932* (London, 1933), p. 223 ,where he wrote that the IMR was then reaching an 'irreducible minimum' (the national IMR was 65 in 1932). See also, G.F. McCleary, 'The influence of ante-natal conditions on infantile mortality', *British Medical Journal* 2 (2,276) (1904), pp. 321-3, here at p. 321, https://doi.org/10.1136/bmj.2.2276.313; H.T. Ashby, *Infant Mortality* (Cambridge, 1915), pp. 76-93; and A. Newsholme, *Fifty Years in Public Health* (London, 1935), p. 346 who writes about non-preventable or partially preventable neonatal deaths. The notion of irreducible levels of mortality derives from Farr's 'healthy districts' which were defined as those with a crude death rate of 17 per 1,000 population or less, see E. Lewis-Fanning, 'A survey of the mortality in Dr Farr's 63 healthy districts of England and Wales during the period 1851-1925', *Journal of Hygiene* 30 (1930), pp. 121-53, https://doi.org/10.1017/s0022172400010342. By the 1940s the Registrar General was arguing that, '[t]here seems no reason to postulate an irreducible hard core of neonatal mortality, nor of infant mortality generally, and any attempt to set "targets" for these is unprofitable', Registrar General, *Registrar General's Statistical Review of England and Wales for the Six Years 1940-1945*, Vol. 1 (London, 1949), p. 32. For a twenty first century discussion of this concept, see, J. Drife, 'Can we reduce perinatal mortality in the UK?', *Expert Reviews in Obstetrics and Gynaecology* 3 (2008), pp. 1-3, https://doi.org/10.1586/17474108.3.1.1.

42 Newman, *Infant Mortality*, p. 89.

43 Newman, *Infant Mortality*, p. 136. Furthermore, Newman concluded that, 'infant mortality … is as much a financial as a hygiene question' (p. 138). Galley, 'Infant mortality in England, 1538-2000: stability and the beginnings of change', pp. 150-1 discusses the industrial employment of women.

44 More general class differentials in IMRs were discovered by Seebohm Rowntree in his survey of poverty in York which showed that in three working class areas, the 'poorest', 'middle' and 'highest' had IMRs of 247, 184 and 173 respectively which compared with 176 for the whole of York and only 94 amongst the 'servant keeping class', see B.S. Rowntree, *Poverty: a Study of Town Life* (London, 1901), p. 206.

conditions detrimental to infant health. Newman notes that some families living in the worst of conditions still managed to raise their children successfully, but here conditions within the home made the crucial difference, 'so long as domestic insanitation exists … the life of infancy among the poor cannot be otherwise injuriously affected'.[45] Also included in this chapter, and perhaps influenced by his Quaker upbringing, is a discussion of alcoholism which—as far as it is possible to tell—may have had a devasting impact on individual families, but not on the overall IMR. The most important influences on infant mortality, feeding and infant management, are discussed in Chapter 8, which begins with the stark statement that, 'expressed bluntly it is the ignorance and carelessness of mothers that directly causes a large proportion of the infant mortality which sweeps away every year in England and Wales alone 120,000 children under twelve months of age'.[46] What follows is a section that promotes the benefits of maternal breastfeeding, an examination of alternative feeding methods if breastfeeding is not possible, and a comprehensive discussion of the best methods of caring for the infant.

The final three short chapters discuss preventive strategies relating to the mother, her child and the wider environment. This hierarchical order reflects Newman's belief that the mother had the ability to shield her infant from the composite dangers posed by the domestic and wider environments and that, while improvements to both would be beneficial, much greater changes could be brought about by improving the health and knowledge of the mother.[47] With respect to the mother these related to her physical condition and the care she devoted to her infant. Thus, existing agencies should be reformed to deal with this issue since 'no society exists in England for the assistance and counsel of married women before, during and after confinement' and, as to improving maternal welfare, this essentially boils down to '*feed the mother*'.[48] Much of the rest of the chapter concerns how best to educate mothers about improper feeding and careless exposure to diseases such as bronchitis,

45 Newman, *Infant Mortality*, p. 196.

46 Newman, *Infant Mortality*, p. 221. This statement would appear directly to criticise mothers, but the extent to which Newman is seeking to blame mothers for high infant mortality revolves around the interpretation of the word 'ignorant'. Most dictionaries define ignorant as 'lack of knowledge', see for example J. Coulson, H.M. Petter, D. Eagle and J. Hawkins (eds), *The Oxford Illustrated Dictionary*, 2nd edn (Oxford, 1975), p. 419, but it can also take on connotations of blame. Thus, it is often assumed that a person described as being ignorant needs to accept some responsibility for their own ignorance. However, the fact that Newman devotes so much effort to improving maternal education suggests that he is not so judgemental. J.M. Campbell, *The Carnegie United Kingdom Trust Report on the Physical Welfare of Mothers and Children: England and Wales*, Vol. 2 (Liverpool, 1917), p. 97 supports Newman on this point.

47 N. Williams and C. Galley, 'Urban-rural differentials in infant mortality in Victorian England', *Population Studies* 49 (1995), pp. 401-20, Figure 4, here at p. 417, https://doi.org/10.1080/0032472031000148746 essentially presents Newman's views in diagrammatic form. Woods, 'Newman's *Infant Mortality* as an agenda for research', pp. 42-4 summarises Newman's preventive measures.

48 Newman, *Infant Mortality*, pp. 258, 260.

pneumonia, measles and whooping cough. Newman believed that many of the leaflets that had been distributed to new mothers were inadequate and better education could be achieved through female health visitors and the instruction of girls in domestic hygiene. He notes that Irish and Italian mothers in Finsbury were more likely to breastfeed their infants and consequently these groups experienced lower IMRs than their English counterparts, even though they lived in similar or worse conditions.[49] Newman also makes recommendations about women's working conditions and believed that one of the benefits of crèches was that they taught mothers cleanliness under medical supervision. With respect to the child, Newman recommends the early registration of births so that health visiting could be more effective and he reviewed the success of three acts of parliament, the Midwives Act (1902), the Infant Life Protection Act (1897) and the Prevention of Cruelty to Children Act (1904). All were beneficial, but they had little impact on the IMR. The rest of the chapter discusses artificial feeding and crèches. The final chapter deals with general health reform in factories, the home and in towns. It includes recommendations about the substitution of water closets for privy-middens, the repairing of defective drains and sewers, better paving and improving the quality of milk.

For its time, *Infant Mortality: a Social Problem* presented a 'state of the art' account of why infant mortality was a problem of national importance and, moreover, one that could be resolved through direct action targeted specifically at those mothers in greatest need. Newman realised that wider environmental problems made the task of those mothers living in the harshest environments substantially more difficult, but improving these would require much greater investment of time and money. Instead, since infant mortality was 'intimately related to the social life of the people',[50] he placed emphasis on educating mothers, albeit expressed in a manner that appeared critical, as the most likely means by which infant mortality decline could be achieved, in the short term at least. Essentially the assumption was that if working-class mothers adopted middle-class values with respect to domestic cleanliness and infant care then IMRs in working class areas would fall, and there is little within his recommendations that would be out of place in a modern infant care manual. There were however a number of issues about which Newman was silent. Most notably he failed to acknowledge the potential for medical advances to improve infant health and he did not realise that the profound demographic changes that were already underway by 1906 were part a pan-European phenomenon. Nevertheless, the timing of the book's publication, just before the first National Conference for the Prevention of Infant Mortality took place, was apt and its findings can serve as a model for assessing the means by which infant mortality decline was brought about.

49 Newman, *Infant Mortality*, pp. 225-6. For similar conclusions about Jewish mothers see L.V. Marks, *Model Mothers: Jewish Mothers and Maternity Provision in East London 1870-1939* (Oxford, 1994).

50 Newman, *Infant Mortality*, p. vi.

Before doing this, it is appropriate to examine the work of perhaps the most important pioneer in infant welfare, Arthur Newsholme.[51]

After a varied medical career, Newsholme (1857-1943) developed an interest in hygiene and this led him to become part-time MOH for Clapham (1884-1888), one of six subdistricts of Wandworth, full-time MOH for Brighton (1888-1908) and finally Medical Officer to the LGB (1908-1919), the body that effectively oversaw national public health policy.[52] It was in this last position that Newsholme published five major reports into infant mortality.[53] These reports were written against the background of a 'widespread awakening to the national importance of child mortality'.[54] They were aimed at a largely professional audience, principally the MOHs who were responsible for implementing policies to reduce infant and childhood mortality. The first report provides Newsholme's most widespread analysis of the problem and he hoped that MOHs would find it 'a useful starting point for intensive investigation of the causes of excessive child and especially excessive infant mortality in their individual counties and districts'.[55] The report has three objectives:

1. [to determine] whether reduction of infant mortality implies any untoward influence on the health of survivors in later years;
2. to indicate the communities which are characterised by a continuing high rate of infant mortality;
3. to assess as far as possible, the relative value of the different factors of excessive infant mortality.[56]

The first objective addresses eugenic concerns that a reduction in infant mortality would necessarily result in an increasing number of 'unfit' individuals within the population. After an extensive county-level analysis of infant mortality, Newsholme is reluctant to make a definitive statement on 'whether a heavy infant mortality has any selective influence on the population beyond infancy', but he shows that 'the

51 A wealth of publications about infant mortality appeared during the early twentieth century, but the only other book length treatment was Ashby, *Infant Mortality*. Ashby's analysis of the problem was not as extensive as either those of Newman or Newsholme, but his recommendations about how best to reduce infant mortality were similar.

52 J.M. Eyler, *Sir Arthur Newsholme and State Medicine* (Cambridge, 1997), pp. 4-8. Newsholme's major publications on hygiene are: A. Newsholme, *Hygiene: a Manual of Personal and Public Health* (London, 1884); A. Newsholme, *School Hygiene: the Laws of Health in Relation to School Life* (London, 1887) and A. Newsholme, *Lessons on Health: Containing the Elements of Physiology and Their Application to Hygiene* (London, 1890).

53 These are listed in footnote 5 above.

54 Newsholme, *Supplement to the Thirty-Ninth Annual Report of the Local Government Board* [First Report], p. 1.

55 Newsholme, *Supplement to the Thirty-Ninth Annual Report of the Local Government Board* [First Report], p. 74.

56 Newsholme, *Supplement to the Thirty-Ninth Annual Report of the Local Government Board*, p. 1.

counties having high infant mortalities continue in general to suffer somewhat excessively throughout the first twenty years of human life and that the counties having low infantile mortalities continue to have relatively low death-rates'.[57] He also suggests that areas with high mortality have high sickness rates and consequently, he concludes that it was the 'overwhelming influence exerted by the evil environment' that was the most important influence on high infant mortality.[58] The second objective is dealt with relatively straightforwardly by an examination of age- and cause-specific IMRs and the patterns Newsholme describes are similar to those reported by Newman.

The third part of the report contains an 'incomplete' list of influences affecting infant mortality:

1. The proportion of male to female births.
2. The proportion of illegitimate to legitimate births.
3. The magnitude of the birth rate, which may for the present purpose be otherwise put as the size of the family.
4. The number of still-births.
5. The quality of the help given at birth.
6. The age of the wife at marriage.
7. Poverty and social conditions.
8. The extra-domestic employment of married women.
9. Urban or rural conditions of life.
10. Domestic and municipal sanitation.
11. Condition of housing.
12. Ignorance and fecklessness of mothers.[59]

Newsholme states that these are 'not given in order of importance' and he notes that climate, which he accepted was an important influence in the short term, has been omitted from the list. He argues that these influences can be classified into pre-natal (1-4 and 6), natal (4, 5) and post-natal (7-12) and that most should be amenable to preventive action. There are only minor differences between Newsholme and Newman in how they viewed the major causes of infant mortality with the main difference being one of emphasis. Newsholme was basically providing information to MOHs to help them put in place policies that would drive down IMRs. Factors 1-3 and 6 can be classified as well established demographic influences (males suffered higher rates than females, illegitimates more than legitimates, there was a tick shaped relationship between mother's age and infant mortality, and lower fertility resulted in lower infant mortality) and there was little that a MOH could do to influence them.

57 Newsholme, *Supplement to the Thirty-Ninth Annual Report of the Local Government Board*, p. 178.
58 Newsholme, *Supplement to the Thirty-Ninth Annual Report of the Local Government Board*, p. 75. See also pp. 78-83 and the discussion in Eyler, *Sir Arthur Newsholme*, pp. 301-5.
59 Newsholme, *Supplement to the Thirty-Ninth Annual Report of the Local Government Board*, p. 40.

The others were more amenable to direct action and Newsholme made a number of recommendations for MOHs.[60] The first was to undertake more detailed investigation into the causes of infant mortality within their districts. The rest referred to the better training of midwives, earlier notification of births, more focused health visiting and a widespread improvement in sanitary conditions, especially in the towns. While Newsholme did identify the ignorance and fecklessness of mothers as being an important influence, perhaps because his target audience was the MOH, he placed greater emphasis on improving the urban sanitary environment than did Newman. He also explains that the mother's lack of knowledge was in part due to:

> the inefficient as well as insufficient care received by a large proportion of parturient women of the wage-earning classes during child-birth, and the ignorant and often mischievous guidance in infantile hygiene which they receive from incompetent midwives and still more from monthly nurses. To this must be added the frequently insufficient nursing both of mother and infant during the period of weakness and greatest danger following birth.[61]

Thus, while Newsholme's wording is similar to that of other writers, he concludes that the education of mothers will bring rewards since, '[h]appily it is beyond doubt that nearly every mother is profoundly wishful to secure the welfare of her offspring, and will welcome any aid judiciously offered in this direction'.[62] Newsholme also states that maternal ignorance 'is a comfortable doctrine for the well-to-do person to adopt; and it goes far to relieve his conscience in the contemplation of excessive suffering and mortality among the poor'.[63]

In subsequent reports Newsholme repeated his general conclusions as to the causes of infant mortality. For example, in his second report published in 1913, the recent decline in infant mortality was ascribed, 'to the result of improved sanitary and housing conditions, of more efficient municipal and domestic cleanliness, of education in hygiene, of increased sobriety of the population, and of the widespread awakening of the national importance of child mortality, with concentration on efforts of child welfare work such as had never previously occurred'.[64] Indeed, in his

60 Newsholme, *Supplement to the Thirty-Ninth Annual Report of the Local Government Board*, pp. 76-8.

61 Newsholme, *Supplement to the Thirty-Ninth Annual Report of the Local Government Board*, p. 56. Newsholme, *Supplement to the Forty-Fourth Annual Report of the Local Government* returned to this theme in his report on maternal mortality where he showed that midwifery practices had a profound effect on maternal and perinatal mortality.

62 Newsholme, *Supplement to the Thirty-Ninth Annual Report of the Local Government Board*, p. 76.

63 Newsholme, *Supplement to the Thirty-Ninth Annual Report of the Local Government Board*, p. 64. See also the discussion in Eyler, *Sir Arthur Newsholme*, p. 312.

64 Newsholme, *Supplement to the Forty-Second Annual Report of the Local Government Board*, pp. iii-iv. This report (Newsholme's second) also sought to provide an assessment of the policies

autobiography published in 1935, Newsholme largely reiterated these views stating that 'no one factor is responsible' for the great reduction in infant mortality that had then taken place.[65] He ascribed the initial decline during the first decade of the twentieth century to 'the relatively small amount of specialized child welfare work and the general enlightenment of the population, the work done in sanitary administration in educating the public mind and conscience, and the improvement in domestic sanitation and personal hygiene resulting from these more general sources of enlightenment and reform'.[66] Improvements in all these factors occurred during the first half of the twentieth century, but with respect to maternal ignorance, Newsholme noted that mothers within all classes were ignorant to some extent and the crucial difference was that 'the mother in comfortable circumstances is able to ensure for her infant certain advantages which the infant of the poorer often cannot obtain'.[67] Thus, the environmental threats were much greater for poor mothers than for better-off mothers and more often overwhelmed their ability to care for their infants.[68]

Table 2 shows the major influences on infant mortality identified in the work of Newman and Newsholme.[69] They are divided into those that affected the mother, those that affected the child and the domestic and wider environments. Most categories are self-explanatory. The ones relating to ante-natal factors are derived from Newsholme's list (see above) with family size probably being the most important. It is not known exactly how this relationship operated, but it is thought to have arisen because in smaller families the mother is able to devote more time to

adopted in 241 urban districts, pp. 118-382. It gives details about the extent of health visiting, but not about its quality. For example, according to the midwife and health visitor, Emilia Kanthack, '[y]ou will not be a scrap of use to them or their babies unless you understand them and they understand you. So you must do your level best to make yourself acquainted with their habits of mind and modes of speech and their code of manners, as well as with their physical and economic conditions', see E. Kanthack, *The Preservation of Infant Life: a Guide for Health Visitors* (London, 1907), p. 2, also quoted in Davin, 'Imperialism and motherhood', p. 41. Some of the limitations of health visiting are discussed in J. Lewis, 'The working-class wife and mother and state intervention, 1870-1918' in J. Lewis (ed.), *Labour and Love: Women's Experience of Home and Family 1850-1940* (Oxford, 1986), pp. 99-120, here at pp. 111-2. Newsholme's second report can, nevertheless, provide useful information for researchers wishing to investigate the influence of health visiting on infant mortality.

65 A. Newsholme, *Fifty Years in Public Health* (London, 1935), p. 325.

66 Newsholme, *Fifty Years*, p. 335. Newsholme also stressed the importance of intimate personal hygiene (p. 326).

67 Newsholme, *Fifty Years*, p. 372.

68 Newsholme, *Fifty Years*, p. 372. Newsholme also noted that poor mothers were more likely to breastfeed, but in some cases this was not sufficient to overcome a poor environment.

69 R.I. Woods, P.A. Watterson and J.H. Woodward, 'The causes of rapid infant mortality decline in England and Wales, 1861-192, part 2', *Population Studies* 43 (1989), pp. 113-32, here at p. 114, https://doi.org/10.1080/0032472031000143876 provides a similar exercise based on the work of Arthur Newsholme.

Table 2 **Factors influencing infant mortality during the early twentieth century, based on those identified by George Newman and Arthur Newsholme**

Mother		Infant	Environment	
Ante-natal	Natal		Home	Wider
Age	Delivery	Feeding type:	Poverty	Water quality
Health	Midwifery (quality)	1. breastfeeding	Housing	Sewage removal
Family size	Maternal mortality	2. artificial	Women's work	Household waste removal
Illegitimacy	Multiple births	Health visiting	Hygiene	Scavenging
Women's work	Medical advances	Infant care		Paving
Alcoholism		Medical advances		Milk supply
Personal hygiene				Climate
Maternal health				Disease environment

Sources: G. Newman, *Infant Mortality, a Social Problem* (London, 1906); A. Newsholme, *Supplement to the Thirty-Ninth Annual Report of the Local Government Board 1909-10 Containing a Report by the Medical Officer on Infant and Child Mortality* (London, 1910); A. Newsholme, *Supplement to the Forty-Second Annual Report of the Local Government Board 1912-13 Containing a Second Report by the Medical Officer on Infant and Child Mortality* (London, 1913); A. Newsholme, *Supplement to the Forty-Third Annual Report of the Local Government Board 1913-14 Containing a Third Report by the Medical Officer on Infant and Child Mortality Dealing with Infant Mortality in Lancashire* (London, 1914); A. Newsholme, *Supplement to the Forty-Fourth Annual Report of the Local Government Board Containing a Report on Maternal Mortality in Connection with Childbearing and its Relation to Infant Mortality* (London, 1915); A. Newsholme, *Supplement to the Forty-Fifth Annual Report of the Local Government Board Containing a Report on Child Mortality at Ages 0-5, in England and Wales* (London, 1916).

the care of her infants, there is less chance of infants being exposed to a range of pathogens, and hence higher parity births suffered higher IMRs.[70] A broad factor, maternal health, has also been added to the list. Whilst this was alluded to by both Newman and Newsholme it was not stated explicitly. However, a mother's childbearing history had, and continues to have, a profound influence on her future infant's life chances, as does her health status. As we have seen, the quality of care

70 See the discussion in Woods *et al.*, 'The causes of rapid infant mortality decline', pp. 121-6.

given at confinement is crucial both to the mother and her infant's survival and future health. Not mentioned by either Newman or Newsholme, multiple births were more dangerous for the mother, with stillbirth rates and IMRs being higher for multiple births than for singletons. With respect to the infant, the most important influence on its survival was how it was fed and cared for, with the advice given to the mother, both informally and by municipal health visitors, being crucial.[71] During the twentieth century medical advances such as mass vaccination programmes, isolation and the widespread use of antibiotics also brought distinct benefits both to infants and their mothers.[72]

The environmental threats faced by individual infants varied considerably, with rural/urban differences being significant. Those that affected the home include the physical state of the house and the level of household poverty, with the two being inextricably linked, although levels of cleanliness within the home were also very important. As to the wider environment, both Newman and (especially) Newsholme stressed the importance of general levels of sanitation, particularly with respect to waste disposal (both human and household). The quality of both the water and milk supplies was also important and the responsibility for improving the wider environment lay with public authorities. We might also add that the disease environment was an important influence, with epidemics—especially of the common diseases of childhood but also 'summer diarrhoea'—being more commonly encountered in densely populated places.

Newman and Newsholme shared many characteristics. They were both middle-class and hardworking, and their deep religious convictions influenced their decisions to devote their lives to public service. Both were married but, perhaps surprisingly for individuals who devoted much of their working lives to improving child health, neither had children. They also had a complicated relationship since they became bitter rivals over whether the LGB or the Ministry of Education should assume responsibility for child welfare work.[73] They were, nevertheless, largely in agreement about the causes of infant mortality and the necessary course of action needed to bring about decline even though they differed about how this process should be administered. They believed that infant mortality decline was a multi-layered process and that improvements in all of the inter-linked factors identified in Table 2 had

71 For a discussion of the work undertaken by female health visitors see F.J. Greenwood, 'Women as sanitary inspectors and health visitors' in E.J. Morley (ed.) *Women Workers in Seven Professions* (London, 1914), pp. 221-34.

72 For example, much of the steep decline in maternal mortality that occurred between 1935 and 1950 was due to the increasing use of antibiotics, first the sulphonamides and then after 1945 penicillin: see I. Loudon, *Death in Childbirth: an International Study of Maternal Care and Maternal Mortality 1800-1950* (Oxford, 1992), pp. 254-62.

73 Eyler, *Sir Arthur Newsholme*, pp. 320-36. At one point, Newman wrote in his diary that Newsholme was 'weak, vacillating, incompetent, untrustworthy & vain' (29 Oct 1918), quoted on p. 335. Unfortunately, we do not have Newsholme's diary, if he kept one, to give us an alternative view of this relationship.

taken place by the 1930s. The frameworks they developed to understand the problem still remain relevant however and they can be used as a means by which the causes of the secular decline in infant mortality during the twentieth century can be investigated further.

Understanding infant mortality during the second half of the twentieth century

In 1950 the infant mortality rate (IMR) was 30 per 1,000 live births, a fifth of what it had been in 1901, and neonatal mortality was twice that of post-neonatal mortality, the reverse of the situation in 1901. The decline in post-neonatal mortality had been achieved mainly due to the increasing control of infectious diseases and better, more hygienic, infant feeding and care practices.[74] Thus by the late 1950s most infant mortality was 'due to conditions present before or during birth, such as malformations, birth injury and immaturity' and this 'hard core' of mortality became increasingly difficult to reduce further.[75] Compared with the Registrar General's annual reports in the first decades of the twentieth century, those from the 1950s onwards (now called 'statistical reviews') tended to avoid any proselytising about the measures needed to reduce infant mortality; instead they merely provided detailed data on patterns and causes of death. They also devoted less space to the problem, in part because infants were responsible for a much lower proportion of all deaths. For example, the Registrar General's *Statistical Review for 1958* provides tables on historical trends from 1841, stillbirth rates, infant deaths by age and legitimacy, IMRs for certain urban and rural districts and by cause.[76] Alongside these tables the commentary devotes only 4 pages to infant mortality but a further 14 to tables giving detailed cause of death data and showing change over time.[77] As a means of providing a framework in which to examine change over time the statistical reviews do provide raw data, but they give little information about the practical measures needed to bring about further change.[78]

Instead, a better way to do this is to examine studies, such as the one undertaken by Morris, Heady and their colleagues on *c.*80,000 stillbirths and infant deaths in England and Wales during 1949 and 1950, which they describe as an 'epidemiological

74 Morris and Heady, 'Social and biological factors in infant mortality: I', p. 343; Heady and Morris, 'Social and biological factors in infant mortality: VII', p. 589.

75 Registrar General, *Registrar General's Statistical Review of England and Wales for the Year 1958, Part III Commentary* (London, 1960), pp. 59-60. The fact that the causes of many early infant deaths were still poorly understood hampered attempts to reduce rates.

76 Registrar General, *Registrar General's Statistical Review of England and Wales for the Year 1958, Part I Tables, Medical* (London, 1960), pp. 4-5, 267-79, 325-9.

77 Registrar General, *Registrar General's Statistical Review of England and Wales for the Year 1958, Part III*, pp. 58-61, 85-98.

78 By the end of the century Office for National Statistics publications had become simply the means by which the relevant statistics were disseminated.

Table 3 **Infant mortality rates by mother's age and parity: England and Wales, 1949**

Mother's parity	Mother's age (years)						
	16-19	20-24	25-29	30-34	35-39	40-44	All ages
1	37.0	24.3	22.8	26.9	35.0	45.1	26.0
2	51.5	31.8	21.4	19.3	23.2	30.3	24.3
3		44.9	30.7	24.0	25.8	31.1	29.8
4		59.7	35.4	28.7	30.1	34.1	33.6
5		84.1	41.2	35.9	34.7	30.8	37.2
6			47.3	38.1	35.2	38.8	39.5
7			74.9	43.0	38.7	42.0	44.6
8				47.9	45.1	49.4	47.0
9					31.0	66.7	48.4
10+					49.4	55.4	54.6
All mothers	38.8	28.3	24.9	24.9	29.6	37.8	27.5

Source: J.A. Heady, C. Daly and J.N. Morris, 'Social and biological factors in infant mortality: II. Variation of mortality with mother's age and parity', *The Lancet* 265 (6,860) (1955), pp. 395-7, here at p. 396, https://doi.org./10.1016/S0140-6736(55)91290-3.

exercise in the vital statistics of infant mortality'.[79] This study sought to identify those vulnerable mothers thought to be at highest risk of losing their infants. By establishing the range of mortality rates throughout the country it argued that the lowest rates 'will indicate a goal which can be achieved in the present state of medical knowledge' and that preventive measures could then be taken to achieve this goal.[80] Set against a background of generally declining rates, the first set of factors that was investigated related to mother's age and parity (the number of live births to the mother), (Table 3). As can be seen, mortality rates increased both with respect to the

79 Morris and Heady, 'Social and biological factors in infant mortality: I', p. 345.

80 Morris and Heady, 'Social and biological factors in infant mortality: I', p. 349. They also argued that the levels of mortality they discovered were just the 'tip of the iceberg of morbidity'.

age of the mother and to the size of her family.[81] Thus, the first births of mothers aged between 40 and 44 years were twice as likely to die as those from mothers aged 25 to 29 years. Likewise, the sixth-born infant of a mother aged 25 to 29 was more than twice as likely to die than the first born. The main exception to these patterns occurred with births to young mothers who experienced very high IMRs and, within this age group, rates at higher parities increased significantly. When the data in Table 3 were broken down into stillbirths, neonatal and post-neonatal mortality the age and parity effects were still apparent, although in a less exaggerated form.[82] However, two major differences appear. Stillbirth rates amongst very young mothers were comparable to those of mothers aged 20 to 30 years and the greatest parity effects occurred within post-neonatal mortality. Thus, two sets of vulnerable mothers could be identified: older ones, who also experienced particularly high stillbirth rates, and young ones, especially those with large families. Morris, Heady and their colleagues concluded that, while biological processes were certainly important, the greater differences within post-neonatal mortality suggested that social factors, in particular the care that was able to be given to the infants, must have played a large role in determining whether some infants survived. They also gave three possible reasons to explain these patterns, 'the increased opportunity for infection in a large family …, other economic consequences of a large family at most levels of income and the ability to "cope" of young mothers, particularly those in adverse circumstances'.[83]

Morris, Heady and their colleagues then went on to examine the influence of social class on infant mortality.[84] Taking account of the fact that, in general, higher-class mothers were older and tended to have smaller families, a distinct social class gradient in mortality was nevertheless observed (Table 4). After the rates had been standardised to take into account age and parity, the unskilled (classified according to father's occupation) experienced mortality rates nearly 1.9 times higher than the professional classes. This gradient was virtually identical for stillbirths, slightly lower for neonatal mortality and over 2.9 times higher for post-neonatal mortality—those deaths thought to be most readily addressed through direct action. This gradient was consistent and evident within all classes. The study also considered change over time and discovered that there had been a 'remarkable similarity of the decline among various social groups', but, '[t]here had been no narrowing of the social gap in infant mortality; if anything it may have widened slightly'.[85] This was despite the post-war boom which led to full employment, higher real wages and an expansion in social services. Morris, Heady and their colleagues were somewhat at a

81 The small number of births within some of the categories, especially those at higher parities, means that these relationships are not perfect. They are however strong enough to identify those mothers at greatest risk of having an infant death.

82 Daly *et al.*, 'Social and biological factors in infant mortality: III', p. 396.

83 Daly *et al.*, 'Social and biological factors in infant mortality: III', p. 397.

84 See R.M. Titmuss, *Birth, Poverty and Wealth: a Study of Infant Mortality* (London, 1943), pp. 22-35 for a discussion of social class variations during the first half of the century.

85 Morris and Heady, 'Social and biological factors in infant mortality: V', p. 556.

Table 4 **Stillbirth and infant mortality rates by social class of the father: England and Wales, 1949**

Class	Description	Stillbirth rate	Infant mortality rate		
			Neonatal	Post-neonatal	Total
I	Professional	14.3	13.3	5.4	18.7
II	Intermediate	18.9	14.1	6.7	20.8
III	Skilled	21.5	16.1	10.7	26.8
IV	Partly Skilled	23.2	18.2	13.3	31.5
V	Unskilled	26.0	19.0	15.8	34.8
All		21.5	16.4	11.1	27.5
Ratio class V to class I		1.82	1.43	2.93	1.86

Note: The rates have been standardised to take into account mother's age and parity. Only single, legitimate births in 1949 were used.

Source: C. Daly, J.A. Heady and J.N. Morris, 'Social and biological factors in infant mortality: III. The effects of mother's age and parity on social-class differences in infant mortality', *The Lancet* 265 (6,861), pp. 445-8, here at p. 446, https://doi.org/10.1016/S0140-6736(55)90229-4.

loss to provide persuasive reasons as to why this was the case and concluded that '[t]he reasons for the persisting social differences in mortality are in fact imperfectly understood'.[86] They did however suggest that a time-lag may be occurring with respect to how best practice was being adopted by some mothers:

> There may be a lag also in the knowledge of, use by, or availability to, families in social classes IV and V of new scientific advances, of services, and of facilities, compared with classes I and II. The better educated, that is to say, may have benefitted more from recent medical progress than others. The disappointing take-up of 'welfare vitamins' may be recalled here. The period being studied, 1911-50, saw the great expansion of personal preventive medical services. But in 1946 it was found that ante-

86 Morris and Heady, 'Social and biological factors in infant mortality: V', p. 559.

> natal services were used mainly by the 'middle classes'. A further survey in 1953 confirmed this observation, and showed that the greatest improvement since 1946 had been among the wives of skilled manual workers, not those in classes IV and V. This may be an example of 'cultural lag' of family traditions (the influence of grandmother?) which might be counteracting the benefits of community provision.[87]

This resistance to change would therefore have counteracted some of the medical and social advances. Moreover, Morris, Heady and their colleagues also argued that some vulnerable groups appeared to be more reluctant to use ante-natal services and they sought medical help later than others who were more enthusiastic users of the various services on offer. They concluded that it was important 'for the medical services to pay attention to these young mothers and to try to reduce the differential mortality within social classes as well as between them'.[88]

Morris, Heady and their colleagues also considered differences in outcomes between the 40 per cent of mothers who gave birth at home and those who gave birth in institutions (hospitals or nursing homes). Many high-risk confinements occurred in hospital and therefore hospital mortality rates were higher than those that occurred elsewhere; however, four groups of high-risk mothers were identified who would have benefited from giving birth in hospital: mothers aged over 35 years having a first confinement, all mothers aged over 40, mothers who had previously lost an infant, and mothers having multiple births.[89] With many mothers having safe deliveries at home, teasing out the benefits of a hospital over a home confinement proved difficult to achieve. Whilst Morris, Heady and their colleagues aimed to identify vulnerable mothers so that inequalities could be addressed and potentially eradicated, compared with the work of the early twentieth century pioneers in child welfare, their study made little attempt to discuss the environmental influences on infant health. In part this was because the scope of their study was epidemiological in nature and the relevant data that would have made it possible to examine environmental effects were not collected. Some discussion of regional variations occurred, but the areal units considered were large and the analyses superficial.[90] While significant environmental improvements had occurred by the 1950s, large

87 Morris and Heady, 'Social and biological factors in infant mortality: V', p. 558.

88 Morrison *et al.*, 'Social and biological factors in infant mortality: VIII', p. 113. See also the discussion on pp. 109-13 which quotes from J.W.B. Douglas and J.M. Bloomfield, *Children Under Five* (London, 1958).

89 Heady and Morris, 'Social and biological factors in infant mortality: VI', p. 103. These four groups were responsible for about 15 per cent of all births. For a critical account of the benefits of hospital deliveries for normal confinements, see M. Tew, *Safer Childbirth. A Critical History of Maternity Care*, 3rd edn. (London, 1998).

90 Daly *et al.*, 'Social and biological factors in infant mortality: III', p. 447; Heady *et al.*, 'Social and biological factors in infant mortality: IV', pp. 500-1; Heady and Morris, 'Social and biological factors in infant mortality: VI', p. 98.

areas of slum housing with poor access to resources still existed (Figure 5). Thus by the 1950s many of the factors identified by Newman and Newsholme were still influential in accounting for the patterns of infant mortality, despite the apparent lack of any interest in 'sanitary improvement'. A striking difference in tone is also evident in the work of Morris, Heady and their colleagues compared with previous studies—there is a complete absence of any inference of blame. Instead, their primary aim was to identify those mothers at greatest risk and then target them for special attention. In this way it was thought that IMRs would continue to be reduced and inequalities diminished.

The means by which further improvements in infant mortality could be achieved lay in the more directed use of pre-war methods backed up by the various medical advances that were then taking place. Writing in 1960 George McCleary, a major public health administrator and MOH for Battersea and then Hampstead, argued that infant mortality decline was brought about by 'the modern agencies of the maternity and child welfare movement' and included the notification of births, state registration of midwives, maternity and child welfare centres, ante-natal clinics and trained health visitors.[91] He also suggested that further decline could be brought about by more efficient, better coordinated use of these services together with the encouragement of family planning. This appears to have happened, as IMRs steadily declined during the second half of the twentieth century, even though the social gradient in infant mortality identified in Table 4 still persisted. Shaw and her colleagues' wide-ranging analysis of health conditions in the 'best' and 'worst' parliamentary constituencies during the 1990s discovered considerable social differences between these two sets of constituencies, with IMRs being about twice as high in the 'worst' than in the 'best' constituencies.[92] Similar differentials were reported in virtually all studies and official publications that appeared during the second half of the twentieth century.[93] Even as late as 2000, the report into childhood, infant and perinatal mortality for that year published by the Office for National Statistics, which gave detailed data on cause of death, age of mother, birth weight, class (based on father's occupation), mother's country of birth and various

91 G.F. McCleary, 'Reducing infant mortality', in G.F. McCleary, *On Detective Fiction and Other Things Including Pickwick, Cambridge, Infant Mortality, Slums, Stevenson, Motherhood and Incentives* (London, 1960), p. 95. McCleary's most important publications on infant welfare were G.F. McCleary, *Infantile Mortality and Infants Milk Depots* (London, 1905); G.F. McCleary, *The Early History of the Infant Welfare Movement* (London, 1933) and G.F. McCleary, *The Maternity and Child Welfare Movement* (London, 1935). See *British Medical Journal* 1 (5,272) (1962), p. 193, https://doi.org/10.1136/bmj.1.5272.193 for an obituary.

92 M. Shaw, D. Dorling, D. Gordon and G. Davey Smith, *The Widening Gap: Health Inequalities and Policies in Britain* (Bristol, 1999), pp. 18-9. The gap between 'best' and 'worst' had also increased during the 1990s, see pp. 161-2. For health inequalities more generally, see E.R. Pamuk, 'Social class inequality in mortality from 1921 to 1972 in England and Wales', *Population Studies* 39 (1985), pp. 17-31, https://doi.org/10.1080/0032472031000141256.

93 Butler and Bonham, *Perinatal Mortality*, p. 25 being one of many examples.

Figure 5 **Back-to-back housing: Courts 1 and 2, Park View Road, Hillsborough, Sheffield, March 1959**

Note: The houses comprised a ground floor room, a bedroom together with an attic and cellar. Some also had a small kitchen annexe. The photograph was taken from the roof of the outside toilets in court 3. The author was born in house 2, court 3.

Source: © PictureSheffield.

combinations thereof, identified a similar pattern.[94] Table 5 gives IMRs and stillbirth rates by father's social class in 2000. The social class gradient is apparent in both sets of figures with Class V (unskilled) infants suffering IMRs 2.2 times higher than class I (professional) infants. The stillbirth gradient was slightly lower (1.9 times higher) and amongst unmarried couples who registered their infants jointly the differentials were virtually the same: 2.2 and 2.0 respectively. According to Shaw and her colleagues, the key factor in explaining these differences was poverty, '[t]he key policy that will reduce inequalities in health is the alleviation of poverty through the reduction of inequalities in income and wealth'.[95] While the exact way in which poverty influences infant mortality and a host of other health conditions remains complicated and difficult to address, this basic conclusion has not been challenged.[96]

Following the introduction of the National Health Service in 1948, a range of high quality services has been available free to all and, while success has been achieved in terms of significantly reducing mortality rates within all sections of the population, inequalities have not been eliminated. According to Nick Freemantle and his colleagues, 'it is well established that determinants of infant mortality outside health services have a more profound effect than the provision of health care per se'.[97] Alongside more general health inequalities, the 2000 report into childhood, infant and perinatal mortality identified certain groups of women who were subject to much higher risks. Table 6 shows infant mortality and stillbirth rates according to mother's country of birth. The differences here are striking, with some mothers born in the New Commonwealth, particularly in Pakistan and the Caribbean, suffering rates over two times those of European-born mothers. Moreover, the differences between what may appear at first sight to be similar ethnic groups, such as those mothers born in Pakistan and Bangladesh, suggest that these inequalities are multi-causal.[98] Likewise, it is interesting that mothers born in the far east experienced some of the best rates of any group. The 2000 report did not give IMRs by mothers'

94 Office of National Statistics, *Review of the Registrar General on Deaths in England and Wales, 2000, Childhood, Infant and Perinatal Mortality Statistics,* Series DH3 no. 33 (London, 2002).

95 Shaw *et al.*, *Widening Gap*, p. 169.

96 For an extensive discussion of contemporary health inequalities, see M. Marmot, *The Health Gap: the Challenge of an Unequal World* (London, 2015).

97 N. Freemantle, J. Wood, C. Griffin, P. Gill, M.J. Calvert, A. Shankar, J. Chambers and C. MacArthur, 'What factors predict differences in infant and perinatal mortality in primary care trusts in England? A prognostic model', *British Medical Journal* 339 (7,717) (2009), b2892, https://doi.org/10.1136/bmj.b2892, which references M. Marmot, S. Friel, R. Bell, T.A.J. Houweling and S. Taylor, 'Closing the gap in a generation: health equity through action on the social determinants of health', *The Lancet* 372 (9,650), pp. 1,661-9, https://doi.org/10.1016/S0140-6736(08)61690-6.

98 Many studies have considered this issue, see for example A.C. Bakeo, 'Investigating variations in infant mortality in England and Wales by mother's country of birth, 1983–2001', *Pediatric and Perinatal Epidemiology* 20 (2006), pp. 127-39, https://doi.org/10.1111/j.1365-3016.2006.00708.x; N. Small, 'Infant mortality and migrant health in babies of Pakistani origin born in Bradford, UK', *Journal of Intercultural Studies* 33 (2012), pp. 549-64, https://doi.org/10.1080/07256868.2012.701610.

Table 5 Infant mortality and stillbirth rates by social class: England and Wales, 2000

	Social class	Infant mortality rate	Stillbirth rate
Inside marriage	I	3.7	4.3
	II	3.6	3.7
	IIIN	5.4	5.1
	IIIM	5.0	5.0
	IV	5.9	5.6
	V	8.0	8.3
	Other	7.7	6.4
	All	4.8	4.8
Outside marriage	I	3.5	3.4
	II	4.4	4.1
	IIIN	6.2	5.5
	IIIM	5.7	5.2
	IV	6.4	5.4
	V	7.8	6.9
	Other	16.8	8.3
	All	6.4	5.3

Note: A 10 per cent sample was coded for social class using the father's occupation. Only those births outside of marriage jointly registered by the mother and father were used for comparative purposes. Social classes were defined as follows: I professional; II managerial and technical occupations; IIIN non-manual skilled occupations; IIIM manual skilled occupations; IV partly skilled occupations; V unskilled occupations; Other All residual groups.

Source: Office of National Statistics, *Review of the Registrar General on Deaths in England and Wales, 2000, Childhood, Infant and Perinatal Mortality Statistics,* Series DH3 no. 33 (London, 2002), p. 61. The social classes are defined on p. xxiv.

Table 6 **Infant mortality and stillbirth rates by selected mother's country of birth: England and Wales, 2000**

Country of birth	Infant mortality rate	Stillbirth rate
All	5.5	5.3
United Kingdom	5.3	4.9
Irish Republic	5.4	4.9
Other European Union	3.8	7.2
Canada, Australia, New Zealand	4.7	4.1
New Commonwealth	8.2	7.9
India	6.5	6.7
Pakistan	12.2	9.4
Bangladesh	4.7	6.9
Caribbean	10.4	8.5
Far East	3.9	3.9

Source: Office of National Statistics, *Review of the Registrar General on Deaths in England and Wales, 2000, Childhood, Infant and Perinatal Mortality Statistics,* Series DH3 no. 33 (London, 2002), p. 82.

ethnicity and Table 5 therefore only provides information about first generation migrants who, perhaps in general terms, were more likely to have been poorer than the rest of the population and perhaps less likely to use the full range of health services on offer. Tables 5 and 6 show that a range of inequalities in infant mortality persisted throughout the twentieth century; indeed, they are still evident today and the challenge remains as to whether they can be addressed successfully. According to the latest UK Government health profile for England, '[h]ealth inequalities are avoidable and unfair differences in health status between groups of people or communities'.[99] Some progress was made towards reducing health inequalities by the last Labour government (1997-2010) and a commitment was made to eliminate them by 2020, but with the advent of austerity post-2010, progress has stalled.[100] It is only through concerted government action that health inequalities will be reduced.

99 Public Health England, *Health Profile for England: 2018*, Chapter 5 [2018] https://www.gov.uk/government/publications/health-profile-for-england-2018/chapter-5-inequalities-in-health [accessed April 2021].

100 Shaw *et al.*, *Widening Gap*, p. 169, writing in 1999 were optimistic about the future: '[t]here is widespread public support for poverty reduction in Britain and the government has pledged

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The general paucity of individual-level data available throughout the twentieth century means that most research will have to be undertaken using official sources or studies already published, unless of course, similar sources, such as the ones unearthed by Alice Reid, can be discovered. Thus, while changes in infant mortality can be charted in some detail throughout the twentieth century, for those researchers wishing to investigate socio-economic influences it is likely that most research will be undertaken on the first half of the century because a wider range of sources are available. In particular MOH reports appear to offer much potential for further research and, with the aim of demonstrating what is possible, the following section will provide short case studies that have the potential to be more widely applied. These will examine the last major epidemic of infantile summer diarrhoea in 1911, the impact of world war on infant mortality and the effects of economic depression during the 1930s.

1911

As Figure 1 showed, the steady decline in infant mortality was interrupted in 1911 when the IMR increased by 25 deaths per 1,000 live births. This increase can be explained relatively easily since in 1911 deaths attributed to diarrhoeal causes rose more than fourfold compared with 1910, with the non-diarrhoeal IMR being 'only 2 per 1,000 in excess of that for 1910, which was the lowest then recorded'.[101] These

to eliminate childhood poverty by 2020'. T. Robinson, H. Brown, P.D. Norman, L.K. Fraser, B. Barr and C. Bambra, 'The impact of New Labour's English health inequalities strategy on geographical inequalities in infant mortality: a time-trend analysis', *Journal of Epidemiology and Community Health* 73 (2019), pp. 564–8, here at p. 564, https://doi.org/10.1136/jech-2018-211679, concluded that '[t]he English health inequalities strategy period [1999-2010] was associated with a decline in geographical inequalities in the IMR. This research adds to the evidence base suggesting that the English health inequalities strategy was at least partially effective in reducing health inequalities, and that current austerity policies may undermine these gains'. The IMRs for 2018 (Public Health England, *Health Profile for England: 2018*, Chapter 5), show that the gap between higher managerial and manual workers has not changed since 2011. Moreover, writing at a time when the use of food banks is increasing and the Covid-19 pandemic is adversely affecting disadvantaged groups within society, the prospects for eliminating inequalities in the immediate future do not look promising.

101 There were 94,962 infant and 7,109 infant diarrhoea deaths in 1910 and 114,600 infant and 31,900 infant diarrhoea deaths in 1911. In 1910 'diarrhoea' deaths appeared under the headings Diarrhoea due to Food, Infective Enteritis, Epidemic Diarhhoea and Dysentery, and in 1911 as Diarrhoea &c. For total infant deaths, see Macfarlane and Mugford, *Birth Counts*, p. 2 and, for diarrhoea deaths, Registrar General, *Seventy-Third Annual Report of the Registrar General of Births, Deaths and Marriages in England* (London, 1912), pp. 290-1; Registrar General, *Seventy-Fourth Annual Report of the Registrar General of Births, Deaths and Marriages in England* (London, 1913), pp. vii and 313. Measles also 'showed more than average mortality' in 1911. See R.

excess diarrhoea deaths were caused by the summer of 1911 being 'abnormally hot and dry',[102] the two most important factors associated with epidemics of infant diarrhoea. This climatic shock, which also occurred throughout much of Europe, overwhelmed the various preventive measures that had been responsible for reducing IMRs since 1900. Yet not everywhere was affected equally, and an analysis of infant mortality in 1911 will allow the effectiveness of early twentieth century public health provision to be examined during a period of great stress. The so-called 'perfect summer' of 1911 was one of the warmest on record and 'included the driest July over England and Wales in the last 100 years, an exceptionally sunny July and one of the warmest Augusts' with the heat and drought being especially pronounced in the Midlands and south and south-east England.[103] The summer of 1911 was also extreme in much of western, central and southern Europe and this also led to increases in infant mortality in many countries.[104] Incidentally, the cool, rainy summer of the following year, which was labelled 'calamitous', was far healthier for infants as the IMR in England and Wales fell to 95, the lowest on record at that time.[105] The climate of the British Isles is however notoriously variable and, while Kendon and Prior note that the heatwave was particularly evident in the southern parts of Britain, it was not necessarily the case that all parts of the country were affected equally.

The impact of the hot summer of 1911 can best be seen by examining its effects on a single community. In Huddersfield the IMR increased from 99 per 1,000 live births in 1910 to 132 in 1911 and, according to the town's MOH, this increase can be 'practically accounted for by the deaths from diarrhoeal diseases, which jumped from 23 in 1910 to 79 in 1911 owing to the phenomenal meteorological conditions

Dudfield, 'Diarrhoea in 1911', *Proceedings of the Royal Society of Medicine* 5 (1912), pp. 99-148 for a discussion of the causes of diarrhoea mortality, especially in Paddington. Dudfield emphasised the association between diarrhoea and artificial feeding, poor housing, climate and flies.

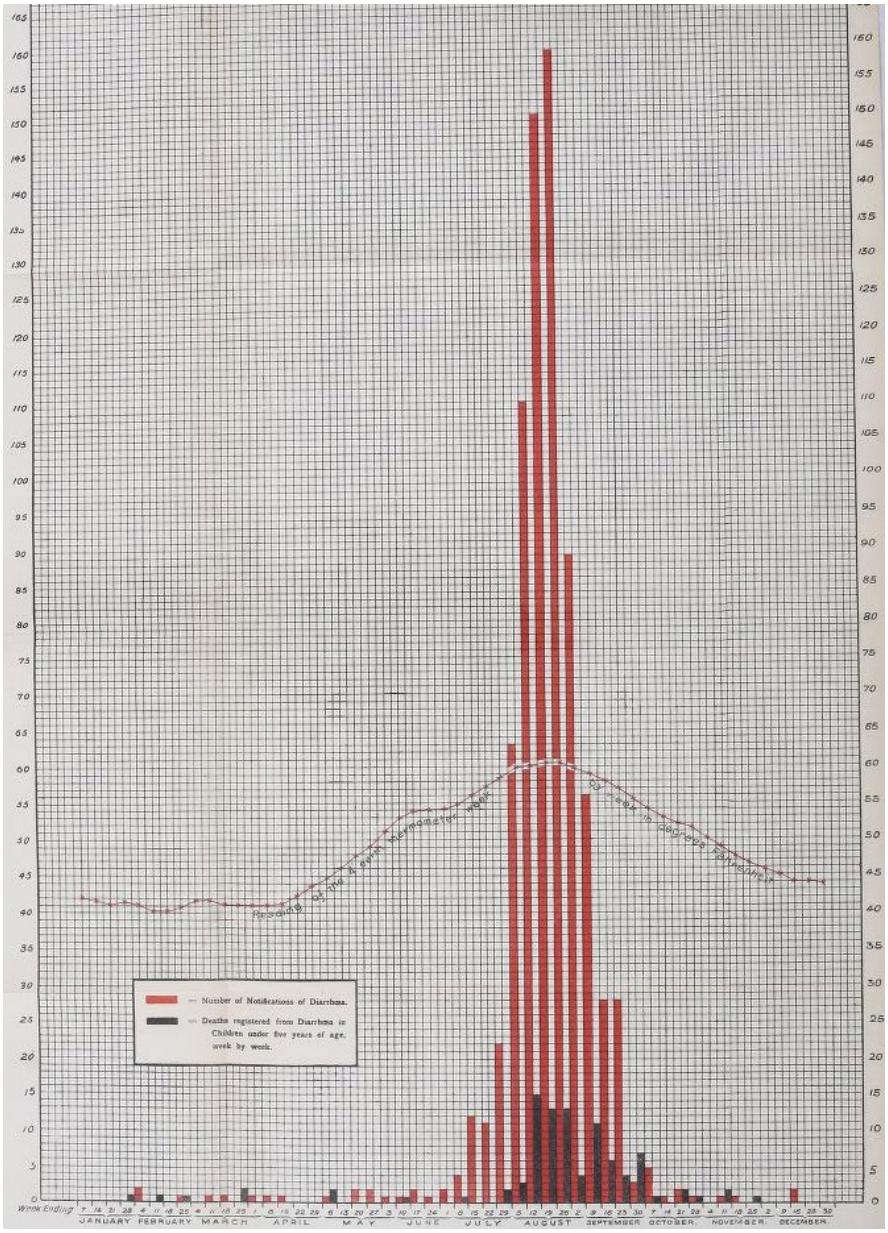
102 Registrar General, *Seventy-Fourth Annual Report*, p. xxxiii.

103 J. Nicolson, *The Perfect Summer: Dancing into Shadow in 1911* (London, 2006). This summer was clearly not 'perfect' for infants however. M. Kendon and J. Prior, 'Two remarkable summers – 'perfect' 1911 and 'calamitous' 1912', *Weather* 66 (2011), pp. 179-84, here at p. 179, https://doi.org/10.1002/wea.818.

104 C. Rollet, 'La canicule de 1911: observations démographiques et médicaleset reactions politiques', *Annales de Démographie Historique*, 120 (2010), pp. 105-20, https://doi.org/10.3917/adh.120.0105; J. Vögele, ' "Has all that has been done lately for infants failed?" 1911, infant mortality and infant welfare in early twentieth-century Germany', *Annales de Démographie Historique* 120 (2010), pp. 131-46, https://doi.org/10.3917/adh.120.0131; L. Pozzi and D.Ramiro Fariñas, 'The heat wave of 1911: a largely ignored trend reversal in the Italian and Spanish transition?', *Annales de Démographie Historique* 120 (2010), pp. 147-78, https://doi.org/10.3917/adh.120.0147; G. Masuy-Stroobant, '1911: Un été exceptionnel Belgique?', *Annales de Démographie Historique* 120 (2010), pp. 179-97, https://doi.org/10.3917/adh.120.0179.

105 Kendon and Prior, 'Two remarkable summers'.

Figure 6 Diarrhoea notifications and deaths at ages under five years: Huddersfield, 1911



Note: The red vertical bars represent diarrhoea notifications and the black bars deaths. The text on the temperature line is: Reading of the 4' thermometer week by week in degrees Fahrenheit.

Source: S.G.H. Moore, *Annual Report of the Urban Sanitary Authority of the County Borough of Huddersfield for the Year 1911* (Huddersfield, no date), after p. 16. © Wellcome Library.

which prevailed during the summer'.[106] Figure 6, taken from the MOH's annual report, gives weekly diarrhoea notifications and deaths at ages under five years and shows that, while a small number of diarrhoea cases occurred throughout the year, it was only when the temperature began to rise in July that first notifications and then deaths increased sharply. Notifications and deaths peaked at the end of August andthen decreased rapidly so that by October numbers were back to what they had been before July. At the peak of the epidemic, in the last week of August, there were 160 notifications and 13 deaths. It is unfortunate that Figure 6 does not separate infants from those aged 1-4 years, but we do know that 79 of the 94 deaths were infant ones.[107] In total there were 769 notifications (up from 206 in the previous year) and these extra 563 cases resulted in an additional 56 infant deaths.[108] With around 1,000 births occurring annually in Huddersfield, the scale of this outbreak suggests that many families must have suffered with the poorer, working class families being hardest hit.[109] The widespread nature of this epidemic suggests that the work of the infant welfare movement in Huddersfield can be considered only partially successful by 1911. Samson Moore, the town's MOH and a leading advocate of infant welfare, had attempted to distribute appropriate advice to mothers, yet he was not surprised that the adverse climatic conditions had resulted in extra deaths. Indeed, he predicted such in 1910 when he argued that infant welfare work,

> needs continually repeated sustentation, otherwise, although some of the good done will remain permanently, the phenomenal success which has apparently rewarded the special work cannot be maintained. Much of the reduction in the death rate among infants resulted from the intense widespread public interest which was due to the passing of the Notification of Births Act, and from the action of Alderman Broadbent during the first year of his Mayoralty. This interest is gradually subsiding, and it is therefore advisable that something should be done if possible to re-awaken and sustain it. The meteorological conditions during the year were favourable, and there is no room to doubt that given unfavourable meteorological conditions the rate will increase.[110]

106 S.G.H. Moore, *Annual Report of the Urban Sanitary Authority of the County Borough of Huddersfield for the Year 1911* (Huddersfield, no date), p. 14.

107 Moore, *Annual Report of the Urban Sanitary Authority of the County Borough of Huddersfield 1911*, p. 26. There were also 15 deaths aged 1 year, 4 aged 2-4 years, 1 aged 5-15, 1 aged 15-25, 12 aged 45-65 and 19 aged 65 years and over. Of the infant deaths, 5 were aged under 1 month, 19 aged 1-3 months, 24 aged 3-6 months, 17 aged 6-9 months and 10 aged 9-12 months.

108 The proportion of infant deaths per notified case remained similar in both 1910 and 1911—it was 9.0 per cent in 1910 (23/206) and 9.7 per cent in 1911 (79/769).

109 Moore, *Annual Report of the Urban Sanitary Authority of the County Borough of Huddersfield 1911*, p. 12. Many infants must have survived infection, although whether their health was impaired to such an extent that they succumbed to some other disease cannot be determined.

110 S.G.H. Moore, *Annual Report of the Urban Sanitary Authority of the County Borough of Huddersfield for the Year 1910* (Huddersfield, no date), pp. 19-20. The difficulties of disseminating advice,

Moore's prophetic words bring out the fragile nature of the progress that had been made in infant welfare, at least amongst that group of families most likely to succumb to infection. Thus, while Moore was unsuccessful with those families who suffered outbreaks of diarrhoea, and especially with the 79 infants who died from that disease, the IMR in 1911 was nevertheless lower than it had been a few years previously which suggests that many families must have benefitted from the advice that had been disseminated.[111]

The IMR in 1911 did not increase everywhere. Figure 7 shows national rates in England and Wales, Scotland and Ireland between 1906 and 1912. The pattern in each country is different: in England and Wales the increase in 1911 was dramatic, in Scotland it was only slight, whilst in Ireland the rate was lower than it was in 1910. The reasons for this could be partly climatic as the western and northern extremes of the British Isles are noted for being wetter and cooler than elsewhere.[112] Moreover both Scotland and Ireland were less urbanised than England and Wales and diarrhoea deaths were much less common in rural areas.[113] This could also be the reason why rates in Scotland and Ireland were more stable between 1906 and 1914, although other factors may have been important. For example, when Belfast is compared with Glasgow, the MOHs of both cities noted that diarrhoea deaths rose because the summer of 1911 was hot and dry. However, in Glasgow the IMR increased from 119 in 1910 to 136 in 1911, but in Belfast it fell from 143 to 128.[114] Both cities promoted policies aimed at tackling infant mortality, although the Belfast MOH explicitly stated that advice about preventing infant deaths had been distributed prior to the epidemic season, '[i]n order to prevent the spread of epidemic [d]iarrhoea very special efforts were made throughout the year, and particularly approaching the season when its advent was to be feared'.[115] Did the proactive policies of Belfast's MOH make the difference or were other factors responsible? Diarrhoea deaths in Belfast were

especially in written form, were highlighted by Moore when he noted that out of 13 untrained midwives working in Huddersfield, 6 were illiterate (p. 16). For a discussion of infant welfare work in Huddersfield see C. Parton, 'The infant welfare movement in early twentieth century Huddersfield', *Journal of Regional and Local Studies* 3 (1983), pp. 69-77; H. Marland, 'A pioneer in infant welfare: the Huddersfield scheme 1903-20', *Social History of Medicine* 6 (1993), pp. 25-50, https://doi.org/10.1093/sochis/6.1.25.

111 The IMR had been 151 in 1900, 138 in 1904, 97 in 1907, 112 in 1908 and 96 in 1909, see Moore, *Huddersfield 1911*, figure after p. 14.

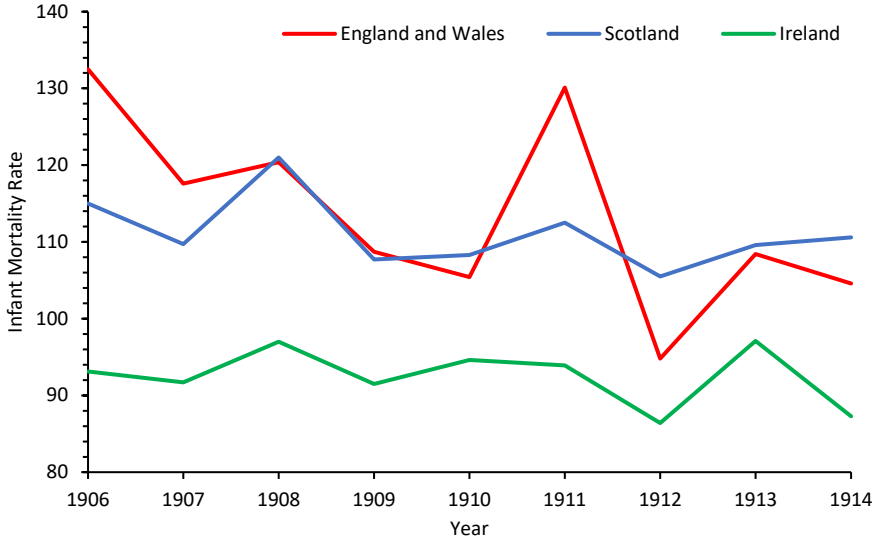
112 Long-term Irish weather data can be found at https://www.met.ie/climate/available-data/long-term-data-sets/ [accessed April 2021].

113 Galley, 'Infant mortality in England, 1538-2000: stability and the beginnings of change', p. 126 showed that some rural registration district recorded very few infant diarrhoea deaths during the 1890s.

114 H.W. Bailie, *Report of the Health of the County Borough of Belfast for the Year 1911* (Belfast, no date), p. 87; A.K. Chalmers, *Report of the Medical Officer of Health of the City of Glasgow* (Glasgow, 1912), p. 11.

115 Bailie, *Report of the Health of the County Borough of Belfast 1911*, p. 64.

Figure 7 **Infant mortality rates in England and Wales, Scotland and Ireland, 1906-1914**



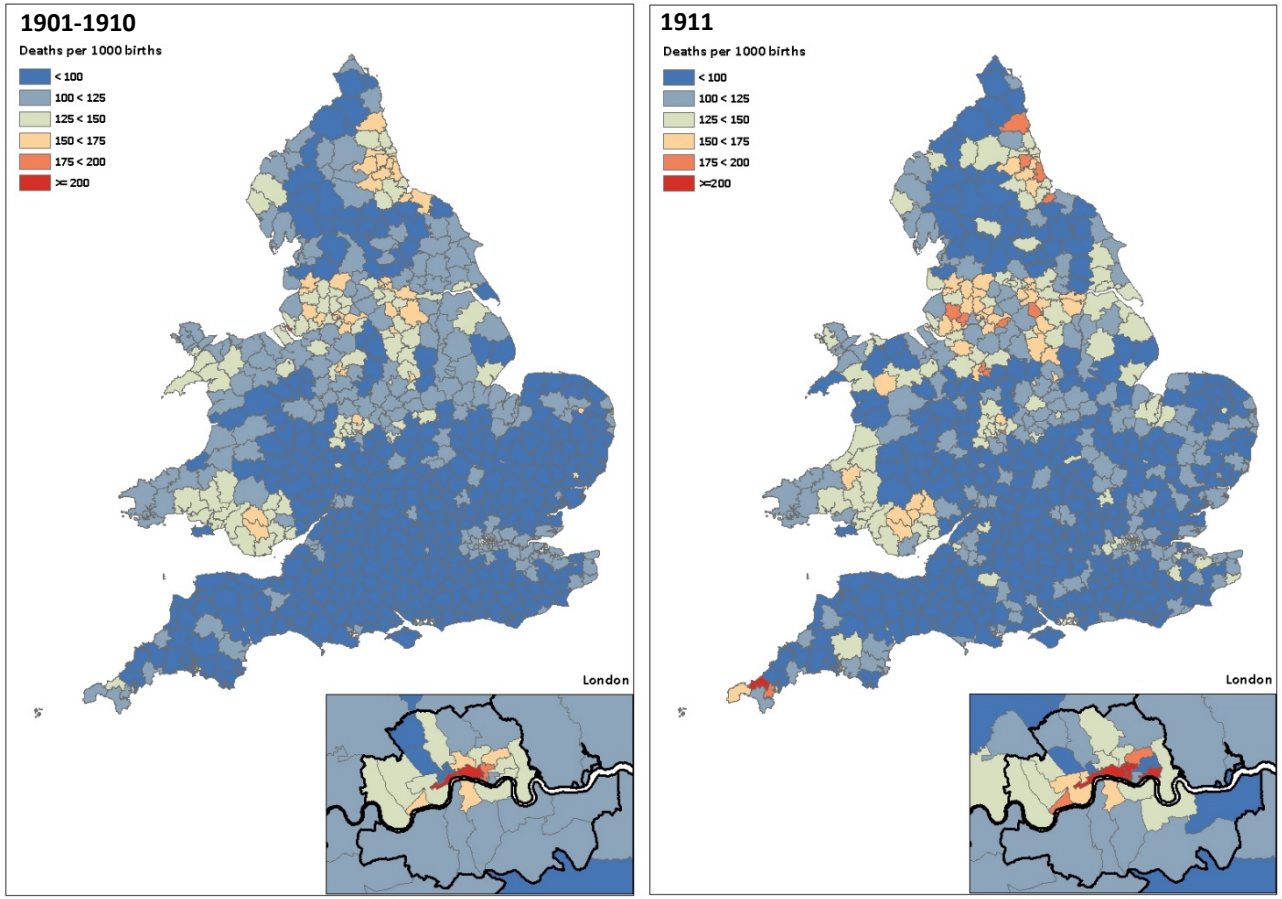
Source: A. Macfarlane and M. Mugford (eds), *Birth Counts. Statistics of Pregnancy and Childbirth,* Vol. 2 (London, 2000), pp. 2, 6.

certainly higher in 1911 than in 1910, but deaths from other causes declined.[116] Belfast had one of the highest IMRs in Britain in 1910 so there was considerable scope for improvement, although further work on both the effectiveness of the policies adopted in Belfast and more detailed climatic data will be required to resolve this apparent anomaly. 'Hot' and 'dry' are relative descriptors and the exact levels at which increases in temperature or reductions in rainfall posed additional risks for infants have yet to be determined. Likewise, was a sustained period of hot weather necessary to increase risks or did short bursts of intense heat have the same effect?[117] Such questions will only be resolved by carrying out detailed local studies. Weather data are available for many places and these could be compared with local mortality series and the various health initiatives that had been put in place. Clearly national rates can only tell part of the story and the variability identified in Figure 7 needs to be examined at a finer level of detail.

116 A strict comparison between 1910 and 1911 is not possible because enteritis deaths were given in 1910, but not in 1911. There were 348 infant diarrhoeal deaths in 1911, but only 241 total diarrhoea deaths in 1910, see Bailie, *Report of the Health of the County Borough of Belfast 1911*, pp. 29, 87-8 and the table on the following page.

117 Dudfield, 'Diarrhoea in 1911', pp. 120-9, noted the importance of flies as vectors of infection and consequently the influence of climate on diarrhoea deaths is bound up with the reproductive biology of flies.

Figure 8 **Infant mortality rates by registration district, 1901-10 compared with 1911**



Note: These RDs refer to the 614 standardised districts used in R. Woods and N. Shelton, *An Atlas of Victorian Mortality* (Liverpool, 1997), pp. 15-20. I wish to thank the authors for allowing me access to these data. The infant mortality rates in 1911 were calculated directly from the Registrar General's quarterly returns.

Source: The boundaries were created by Joe Day for the research project, *An Atlas of Victorian Fertility Decline*, see J.D. Day, *Registration Sub-District Boundaries for England and Wales 1851-1911* [2016]. This dataset was created by the 'Atlas of Victorian Fertility Decline' project (Principal Investigator: A.M. Reid) with funding from the Economic and Social Research Council (ES/L015463/1). Day's dataset has been created using A.E.M. Satchell, P.M.K. Kitson, G.H. Newton, L. Shaw-Taylor and E.A. Wrigley, *1851 England and Wales Census Parishes, Townships and Places* [2016] https://www.geog.cam.ac.uk/research /projects/occupations/datasets/documentation.html [accessed 30 November 2021]. The Satchell *et al*. dataset is an enhanced version of N. Burton, J. Westwood and P. Carter, *GIS of the Ancient Parishes of England and Wales, 1500-1850* [computer file] Colchester, England, UK Data Archive [distributor] 2004, SN 4828, which is in turn a GIS version of R.J.P. Kain and R.R. Oliver, *Historic Parishes of England and Wales: an Electronic Map of Boundaries before 1850 with a Gazetteer and Metadata*, Colchester, England, UK Data Archive [distributor] 2001, SN 4348. The original data have been deposited at the UK Data Service, University of Essex: see R. Woods, *Causes of Death in England and Wales, 1851–60 to 1891–1900: the Decennial Supplements* [computer file] Colchester, England, UK Data Archive [distributor] 1997. SN 3552, http://doc.ukdataservice.ac.uk/doc /3552/mrdoc/UKDA/UKDA_Study_3552_Information.htm. I am grateful to Eilidh Garrett for drawing these maps.

Figure 8 shows registration district (RD) IMRs in 1911 compared with the average for the decade 1901-10.[118] The pattern within each map is similar, with increases in 1911 being apparent in many districts. Central London, South Wales, the industrial heartlands of the north Midlands, Yorkshire, Lancashire and north-east England stand out as having the highest rates, with many districts being in a higher band than in the previous decade. Rates in some Cornish RDs were also much higher and a number of mainly rural districts, mostly south of a line from the Severn to The Wash, were also in a higher band in 1911. By contrast, rates were lower than they had been in the 1900s in some districts in rural North Wales, Yorkshire and the north of England. Figure 8 suggests that, with some exceptions, large parts of the country were affected by the hot dry summer of 1911 and the urban areas more so.

Figure 8 is useful in allowing comparison over time and identifying districts where further research is warranted, but it hides many local differences and may mask some changes, since these will only be apparent if a district moved into a different level. As a first step towards providing more in-depth analysis, Table 7 compares IMRs between 1910 and 1911 at the county level.[119] The IMR in England and Wales increased by 24 per cent (from 105 in 1910 to 130 in 1911), but the percentage change in different counties varied considerably. Middlesex had the greatest increase (62 per cent) and a few counties even recorded decreases. It should be noted, however, that measuring change with a percentage means that if an increase of say 25 deaths per 1,000 live births (the overall national increase) occurred uniformly across the country, then those counties with the lowest rates would experience the greatest percentage increases.[120] Thus, part of the reason why Radnorshire recorded such a large decrease was that it only recorded 29 infant deaths in 1911.[121] Notwithstanding this, Table 7 shows that the counties that recorded the highest increases tended to be south of a line from the Severn to The Wash, precisely those that suffered the most intense summer heat. Likewise, northern counties such as Northumberland, Westmorland and Cumberland, where the climate was likely to have been milder, recorded some of the lowest increases. Alongside these broad geographical patterns there are some interesting anomalies that will bear further investigation. For example, Sussex experienced only a slight increase, while neighbouring Surrey was well above the national average. Likewise, Cornwall

118 The scale used is identical to that in Figure 3 of Galley, 'Infant mortality in England, 1538-2000: stability and the beginnings of change, 1837-1910', pp. 113-6.

119 From 1911 the Registrar General changed the primary reporting units from RDs to local authority districts which were identical to those used by MOHs. In 1911 the Registrar General also began to use the International List of Causes of Death and redistributed births and deaths to place of residence, see Registrar General, *Seventy-Third Annual Report*, p. viii.

120 A uniform increase in infant mortality of 10 per 1,000 live births would result in the following percentage increases for the given IMRs: 200—5 per cent, 100—10 per cent, 75—13 per cent, 50—20 per cent.

121 Registrar General, *Seventy-Third Annual Report*, pp. 190-1. This means that there were about 13 fewer infant deaths recorded in 1911 than in 1910. There were 3,247 infant deaths recorded in Middlesex in 1911.

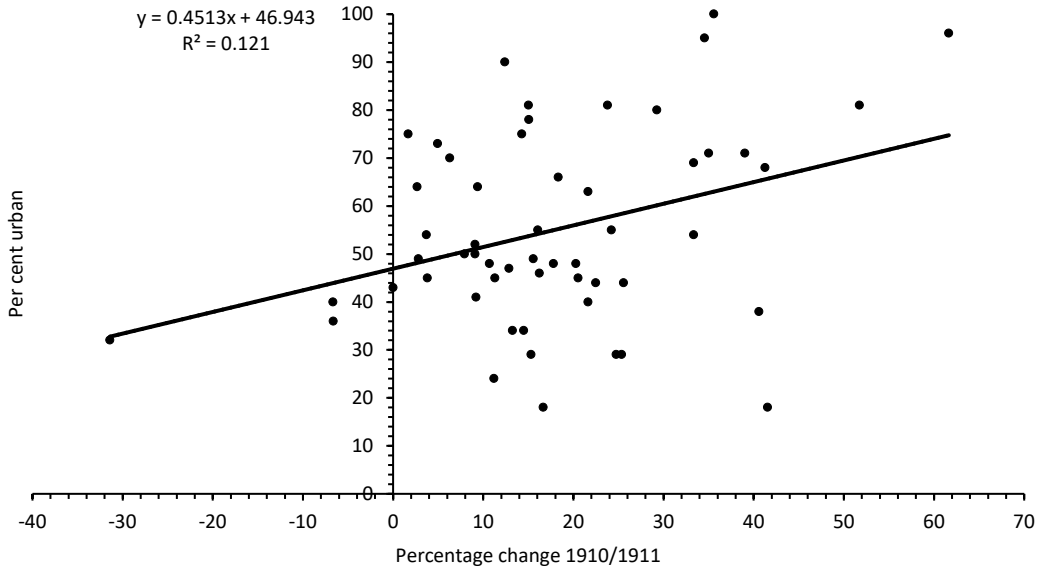
Table 7 **Percentage difference in infant mortality rates, by registration county, 1911 compared with 1910**

Greater than 20 per cent	Between 10 and 20 per cent	Less than 10 per cent	Negative difference
Middlesex (62)	Yorkshire, West Riding (18)	Worcestershire (9)	Carmarthenshire (-7)
Cornwall (52)	Somerset (18)	Westmoreland (9)	Yorkshire, East Riding (-7)
Rutland (42)	Norfolk (17)	Northamptonshire (9)	Radnorshire (-31)
Hertfordshire (41)	Suffolk (16)	Devon (9)	
Montgomeryshire (41)	Hampshire (16)	Carnarvonshire (8)	
Bedfordshire (39)	Merionethshire (16)	Cumberland (6)	
London (36)	Cardigan (15)	Nottinghamshire (5)	
Kent (35)	Glamorgan (15)	Sussex (4)	
Monmouth (35)	Staffordshire (15)	Pembrokeshire (4)	
Surrey (33)	Berkshire (14)	Leicestershire (3)	
Derbyshire (33)	Northumberland (14)	Warwickshire (3)	
Essex (29)	Gloucestershire (13)	Yorkshire, North Riding (2)	
Flintshire (26)	Lincolnshire (13)	Herefordshire (0)	
Oxfordshire (25)	Lancashire (12)		
Brecknockshire (25)	Anglesey (11)		
Cheshire (24)	Denbighshire (11)		
Durham (24)	Shropshire (11)		
England and Wales (24)			
Cambridgeshire (23)			
Buckinghamshire (22)			
Dorset (22)			
Huntingdonshire (21)			
Wiltshire (20)			

Note: Percentage change is given in brackets. In 1911 infant mortality rates were given for males and females separately and the average of the two was taken. Boundary changes affected a few counties in 1911. For example, Suffolk was divided into Suffolk, East and Suffolk, West in 1911 and an average of the two was taken to represent Suffolk.

Sources: Registrar General, *Seventy-Third Annual Report of the Registrar General of Births, Deaths and Marriages in England and Wales (1910)* (London, 1912), p. 88; Registrar General, *Seventy-Fourth Annual Report of the Registrar General of Births, Deaths and Marriages in England and Wales (1911)* (London, 1913), pp. 30-1.

Figure 9 **Percentage increase in infant mortality rates from 1910 to 1911 compared with percentage urban, registration counties in England and Wales, 1911**



Source: Registrar General, *Seventy-Third Annual Report of the Registrar General of Births, Deaths and Marriages in England and Wales (1910)* (London, 1912), p. 88; Registrar General, *Seventy-Fourth Annual Report of the Registrar General of Births, Deaths and Marriages in England and Wales (1911)* (London, 1913), pp. 30-1, 187-93.

experienced the second highest increase (52 per cent) which compared with only a 9 per cent increase in Devon. Climatic variations are unlikely to account for such differences, but Surrey and Cornwall were respectively more urbanised than Sussex and Devon and consequently greater percentages of infant deaths were recorded in the urban parts of Surrey (69) and Cornwall (81) than in the urban parts of Sussex (54) and Devon (52).[122] Figure 9 compares percentage change in IMRs between 1910 and 1911 with the percentage of the county that is urban. There is a broad correlation between these variables with the greatest percentage increases tending to be associated with higher levels of urbanisation. The relationship is far from perfect, although not unexpected; indeed, when the Registrar General compared urban and rural diarrhoeal IMRs he found that rates were almost twice as high in the major towns than in rural areas (45.9 per 1,000 live births compared to 23.7).[123] Figures 6-9 and Table 7 therefore show that the diarrhoea epidemic caused by the summer of

122 Registrar General, *Seventy-Third Annual Report*, pp. 188, 191.
123 Registrar General, *Seventy-Third Annual Report*, pp. 65, 69.

Figure 10 Infant mortality rates in Lancashire towns, 1910 and 1911

Name of Town.	1910.	1911.
BURNLEY	**168**	**210**
Ashton-under-Lyne	147	193
Wigan	131	193
Blackburn	136	187
Middleton	100	181
Accrington	109	180
Preston	158	173
Stalybridge	165	172
Stockport	136	172
Chorley	133	171
Bury	125	166
Bolton	116	161
Oldham	127	159
St. Helens	122	158
Liverpool	139	154
Salford	130	154
Widnes	122	153
Darwen	124	153
Swinton and Pendlebury	165	150
Hindley	122	146
Bootle	127	145
Colne	149	144
Rochdale	103	140
Birkenhead	135	135
Rawtenstall	97	129
Blackpool	111	127
Southport	102	118
Eccles	120	115
Waterloo-with-Seaforth	75	113
Bacup	102	111
Barrow-in-Furness	119	110
Lancaster	139	100
Nelson	113	77

Source: T. Holt, *Report on the Public Health and Sanitary Administration for the Year 1911* (Burnley, no date), p. 19**.**

1911 affected nearly the whole country and that climate and urbanisation were important in determining overall levels of mortality. Other more local factors, most notably levels of sanitation within individual places, coupled with the ability of local authorities to mitigate the threat posed by these exceptional circumstances were also crucial in explaining some of the differences identified above.

In order to examine local diversity in greater detail it is appropriate to focus on a single county. Figure 10, taken from Burnley's 1911 MOH report, compares IMRs in Burnley with other Lancashire towns. In 1911 the IMR in Burnley was 210 per 1,000 live births making it one of the highest in the country and 25 per cent higher than it had been in 1910. Such rates were common in industrial towns at the turn of the century, although in Burnley the IMR had been as high as 273 in 1899 which means that some decline had occurred in the first decade of the twentieth century. There had been spikes in 1904 (232) and 1906 (212), both years with hot summers, and even in 1908 the rate was still 201, well above most other industrial towns.[124] Thus, high infant mortality seems to have been endemic in Burnley and the hot summer merely exacerbated what was already a serious problem. Three female health visitors were working in 1911 and nearly 9,000 visits were made in respect of infant welfare, yet their impact can only have been marginal.[125] Even in the workhouse, where presumably the medical authorities had some influence, 14 of the 19 infants who were born there in 1911 died, which implies a staggering IMR of 737.[126] The MOH was clear as to the cause of Burnley's high IMR—201 of the 520 infant deaths in 1911 were caused by diarrhoea and, at the time of their death, 188 of these 201 infants were being fed artificially.[127] Further inquiries by the health visitors into the deaths of infants born in 1910 and 1911 revealed a high prevalence of artificial feeding: only 22 per cent of these infants were breastfed, 33 per cent were fed artificially, 31 per cent were fed a mixture of breast milk and artificial food and the

124 T. Holt, *Report on the Public Health and Sanitary Administration for the Year 1911* (Burnley, no date), p. 21. The illegitimate IMR in 1911 was 323 (p. 17).

125 Holt, *Report on Public Health 1911*, p. 63: '[t]he routine of visiting infants consists of a visit as soon after birth as possible, except in those cases where a medical man has been in attendance, when a visit is usually paid about the end of ten days. Re-visits are paid where necessary, and a second routine visit is paid at the end of six months. In addition to these routine visits, special visits are paid when illness is known or thought to exist and is not being attended by a doctor'. A total of 10,269 visits were made by the 3 women (including some to school children and workshops) which, assuming a 6 day week and no holidays, means that each visitor must have carried out about 11 visits per day. Along with travelling time, visits when the mothers were out and time needed for training and record keeping this suggests that each visit must have been relatively short. In an analyis of causes of death the MOH considered that 337 out the 520 infant deaths were preventible (65 per cent) (p. 18). The MOH for Blackburn had stressed the importance of re-visiting since in many instances he noted that the advice given had been ignored, see A. Greenwood, *Annual Report upon the Health of Blackburn for the Year 1908* (Blackburn, 1909), p. 35.

126 Holt, *Report on Public Health 1911*, p. 26.

127 Holt, *Report on Public Health 1911*, p. 18. Only 99 infants had died from diarrhoea in 1910 (p. 21).

method of feeding of the other 14 per cent was 'not stated'.[128] Overall, at least 64 per cent of the infants who died had received some form of artificial food. The MOH also noted a high prevalence of mothers working in factories and while he provided some evidence as to the extent of this practice, it is difficult to assess the precise effect it had on levels of infant mortality, even though the MOH clearly thought that it was important.[129] Social class differences were also in evidence in Burnley, with the IMR amongst those infants born in back-to-back houses being 318 compared to only 45 among those, presumably middle-class, infants who were not given a health visit.[130] Burnley therefore appears to have had culture of high infant mortality and high levels of artificial feeding that stretched back well into the nineteenth century and, while the MOH had made some attempts to deal with this problem, by 1911 they had been largely unsuccessful.

While many of the towns that feature in Figure 10 may appear to share similar characteristics to Burnley their experiences during 1911 differed markedly. Climatic factors cannot have been responsible for these differences and in the main they must have been due to the sanitary nature of the different towns and the success by which the authorities could combat the climatic shock. For example, in Accrington the MOH explained that the town's substantial increase in infant mortality was due to a rise in diarrhoea deaths coupled with a whooping cough epidemic, although it is noteworthy that the Notification of Births Act was not in force in that town because it had not employed any female health visitors.[131] By contrast, in Birkenhead the IMR remained stationary in spite of the fact that the number of diarrhoea deaths increased from 98 in 1910 to 158 in 1911.[132] These excess diarrhoea deaths were balanced by declines in other causes. There had also been 152 diarrhoea deaths in 1906, the previous year with a hot summer, and throughout the first decade of the twentieth century the IMR had steadily declined.[133] Other than providing basic statistics on infant mortality the MOH was silent as to why the IMR did not increase in 1911 and female health visitors were not appointed until January 1912.[134] Thus, whatever was being done to tackle infant mortality in Birkenhead it was successful to a certain degree in spite of the more than 60 per cent increase in diarrhoea deaths in 1911.

128 Holt, *Report on Public Health 1911*, p. 141.

129 Holt, *Report on Public Health 1911*, pp. 136-42.

130 Holt, *Report on Public Health 1911*, p. 26.

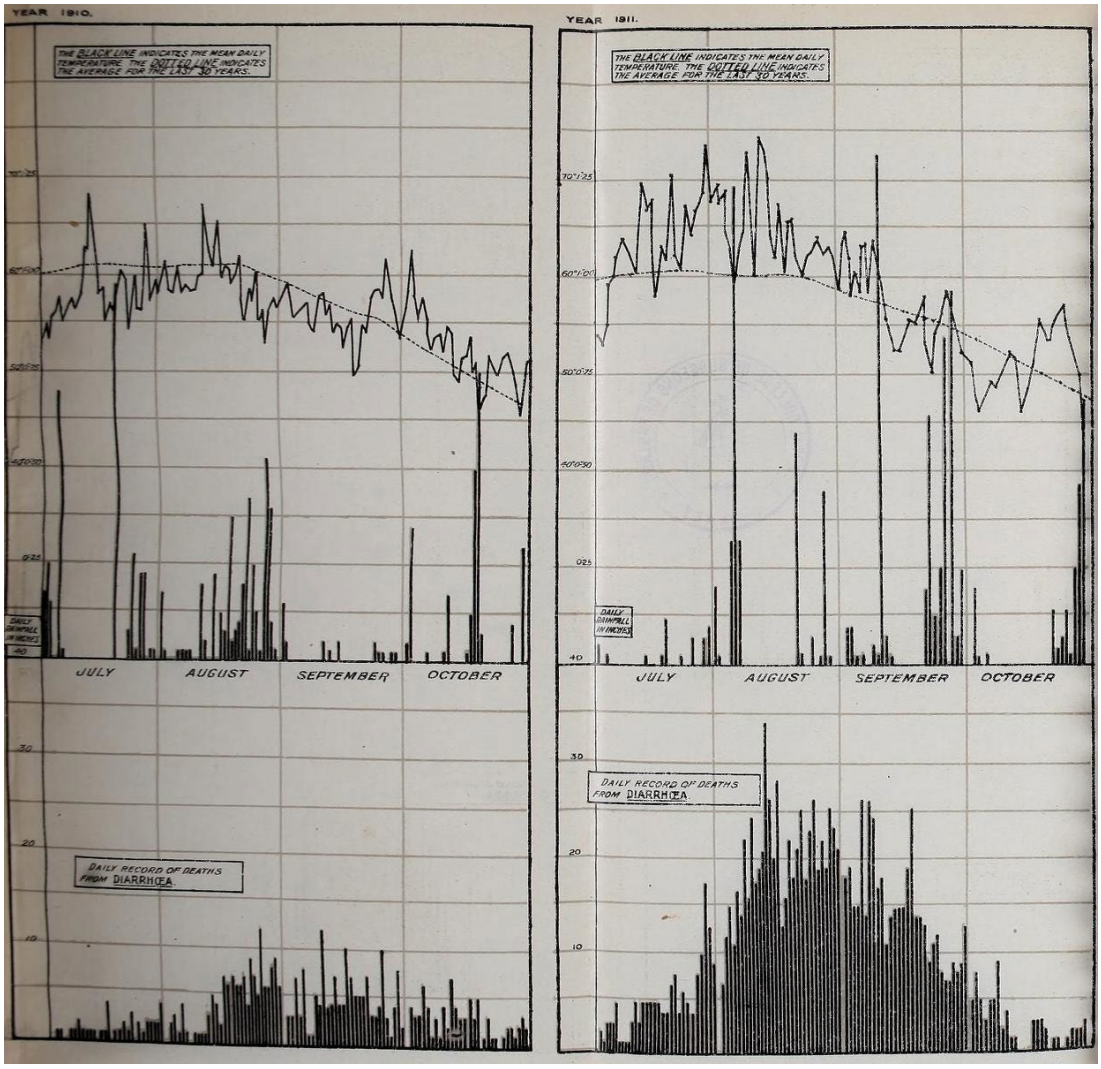
131 A. Greenhalgh, *Annual Report of the Medical Officer for the Year 1911* (Accrington, no date), p. 17, Table IV. The appointment of 'Lady Health Visitors' had been discussed by the council, 'although the wisdom of such an appointment has grown in favour it has not so far been able to secure a majority of the Councillors to support it'.

132 R.S. Marsden, *Report on the Sanitary Condition of the County Borough of Birkenhead for the Year 1911* (Birkenhead, 1912), p. 31. The MOH gives the IMR in 1911 as 136 which is the revised rate after the Registrar General had transferred births from other places.

133 Marsden, *Report on the Sanitary Condition of Birkenhead 1911*, p. 31.

134 R.S. Marsden, *Report on the Sanitary Condition of the County Borough of Birkenhead for the Year 1912* (Birkenhead, 1913), p. 19.

Figure 11 **Daily temperature, rainfall and diarrhoea deaths, Liverpool: July to October 1910 and 1911**



Note: The top boxes read: 'The black line indicates the mean daily temperature. The dotted line indicates the average for the last 30 years'; 'Daily rainfall in inches'. The bottom boxes read: 'Daily record of deaths from diarrhoea'.

Source: E.W. Hope, *Report on the Health of the City of Liverpool During 1911* (Liverpool, 1912), after p. 46.

Huddersfield (Figure 6) although greater in extent, as deaths in 1911 began to increase in late July and continued at a high level until early October. Note that there was also a lag between the increase in temperature and deaths suggesting an intermediate variable, perhaps the need for the fly population to build up and facilitate the spread of infection. The temperature was much higher in 1911 than in 1910 throughout July and August and August was also particularly dry.[135] In 1910 summer diarrhoea still occurred, although deaths were lower as that summer was less hot and had more rain than 1911. It is however interesting that in late September and early October of 1910, when the temperature was higher than in 1911, high numbers of diarrhoea deaths continued throughout October.

Liverpool's MOH, Edward William Hope, was forthright in his opinion as to the principal causes of infant mortality which he summarised as 'neglect', 'inattention', 'improper food' and 'scanty clothing'.[136] He was also pessimistic as to extent to which MOHs could bring about change since

> as far as infantile diarrhoea is concerned, it must never be forgotten, however, that whatever is in the power of the municipality to do in regard to the preservation of infant life is insignificant when compared with what is in the power of the mother to do.[137]

It is difficult to judge whether Hope's culture of blame hampered his attempts to reduce rates, but as he did throughout his tenure, he reiterated his view that families living in the same environment often had very different experiences of infant mortality.[138] In Liverpool various means by which infant mortality could be prevented were in place by 1911. These included health visiting, midwives being instructed to give out appropriate advice, milk depots, hospital treatment for infants suffering measles, whooping cough and in some cases diarrhoea, improved scavenging and street cleaning.[139] With respect to diarrhoea, Hope concluded that

> [i]nvestigation proves incontestably that the deaths of infants from this cause [diarrhoea] are closely associated with the method of feeding, putrefying food being the medium by which the specific poison is commonly introduced … The deaths amongst children under three months of age, either wholly or partially fed on artificial foods, are fifteen

135 These more detailed weather and rainfall statistics will also allow more sophistical statistical analyses to be undertaken.

136 Hope, *Report on the Health of Liverpool 1911*, p. 17. See Galley, 'Infant mortality in England, 1538-2000: stability and the beginnings of change' pp. 165-76 for a discussion of attempts by Liverpool's MOHs to tackle infant mortality during the nineteenth and early twentieth centuries.

137 Hope, *Report on the Health of Liverpool 1911*, p. 18

138 Hope, *Report on the Health of Liverpool 1911*, p. 18

139 Hope, *Report on the Health of Liverpool 1911*, pp. 17-18, 42, 48-9.

> times as great as they are amongst an equal number of infants fed upon breast milk.[140]

During the summer Hope geared much of his efforts towards the fight against infantile diarrhoea. On 18 August he received a circular from the LGB concerning

> the necessity for close attention to municipal cleanliness during the hot season. It suggested that 'the Council may consider it advisable during the next few weeks to divert the Sanitary Inspectors from less urgent work, and to instruct them to make rapid visits with a view to securing efficient sanitation, especially in and about the houses of the working classes'.[141]

Unfortunately, Hope was unable to act on this advice because of the general transport strike which culminated in the events known as 'Bloody Sunday' when the police baton charged a crowd of 85,000.[142] According to Hope the strike interrupted the milk supply and was

> accompanied by conduct which threatened to affect most seriously the well-being of the poorer sections of the community, and still more seriously the health and lives of their infants and young children … the growing turbulence shared in by multitudes of women in the poorer quarters of the City was accompanied by the neglect of the infants and young children and of the homes, whilst the distracted women were lounging or fighting in the streets.[143]

Only parts of the city were affected by the strike, although it did mean that cleansing activities ceased in some districts, as did house to house visiting.[144]

It is difficult to judge the effects of the strike on infant health in Liverpool. Hope was once again highly critical of some working-class mothers, although it is hard to believe that many mothers were so caught up in the political fervor that they neglected their infants to such an extent that they died. Moreover, the overall increase in IMR in 1911 was only 12 per cent, well below the national average and many of the towns in Figure 10. Indeed, Liverpool had a number of circumstances favourable

140 Hope, *Report on the Health of Liverpool 1911*, p. 41. On p. 268 there is an analysis of infant feeding methods amongst 63 cases admitted to the City Hospital, Fazakerley suffering from infantile diarrhoea: 4 were breast fed alone, 27 were fed cow's milk, alone or combined with artificial foods and 32 were only given artificial foods.

141 Hope, *Report on the Health of Liverpool 1911*, p. 51.

142 S. Davies and R. Noon, 'The rank-and-file in the 1911 Liverpool General Transport Strike', *Labour History Review* 79 (2014), pp. 55-81, https://doi.org/10.3828/lhr.2014.4.

143 Hope, *Report on the Health of Liverpool 1911*, pp. 49-50.

144 Hope, *Report on the Health of Liverpool 1911*, p. 50-1.

to good infant health, most notably the high prevalence of maternal breastfeeding that occurred throughout the city. In respect of over 15,000 visits made in connection with the Notification of Births Act in 1911, 80 per cent of infants were found to be breastfed, 4 per cent were given artificial supplements in addition to breast milk and the remaining 16 per cent were fed various forms of artificial foods.[145] In the wealthier, less crowded parts of the city IMRs were low and the IMR varied from 80 to 220 within districts.[146] This meant that many diarrhoea deaths were concentrated into the central parts of the city (Figure 12). Published without comment, this figure illustrates how infantile diarrhoea was widespread throughout the central part of Liverpool. It is clear that certain streets seem to have been especially affected, although the facts that deaths from three years were grouped together and it is not known how many babies were born in each street means that Figure 12 remains difficult to interpret. Reasons why concentrations of diarrhoeal deaths occurred in certain streets are easy to find, with the MOH providing some examples of poor housing (see Figure 13 for an example). By contrast some parts of the city had undergone considerable improvement by 1911 and Figure 14 shows the recent development of Bevington Street (indicated by an arrow in Figure 12). Here we can see an example of ideal, early twentieth century housing with a widened street; but even here, a single black dot appears on this street in Figure 12, showing that infantile diarrhoea could still persist even in the best environments.

Despite the substantial increase in diarrhoea mortality shown in Figure 11, Hope's pessimistic view of some working-class mothers, the poor living conditions of many Liverpool residents and the strike that affected municipal efforts to combat the exceptional circumstances of 1911, it should be concluded that Liverpool was partially successful in mitigating the worst of the extreme summer weather as the IMR only increased by 17 per 1,000 live births (12 per cent). It was certainly more successful in combatting this crisis than most of the towns listed in Figure 10 and probably more successful that many other places in the rest of the country.

It is appropriate to end this section by examining what happened in the other two districts that were examined in the third of these series of papers: the London Borough of St Pancras and the Isle of Wight rural district.[147] In St Pancras the IMR increased from 108 in 1910 to 121 in 1911, a rise of 12 per cent.[148] This relatively low rate was due in part to this district being one of the leaders in infant welfare with

145 Hope, *Report on the Health of Liverpool 1911*, p. 124.

146 Hope, *Report on the Health of Liverpool 1911*, graph after p. 18.

147 See Galley, 'Infant mortality in England, 1538-2000: stability and the beginnings of change', pp. 176-87.

148 J.F.J. Sykes, *Fifty-Sixth Annual Report of the Medical Officer of Health on the Vital and Sanitary Condition of the Metropolitan Borough of St Pancras* (London, n.d.), p. 25. The corrected IMR, once institutional births and infant deaths had been reallocated to their place of residence, was 112 in 1911 which was low for an urban centre. The published rate for 1910 was uncorrected; had it been corrected, it would probably have been lowered to less than 108, meaning that some increase would still have occurred in 1911.

Figure 12 Map of central Liverpool showing streets recording infant diarrhoea deaths, 1909-1911

Note: Bevington Street has been indicated.

Source: E.W. Hope, *Report on the Health of the City of Liverpool During 1911* (Liverpool, 1912), after p. 18.

Figure 13 Insanitary housing in an unnamed part of Liverpool

A TRIANGULAR SHAPED COURT, WITH TUNNEL ENTRANCE, CONTAINING NINE INSANITARY HOUSES, BACK TO BACK WITH ADJACENT FRONT HOUSES.

Source: E.W. Hope, *Report on the Health of the City of Liverpool During 1911* (Liverpool, 1912), after p. 257.

well-established and efficient health visiting, appropriate advice given to mothers and help with maintaining mothers' health, both in the ante- and post-natal periods, thereby ensuring that they were able to continue breastfeeding her infant.[149] John Sykes, the MOH, also enthusiastically followed up the advice given by the LGB in August (see above) and, in summarising the means by which the causes of infant mortality were understood and could be tackled, he stated that

149 Sykes, *Fifty-Sixth Annual Report of the Medical Officer of Health*, p. 27.

the foremost means of securing a low infant mortality are: [e]fficient domestic and municipal sanitation and housing, and intelligent and painstaking motherhood. There is much machinery which has already been devised to meet the last-mentioned end, including paid and voluntary women health visitors, schools for mothers, consultation centres for mothers, infant milk depots.[150]

Figure 14 Housing in Bevington Street, Liverpool, 1911

A VIEW OF SELF-CONTAINED COTTAGES IN BEVINGTON STREET, LOOKING FROM TITCHFIELD STREET.
Erected on the site of former insanitary property.
(This Street was formerly only 28ft. wide, and is now 60ft. wide.)

Source: E.W. Hope, *Report on the Health of the City of Liverpool During 1911* (Liverpool, 1912), after p. 257. Plans of this development are also included in the same part of the report.

150 Sykes, *Fifty-Sixth Annual Report of the Medical Officer of Health*, p. 27. Schools for mothers are discussed on pp. 29-32. See Campbell, *Carnegie United Kingdom Trust Report on the Physical Welfare of Mothers and Children*, pp. 83-119 for a wider discussion of these institutions.

Thus, much of the structure for good infant welfare was in place by 1911, but its operation was clearly not entirely effective as the various messages failed to reach or were not fully acted upon by a small percentage of mothers. In an investigation of 129 infants who died from diarrhoeal diseases, the MOH found that 96 (74 per cent) were hand-fed at the time of death, 22 (17 per cent) 'mixed-fed' and only 11 (9 per cent) breastfed.[151] He also found that 44 of the infants not exclusively breastfed had been hand-fed from birth with a further 49 being moved onto artificial foods by the time they were one month old. Amongst a wider sample of 685 infants who were given regular visits, 606 (88 per cent) were breastfed, 41 (6 per cent) mixed-fed and only 38 (6 per cent) hand-fed.[152] IMRs were therefore relatively low in St Pancras in part because maternal breastfeeding rates were high and infant welfare measures effective and, despite experiencing the worst of the summer heat, the overall increase in infant mortality in 1911 was modest. While the various preventive measures that had been put in place by the council could not save every infant, with those infants whose mothers were not able to breastfeed them for whatever reason being especially vulnerable, the health authorities in St Pancras could claim some success in averting even higher increases in mortality.

In the rural district of the Isle of Wight the summer of 1911 passed almost without notice. The intense heat was noted by the MOH, but only one infant diarrhoea death was recorded in 1911 and the IMR was 50 up from 46 in the previous year.[153] The rate had been about 100 at the end of the nineteenth century, but too much should not be made of small differences since only 26 infant deaths were recorded in 1910 and 27 in 1911. Perhaps because the IMR was so low, the MOH was silent about what was being done, if anything, to improve infant welfare. A section of the 1911 *Annual Report* is titled 'Means for Prevention of Mortality in Childbirth and in Infancy', but this only concerns midwives especially in respect of the 1902 Midwives Act and nothing is recorded about other infant welfare issues.[154] The rural environment would have certainly helped to mitigate any climatic threat, but it could be that, even in the absence of municipal involvement, knowledge about how to reduce IMRs had diffused into the wider public consciousness.

This short examination of the impact of an adverse climate on infant mortality in 1911 has raised many questions, but provided few answers. It was already well known that hot dry weather placed some infants at additional risks and the extreme weather tested many local authorities to their limit with their responses differing greatly from place to place. Climate and levels of urbanisation are key variables in

151 Sykes, *Fifty-Sixth Annual Report of the Medical Officer of Health*, p. 33.

152 Sykes, *Fifty-Sixth Annual Report of the Medical Officer of Health*, p. 36. These infants were visited at various ages and some breastfed infants would no doubt have been moved onto mixed- or hand-feeding at some stage during their first year. These data do of course exclude infants who died prior to being visited.

153 J.A. Gibson, *1911 Annual Report on the Health of the Rural Sanitary District of the Isle of Wight* (Newport, 1912), pp. 9-11 and 65.

154 Gibson, *1911 Annual Report on the Isle of Wight*, pp. 9-11.

explaining some of the broad differences, but personal factors were crucial. Social class was also important, especially as it influenced the ability of families to choose where they lived. The 1911 *Annual Report* of the Registrar General showed that infants whose fathers engaged in largely middle-class occupations, such as artists, medical practitioners and clergymen, suffered an IMR of only 45 per 1,000 live births compared with 186 amongst infants whose fathers had working-class occupations such as general labourers, ironworkers and scavengers.[155] This class relationship also held for illegitimate infants. The overall illegitimate IMR was 245, almost double that for legitimates, but it was 160 amongst infants whose mothers had lower middle-class occupations and 316 for mothers in working-class occupations.[156] The relationship between place and class was complicated, but by 1911 the middle classes were increasingly able to counter the detrimental effects of the climate either by living in healthier environments or by adopting more hygienic child care practices.[157] These relationships had existed throughout the nineteenth century, and perhaps even earlier, but what was different in 1911 was that many MOHs had by then taken active measures to reduce rates and, whilst these were mainly targeted at the working classes, the middle classes also benefitted so that, almost without exception, overall IMRs in 1911 were lower than they had been a decade earlier.

This case study suggests that prior to the outbreak of the Great War the progress made in tackling high infant mortality could be halted by an extreme event such as a heatwave, with those suffering most tending to be artificially-fed infants living in the worst urban conditions. It has identified a variety of experiences and shown that a wider examination of local responses to this crisis will enable further insights into the effectiveness of infant welfare provision at the beginning of the second decade of the twentieth century. In particular, the extent to which artificially-fed infants bore the brunt of the excess mortality is an issue worthy of further investigation. Likewise, the precise influence of climate on infant health has yet to be explored in detail. The impact of climate could also be examined in 1904 and 1906, both years when

155 Registrar General, *Seventy-Fourth Annual Report of the Registrar-General*, p. xliv. The full list of occupations in Group A (middle-class) is: artists, merchants, medical practitioners, naval officers, solicitors, army officers, woodmen, C.E. clergymen, others connected with education; and in Group B (working-class): general labourers, foundry labourers, dock labourers, ironworkers, earthenware manufacture, brassworkers, tube manufacture, flax, hemp etc. workers, navvies, lamp etc. makers, tin miners, salt makers, factory labourers, scavengers, provision curers, costers, hawkers, patent fuel manufacture.

156 Registrar General, *Seventy-Fourth Annual Report of the Registrar-General*, p. xlv. The full list of occupations in Group A (lower middle-class) is: commercial clerks, milliners, shopkeepers and shop assistants, other workers in paper, sick nurses, teachers; and in Group B (working-class): other workers in dress, wool and worsted manufacture, barmaids, cotton manufacture, costermongers, hawkers, earthenware manufacture. Not all mothers of illegitimate infants would have recorded an occupation.

157 See E. Garrett, A. Reid, K. Schürer and S. Szreter, *Changing Family Size in England and Wales. Place, Class and Demography, 1891-1911* (Cambridge, 2001), pp. 139-47 for a wider discussion of this relationship.

summers were hot and IMRs increased (Figure 1). The next comparable summer to 1911 occurred in 1933, although 1921 was also considered to be hot.[158] However, as far as the national rate was concerned there was only a slight increase in 1921 and none in 1933 (Figure 1).[159] It seems therefore that by 1933 greater progress had been towards to the elimination of summer infantile diarrhoea, although further research is needed to prove this assertion (see Table 1).[160]

World wars, epidemics and recession

Other major events that might have influenced infant mortality include the two world wars, the influenza pandemic that swept the world between 1918 and 1920 and the economic recession of the early 1930s. However, as Figure 1 showed, there are no obvious correlations between any of these events and an increase in the IMR, although this does not preclude the possibility that they did have some impact. For example, the 1930s recession particularly affected northern industrial and mining areas as unemployment rates reached 70 per cent in some places; however, other parts of the country were much less affected. The national trend could therefore mask considerable local variations and, as with all these events, their full impact can only be assessed through detailed local case studies.

It is appropriate to begin this discussion by examining the trend of infant mortality during the First World War. For Britain the war began on 4 August 1914 and ended on 11 November 1918, although small numbers of British troops were still fighting in Russia during 1919. Any impact that the war may have had on infant mortality is likely to have been felt during the years 1915-1918, although some lasting effects may have lingered into subsequent years. Figure 15 shows IMRs in England and Wales between 1910 and 1920 with diarrhoeal, non-diarrhoeal and neonatal rates being shown separately. The IMR was 105 in 1910 and 80 in 1920, an overall fall of 24 per cent, and during the five war years rates were 105, 110, 91, 96 and 97.[161] Not surprisingly, there was some fluctuation throughout this period and, given that IMRs were high in 1911 and low in 1912, it is difficult to calculate a representative pre-war rate. Consequently, the amount of change that occurred during the war will depend

158 Kendon and Prior, 'Two remarkable summers', p. 181.

159 National IMRs for the following years were: 80 per 1,000 live births in 1920, 83 in 1921, 77 in 1922, 65 in 1932, 64 in 1933, and 59 in 1934.

160 IMRs in some places did increase in 1933. For example, in Liverpool the IMR was 98 which compared with 93 in 1931 and 91 in 1932 with this increase being mainly caused by a rise in diarrhoea deaths, see W.M. Frazer, *Report on the Health of the City of Liverpool in the Year 1933* (Liverpool, 1934), pp. 17, 20, 110.

161 See J.M. Winter, 'Aspects of the impact of the First World War on infant mortality in Britain', *Journal of European Economic History* 11 (1982), pp. 713-38 for a wider discussion. Mortality rates also declined throughout the rest of the civilian population: see J.M. Winter, 'The impact of the First World War on civilian health in Britain', *Economic History Review* 30 (1977), pp. 487-507, https://doi.org/10.2307/2594880; J.M. Winter, *The Great War and the British People* (Basingstoke, 1985), pp. 103-40.

on exactly which years are selected for comparison.[162] The difficulty of assessing the impact of the war is compounded by falling birth rates from 1916 and the post-war baby boom. In 1914 879,096 births were registered in England and Wales, but the number of births fell to 662,661 in 1918 and then increased to 957,782 in 1920.[163] In a period of fluctuating birth rates, the method of calculating IMRs by dividing infant deaths by live births in a particular year becomes less reliable and the Registrar General made attempts to calculate alternative rates. Since about 30 per cent of infants who died in any year were born in the previous one, the Registrar General used 70 per cent of births in that year and 30 per cent of births in the previous one in the denominator of his infant mortality calculations.[164] The effect of this change was to reduce the rate in 1917 from 96 to 91 and increase the rate in 1918 from 97 to 98.[165] Notwithstanding these relatively small differences, the conclusion still holds, as the Registrar General noted as early as 1916, that 'the war has not arrested the fall in infant mortality'.[166]

Figure 15 also reveals that neonatal mortality declined only slightly during the war years (it was 38 per 1,000 life births in 1910, 39 in 1914 and 36 in 1918, although it did increase to 40 in 1919) which means that most of the changes occurred within post-neonatal mortality.[167] After 1912 there was a year-by-year downward drift in diarrhoeal mortality so that all of the small increases were concentrated within post-neonatal, non-diarrhoeal mortality. Childhood infectious diseases accounted for the

162 For example, see the discussion in J.M. Winter, J. Lawrence and J. Ariouat, 'The impact of the Great War on infant mortality in London', *Annales de Démographie Historique* (1993), pp. 329-53, here at p. 330.

163 Macfarlane and Mugford, *Birth Counts*, p. 2.

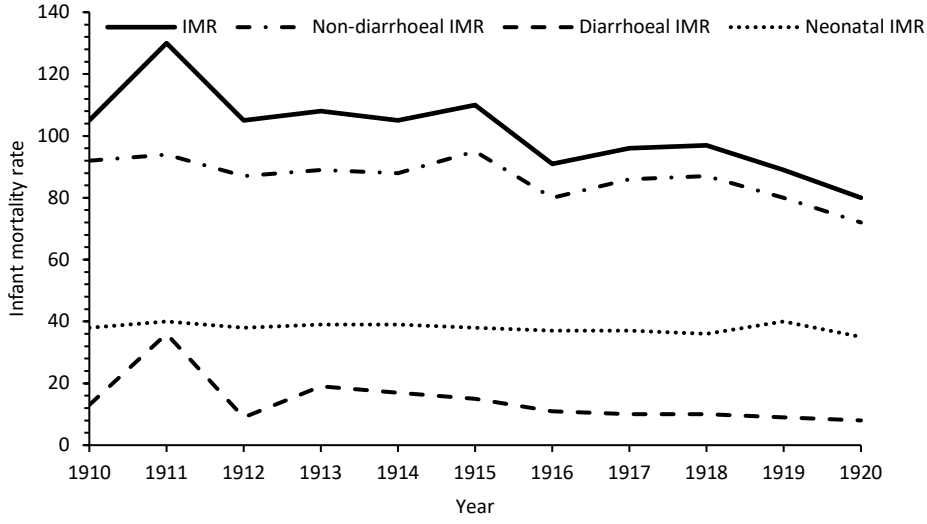
164 Registrar General, *Eighty-First Annual Report of the Registrar General of Births, Deaths and Marriages in England and Wales (1918)* (London, 1920), p. xxxii. The Registrar General also related deaths at ages under three months to births in that year, and deaths at higher ages to the estimated population aged under one year, but the same trend is apparent in this alternative IMR series. For a general account of demographic changes during the war, see B. Mallett, 'Vital statistics as affected by war', *Journal of the Royal Statistical Society* 81 (1918), pp. 1-36, https://doi.org/10.2307/2340566.

165 Registrar General, *Eighty-Third Annual Report of the Registrar General for England and Wales (1920)* (London, 1922), p. xxxviii.

166 Registrar General, *Seventy-Ninth Annual Report of the Registrar General of Births, Deaths and Marriages in England and Wales (1916)* (London, 1918), p. xxv. This was in sharp contrast to some other combatant counties as the IMR in Germany plateaued whilst in France, Italy and Austria it increased, see Winter, *Great War and the British People*, p. 142. In Berlin, illegitimate births soared which caused overall IMRs to increase, see J. Winter and J. Cole, 'Fluctuations in infant mortality rates in Berlin during and after the First World War', *European Journal of Population* 9 (1993), pp. 235-63, https://doi.org/10.1007/BF01266019.

167 Low levels of neonatal mortality occurred throughout the country as urban neonatal rates were only 2 per cent higher than rural ones in 1916. This differential increased to 50 per cent for infants aged 3-6 months, 56 per cent for infants aged 9-12 months. For all infants taken together the differential was 25 per cent. See Registrar General, *Eighty-Third Annual Report of the Registrar General*, p. xl. This pattern was similar in other years.

Figure 15 **Infant, non-diarrhoeal, diarrhoeal and neonatal mortality rates: England and Wales, 1910-1920**



Source: Registrar General, *Eighty-Third Annual Report of the Registrar General for England and Wales (1920)* (London, 1922), pp. xxxviii-xxxix.

increase in infant mortality in 1915 as there was an epidemic of measles in the spring and greater numbers of winter bronchitis and pneumonia deaths.[168] The rise in 1918 was caused by an epidemic of whooping cough, and there were increases in respiratory diseases, especially influenza, with deaths from this cause being more than 900 per cent higher than the pre-war average.[169] None of these increases was a direct consequence of the war, although it could be argued that the influenza pandemic was exacerbated by war conditions, and it is therefore necessary to conclude that the increasing economic hardships of war, which resulted in some food shortages, appear to have had little detrimental effect on infant health.[170] Jay Winter and his colleagues noted that in London the decline in infant mortality during the war was less than in some northern industrial towns and, while they discussed a number of possible

168 Registrar General, *Seventy-Eighth Annual Report of the Registrar General of Births, Deaths and Marriages in England and Wales (1915)* (London, 1917), p. xx. Pneumonia is often a secondary complication of measles.

169 Registrar General, *Eighty-First Annual Report of the Registrar General*, p. xlv.

170 For discussions of the food supply see L. Bryder, 'The First World War: healthy or hungry?', *History Workshop Journal* 24 (1987), pp. 141-57, https://doi.org/10.1093/hwj/24.1.141; P.E. Dewey, 'Nutrition and living standards in wartime Britain' in R. Wall and J. Winter (eds) *The Upheaval of War* (Cambridge, 1988), pp. 197-220; G. DeGroot, *Back in Blighty: the British at Home in World War 1* (London, 2014), pp. 128-33.

reasons for this, they were unable to reach any firm conclusions.[171] Thus, while some local variations may be expected, the wars years were characterised by a general decline in infant mortality with the greatest declines occurring in those places suffering the highest rates.

The most extensive discussion of the impact of war on infant health is Deborah Dwork's *War is Good for Babies* which highlighted the indirect benefit of war for Britain's babies as the national need for a healthy fighting force, coupled with growing national concern over the declining birth rate, ensured that attention became increasingly focused on improving infant health.[172] Her book is essentially about the impact of the Boer War and the subsequent National Deterioration Report on infant health, although she notes that efforts to improve infant health accelerated during the First World War:

> the quickened interest in infant health aroused by the Great War was reflected in the increase in the number and variety of services which were made available. In 1914 local authorities employed 600 health visitors, and by 1918 this figure had more than quadrupled to 2,577. Whereas 300 municipal and 350 voluntary maternity and child welfare centres had been established by the beginning of the war, 700 of the former and 578 of the latter were in operation in 1918.[173]

Indeed, according to John Eyler, a circular issued by the LGB in July 1914 announcing grants for baby clinics which included a short memorandum from Sir Arthur Newsholme 'that outlined an ideal infant and maternal welfare scheme' marked the beginning of a significant increase in publicly funded infant welfare work; and throughout the war Newsholme, in spite of his many other responsibilities, 'spent more time on infant welfare than any other subject, other than war-related services'.[174] Thus, as both the scale and scope of the services on offer expanded, infant welfare achieved increasing prominence and, as a consequence of the work done by the large army of both paid and voluntary workers, this ensured that the IMR continued its downward trajectory despite any disruption brought about by the war.[175] The assertion that the infant welfare movement was instrumental in bringing about decline is supported by diarrhoea deaths, the group of diseases that was

171 Winter *et al.*, 'Impact of the Great War on infant mortality in London'. See also Winter, *Great War and the British People*, pp. 141-53.

172 D. Dwork, *War is Good for Babies and other Young Children: a History of the Infant and Child Welfare Movement in England 1898-1918* (New York, 1987).

173 Dwork, *War is Good for Babies*, p. 211.

174 Eyler, *Sir Arthur Newsholme*, p. 329.

175 For an example of how infant welfare gained increasing prominence amongst the wider public, see L. Bryder, 'Mobilising mothers: the 1917 National Baby Week,' *Medical History* 63 (2019), pp. 2-23, https://doi.org/10.1017/mdh.2018.60.

particularly targeted by MOHs, slowly declining after 1912 and the fact that those places with the highest pre-war rates tended to have the greatest decreases—since these places had a greater number of deaths that were more amenable to preventive action. An alternative view was taken by Winter who argued that the underlying reason why mortality declined during the war was an increase in living standards.[176] Whilst a sudden increase in living standards would no doubt have been welcomed it is hard to see how, during wartime, this could cause an immediate reduction in infant mortality given that a higher income could not easily be translated into improvements in those socio-economic factors, such as better housing or environmental conditions, that were necessary to improve infant health. Once again local studies are needed to examine this issue in more detail and one of few to have been carried out, Erin Miller's examination of Wigan which began the war with one of the highest IMRs, concluded that there the infant welfare movement did much to reduce rates in the town.[177] Thus, while similar studies would be welcomed, it would seem that the downward trend that was established before the war, and which most commentators agree was mainly due to targeted intervention coupled with increased attention towards sanitary improvement, continued during the war and this was the main reason for the decline in infant mortality.

As a postscript to this discussion of World War I it is appropriate to mention the influenza pandemic that swept the world from 1918. This epidemic was unusual because the highest mortality rates occurred disproportionately within the young adult population, rather than within older age groups, as was normally the case.[178] Infants were also exposed to increased risk. In 1917 only 250 infant influenza deaths were recorded; this figure increased nearly ten-fold to 2,478 in 1918, although this still only represents an influenza IMR of 3.8 per 1,000 live births.[179] The likelihood is that some influenza deaths 'leaked' into other causes, but as the Registrar General noted in his 1918 annual report:

176 Winter, *Great War and the British People*, pp. 188-204. Winter also argued that 'although there were substantial improvements in public policy on maternal and infant welfare during the war, the major impact of these measures was not immediate, but lay, rather, in the future' (p. 188). Individual-level data are needed to test the hypothesis that increased living standards brought about a reduction in infant mortality.

177 E. Miller, *Infant Health in Wigan, England during the First World War* [2006] available at https://erinashleymiller.com/writing/the-effect-of-the-first-world-war-on-infant-health-in-wigan-england-abstract/ [accessed April 2021]. See also F. Walsh, ' "Every human life is a national importance": the impact of the First World War on attitudes to maternal and infant health', in D. Durnin and I. Miller (eds) *Medicine, Health and Irish Experiences of Conflict 1914–45* (Manchester, 2017), pp. 15-30. The impact of absent fathers on infant and child health during the war has not been examined in any detail.

178 Registrar General, *Supplement to the Eighty-First Annual Report of the Registrar General of Births, Deaths and Marriages in England and Wales: Report on the Mortality from Influenza in England and Wales During the Epidemic of 1918-19* (London, 1920), pp. 7-10, 38.

179 Registrar General, *Eightieth Annual Report of the Registrar General of Births, Deaths and Marriages in England and Wales (1917)* (London, 1917), p. 130; Registrar General, *Eighty-First Annual Report of the Registrar General*, p. 72. A total of 64,386 deaths was recorded in 1918.

> if we deduct the excess of mortality from influenza and pneumonia over that recorded in 1917, in order to obtain an indication of what the rate might have been had there been no great epidemic of influenza, [the IMR] is reduced to 93, which is lower than any recorded rate except that of 1916.[180]

Thus, in spite of the effects of this extreme event, the overall trend remains one of decline. Moreover, given that influenza particularly affected women of childbearing ages, the loss or illness of a mother could have had a substantial impact on their infant's health. This issue was examined as part of Alice Reid's study of health visiting in Derbyshire and she concluded:

> influenza infection in the first or second trimesters of pregnancy can provoke premature delivery, and therefore stillbirths or vulnerability to early death. Older infants may be disadvantaged by their ailing mother's inability to provide adequate care and nutrition, such as through breast-feeding. Of course, infants out of the womb were also at risk of catching the disease, and there was a higher risk of death from the direct effects of the 'flu itself than from the indirect effects of a mother's health, but it is very likely that the latter raised the death rate more than it would otherwise have been. In a sense, therefore, increased adult mortality contributed to increased infant mortality.[181]

Such effects are of course difficult to verify, especially in the context of generally declining IMRs and the absence of national stillbirth registration. Once again further studies that utilize similar or alternative sources would be welcomed.

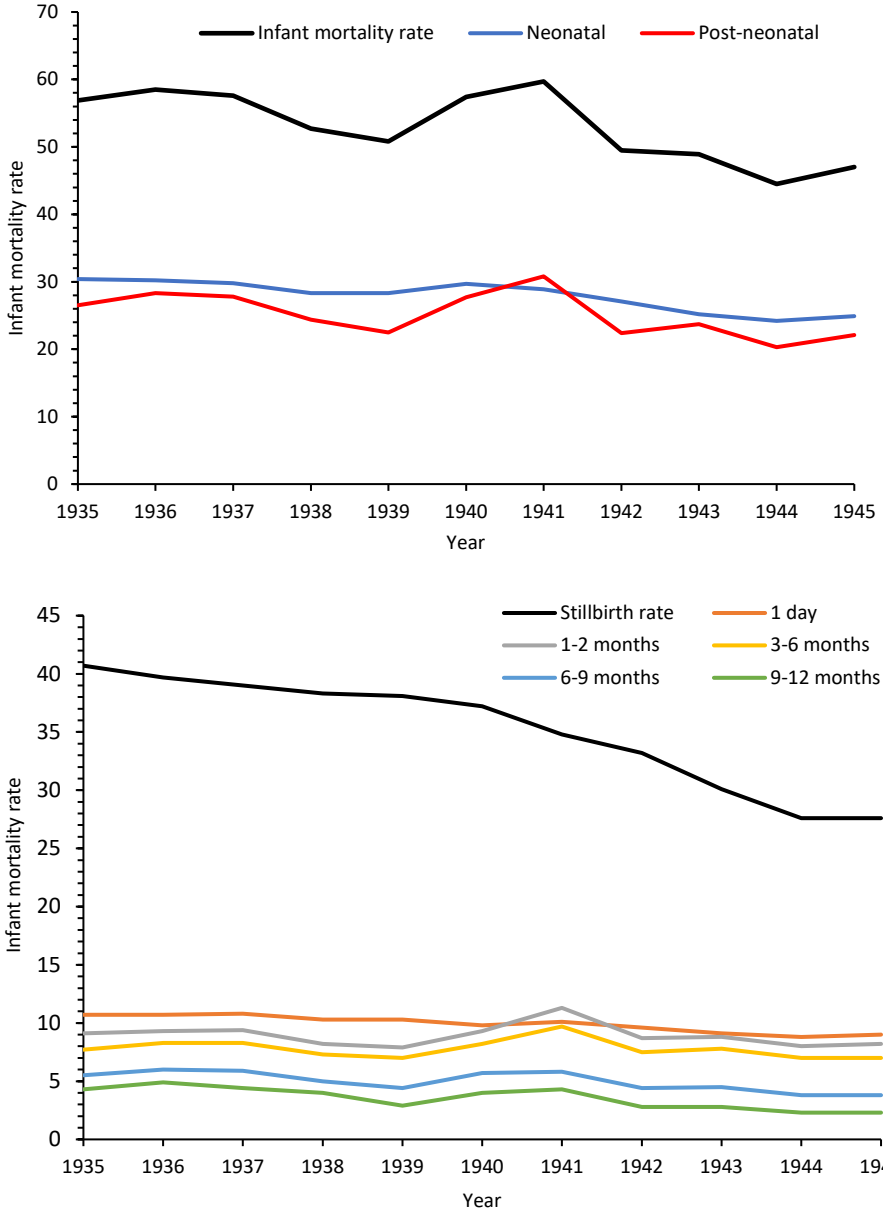
On the theme of war, relatively little has been published about infant mortality trends during the Second World War. The Registrar General's annual reports ceased publication during the war and instead a three-volume combined report for the six years 1940-1945 began to appear from 1949.[182] This report was largely descriptive of the trends that had occurred. Figure 16 shows IMRs in the war years compared with the five previous years. The trend is one of decline notwithstanding that significant increases occurred in 1940 and 1941 (see Figure 1 for the significance of these

180 Registrar General, *Eighty-First Annual Report of the Registrar General*, p. xxxii.

181 A. Reid, 'The effects of the 1918-1919 influenza pandemic on infant and child health in Derbyshire', *Medical History* 49 (2005), pp. 29-54, here at p. 53, https://doi.org/10.1017/S0025727300008279.

182 Registrar General, *Registrar General's Statistical Review of England and Wales for the Six Years 1940-1945*, 3 vols (London, 1949, 1951 and 1954). The reports for 1938 and 1939 also appeared as a single volume, see Registrar General, *The Registrar General's Statistical Review of England and Wales for 1938 and 1939* (London, 1947).

Figure 16 **Infant mortality rates in England and Wales by selected age groups, 1935-1945**



Source: Registrar General, *The Registrar General's Statistical Review of England and Wales for the Six Years 1940-1945, Text Vol. 1: Medical* (London, 1949), pp. 31, 33.

increases within the twentieth century as a whole). Neonatal mortality decreased steadily so that the increases in 1940-1941 were confined to post-neonatal mortality, especially within the age groups 1-6 months. The winter of 1941 was particularly severe and respiratory diseases were higher than pre-war levels in both years, as were whooping cough deaths in 1941.[183] Both these phenomena appear to have affected the whole country and, while they do not account for all of the increase, they were largely independent of the effects of war—direct infant war deaths, presumably mainly from aerial bombardment, were 203, 231, 38, 26, 109 and 30 for the years 1940-1945 respectively.[184] According to the Registrar General, a possible explanation for the rise in infant mortality in 1940 and 1941 was 'that increased demands upon women resulted in a decline in breast feeding which counteracted at ages 1-6 months the effects of the factors tending to reduce infant mortality'.[185] No evidence is provided to support this statement, but it does appear to be worthy of further investigation. After 1941 the rest of the war years were notable as ones of decline with the Registrar General again providing an explanation of why this might have been the case:

> [t]he pronounced improvement in infant mortality, which occurred after 1942, was confined to two distinct age periods, the first week and the second half of the first year. The first probably resulted from the special attention devoted to pregnant women up to completion of maternity.[186]

This special attention also perhaps accounts for the dramatic decline in stillbirth rates which fell from 38.1 in 1939 to 27.6 in 1945, an overall decrease of 27.6 per cent. There was also a similar decline in the illegitimate IMR from a pre-war 87 (1936-1939) to 82 in 1940, 71 in 1943 and 65 in 1945, an overall decrease of 25 per cent, this in spite of the fact that illegitimate births nearly doubled during the war.[187] Illegitimate mortality rates were higher than legitimate rates (91 compared with 50 in 1939), but the war witnessed a remarkable convergence so that by 1945 the illegitimate rate was 65 compared with a legitimate rate of 47.[188] It is also instructive to examine early illegitimate deaths since these allow insights to be given into both

183 Registrar General, *Statistical Review for 1940-1945*, Vol. 1, pp. 30, 47. The mortality rate from bronchitis and pneumonia was 10.5 per thousand in 1936-1939, 12.7 in 1940 and 13.7 in 1941. By 1945 it had declined to 9.3. The mortality from whooping cough was 2.1 in 1941 which compares with 1.2 in 1936-1939 and 0.6 in 1940.

184 Registrar General, *Statistical Review for 1940-1945*, Vol. 1, p. 29. There were 34,550 infant deaths recorded in 1941.

185 Registrar General, *Statistical Review for 1940-1945*, Vol. 1, p. 46.

186 Registrar General, *Statistical Review for 1940-1945*, Vol. 1, p. 29.

187 Registrar General, *Statistical Review for 1940-1945*, Vol. 1, pp. 29, 47. There were 2,331 illegitimate births in 1939 and 4,005 in 1945.

188 Registrar General, *Statistical Review for 1940-1945*, Vol. 1, p. 29. Illegitimate IMRs for the years from 1939 to 1945 were 91, 83, 78, 73, 69, 65 and 65 respectively.

the circumstances and quality of the birthing process, as well as illustrating the disadvantages of an illegitimate birth. Within the first 30 minutes, the illegitimate IMR was 6.1 per 1,000 live births in 1940 compared with only 1.1 for legitimates (5.5 times higher).[189] Illegitimates comprised a disproportionally high number of first births which are at higher risk than higher parities, but a 5.5-fold difference suggests much poorer pre-natal and lying-in care. By comparison, in the same year, the differential amongst infants dying on the rest of the first day was only 1.4 times (11.3 for illegitimates and 8.3 for legitimates).[190] However, during the war illegitimate deaths in the first thirty minutes declined steadily so that by 1945 the rate had declined to 4.2 with the differential reducing to 3.2-fold.[191] In 1945 the rest of the first day mortality was slightly higher for both legitimates and illegitimates (8.5 and 13.6) and the differential was 1.6-fold.[192] Such figures support the Registrar General's supposition about the devotion of care given to pregnant women and it is particularly impressive that mothers giving birth outside of wedlock appeared to have benefitted the most.[193] The war years marked significant improvements in infant health, although exactly how this was achieved has yet to be determined.

The other period that may warrant further investigation is the 1930s since this decade is associated with a major economic recession. However, J.M. Winter has shown that infant mortality continued to decline throughout the period (Figure 1) and that decline occurred in all parts of England and Wales and also in Scotland.[194] In spite of the considerable economic hardships suffered by some sections of the population it would appear that these did not translate into higher mortality amongst infants, at least at the national, county or local authority level.[195] There were some local variations in levels of decline; however, these may well have been due to differences in the implementation of infant health initiatives and it does not preclude the possibility that unemployment affected infant health, but this can only be tested using individual family-level data. Throughout this period, and indeed from much

189 Registrar General, *Statistical Review for 1940-1945*, Vol. 1, p. 38.

190 Registrar General, *Statistical Review for 1940-1945*, Vol. 1, p. 38.

191 Registrar General, *Statistical Review for 1940-1945*, Vol. 1, p. 42.

192 Registrar General, *Statistical Review for 1940-1945*, Vol. 1, p. 42.

193 The war may also have encouraged a more enlightened attitude towards unmarried mothers.

194 J.M. Winter, 'Infant mortality, maternal mortality and public health in Britain in the 1930s', *Journal of European Economic History* 8 (1979), pp. 439-62; J.M. Winter, 'Unemployment, nutrition and infant mortality in Britain, 1920-50', in J. Winter (ed.) *The Working Class in Modern British History: essays in Honour of Henry Pelling* (Cambridge, 1983), pp. 232-56. See also C. Webster, 'Healthy or hungry thirties?', *History Workshop* 13 (1982), pp. 110-29, https://doi.org/10.1093/hwj/13.1.110.

195 Winter, 'Infant mortality in the 1930s', pp. 447-9. In spite of the recession, and for working families at least, I. Gazeley and A. Newell, 'The end of destitution: evidence from urban British working households 1904–37', *Oxford Economic Papers* 64 (2012), pp. 80–102, https://doi.org/10.1093/oep/gpr032, estimate that absolute poverty among working-class households in urban Britain had been virtually eliminated by 1937.

earlier, the relationship between place and class that is so difficult to distinguish remains the key to explaining the emergence of infant mortality differentials.

Discussion and conclusions

This all-too-brief survey has shown that the initial stages of the twentieth-century decline in infant mortality can be attributed, both directly and indirectly, to what can loosely be described as the infant welfare movement—a view being shared by many of those charged with reducing IMRs, the most prominent being George Newman and Arthur Newsholme. The implementation of policies designed to reduce infant mortality was relatively slow and haphazard, but the means by which lives could be saved became widely disseminated and this meant that the middle classes often benefitted the most, even though they were not targeted specifically. At the same time the health of all sections of the population was steadily improving and fertility falling, both of which helped to reduce infant mortality rates. As understanding of the causes of infant mortality improved it became increasingly easy to mitigate environmental threats and, as towns and cities expanded, heathier suburbs were developed, slums cleared and urban environments gradually improved. Treatments also improved. All these processes occurred at more or less the same time and each had a cumulative effect on lowering IMRs. By 1950 much of the mortality associated with infectious diseases had been eradicated and deaths became, and continued to be, increasingly concentrated within the neonatal age range. Throughout the whole period significant socio-economic influences on infant mortality were also apparent. There was a substantial social class gradient in rates, spatial variations within towns and cities emerged, and the experience of individual families living in the same environments could often be radically different. Thus, by the beginning of the twenty-first century the main issue with respect to infant mortality, as with many other aspects of health, was the persistent inequalities that have proved so difficult to reduce.

Infant mortality decline was, and still is, multi-layered, and teasing out the proportional contributions of each of the many responsible factors has proven difficult to achieve. Correlations between socio-economic variables and levels of infant mortality are easy to demonstrate, but this does not necessarily mean that causation can be demonstrated, especially when access to individual-level data is limited and significant amounts of mortality were concentrated into certain groups and families. The problems associated with assessing infant health initiatives during the first two decades of the twentieth century can be illustrated by what happened in Sunderland. In 1914 H. Renney, the town's MOH, writing in response to a circular sent out by the LGB which aimed to stimulate 'local authorities who have not yet taken up the work of maternity and child welfare to do so, and to those already

engaged in the work to develop it still further',[196] outlined the work undertaken in Sunderland in this respect:

> In Sunderland the Health Committee appointed the first health visitor in 1904, and allocated to her one of the poorest slum districts. There was then no notification of births, but a list was obtained weekly from the district registrars. We were working at a great disadvantage, for the infants on these lists were several weeks old, often more than six weeks, before we could know of their existence. In October, 1907, however, the Corporation obtained Parliamentary powers for the compulsory notification of births for a period of four years, the question of continuing notification to be considered at the end of this period. The Local Government Board would not allow us to proceed with our local Act, so far as it related to notification of births, after the expiration of the four years, so the Corporation adopted the Notification of Births Act in August, 1911. In 1907 two additional health visitors were appointed, and the town was divided for the purpose of infantile visitation into three districts, a health visitor being allocated to each. From the year 1904 the health visitor had been engaged in the visitation of infants under one year of age, and frequently gave health talks at mothers' meetings and other societies.[197]

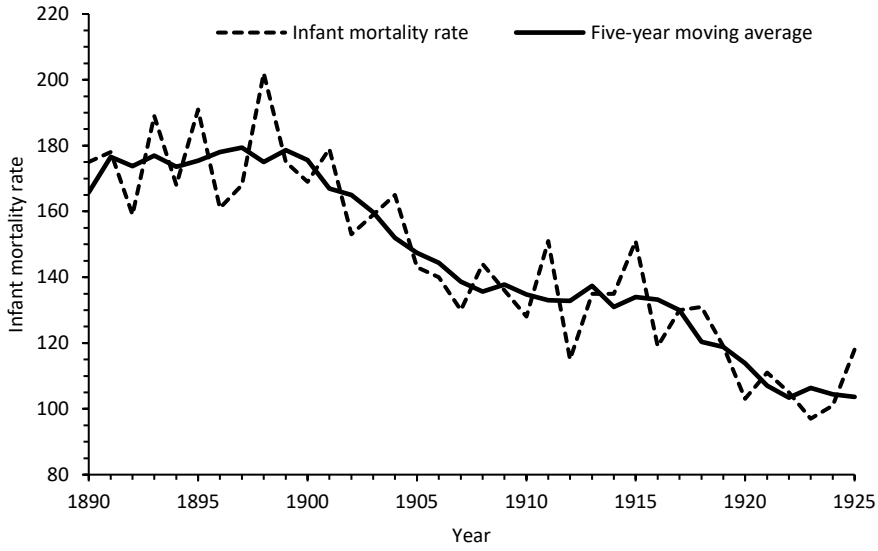
Thus, there was a steady increase in infant welfare work undertaken in the town and it appears to have been carried out more efficiently, but it still remains difficult to evaluate how each initiative made an impact on the IMR (Figure 17). The decline in infant mortality began, as in many places, quickly at the turn of the century, it slowed during the early 1910s and then accelerated afterwards. This can be seen best by the five-year moving average which smooths out annual variations. While the MOH noted 1904, 1907 and 1911 as being key dates, Figure 17 does not reveal any obvious sudden changes, but this is not necessarily to be expected as there was always likely to have been a lag between advice offered and advice acted upon and it was probably the cumulative effect of this advice, coupled with growing public awareness of what could be done to reduce infant mortality, that was of key importance.

The problem of disentangling the factors influencing infant mortality is complicated by the reliance on official publications or secondary studies rather than primary source material and this becomes increasingly the case over the course of the century as the publications produced by the GRO and its successor, the ONS, no longer sought to shape policy and instead became a means by which statistics

196 H. Renney, 'A discussion of maternity and child welfare', *Public Health* (May 1916), pp. 180-6, here at p. 186. Parents had up to six weeks to register a birth so there was an inevitable gap between the MOH could be notified of a birth, see Galley, 'Infant mortality in England 1538-2000: stability and the beginnings of change, 1837-1910', p. 100.

197 Renney, 'Discussion of maternity and child welfare', pp. 182-3.

Figure 17 Infant mortality rates in Sunderland, 1890-1925



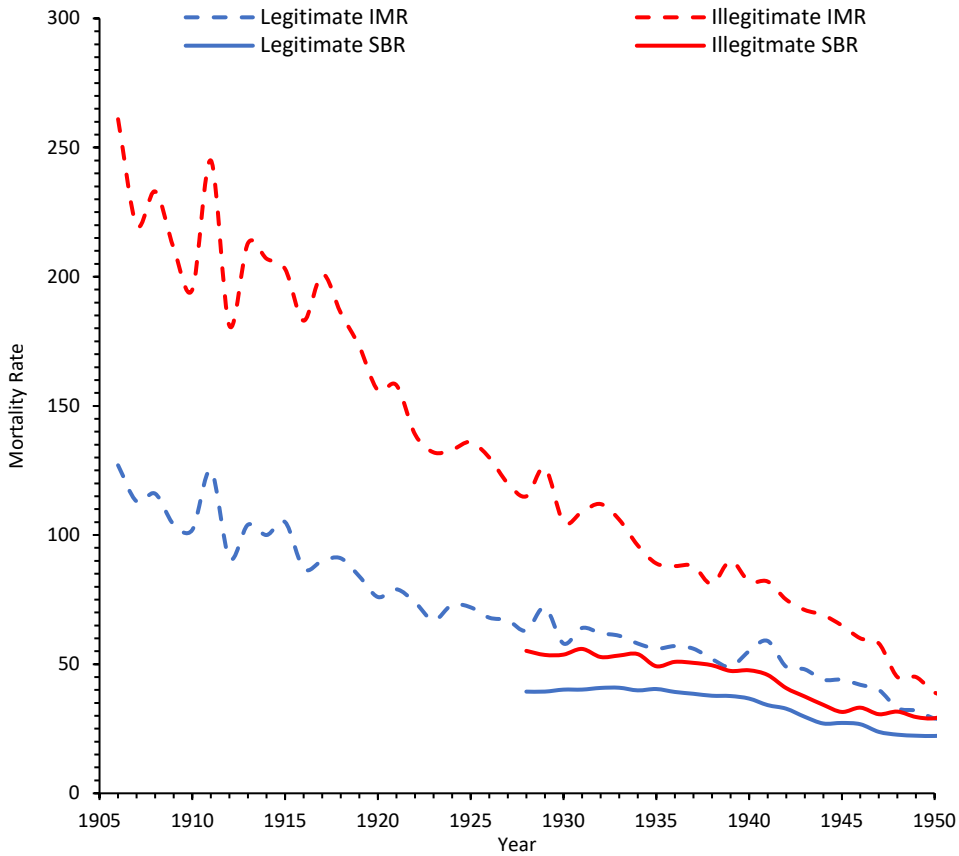
Source: E. Thorp, *Annual Report on the Sanitary Condition of Sunderland, for the Year 1926* (Sunderland, 1927), p. 36.

were reported. The sheer wealth of material available also creates problems since, even with the aid of considerable digital archives, there is a limit to the amount of data that an individual, or a group of individuals, can process. Moreover, with data confidentiality, the so-called '100-year rule', being applicable for most of the century, the challenge remains to discover new, relevant family-level data. As Alice Reid has shown, considerable advances can be made towards providing a fuller understanding of infant mortality in this period when such sources exist and can be examined and analysed. Local MOH reports, few of which have been examined in detail, contain a wealth of data on this and many other relevant subjects and their further exploitation will no doubt prove rewarding.

The framework developed in the third of this series of papers, coupled with the factors listed in Table 2 above, outline how a better understanding of the influences associated with declining infant mortality during the twentieth century can be achieved.[198] The three-fold grouping of threats, inherited disorders, infection and injury still applies, with infections making up the bulk of infant deaths during the first half of the century. As these began to be controlled, neonatal deaths, many of which had a pre-natal cause, gradually began to assume greater importance as they were harder to reduce because many of their causes remained unknown. Violent

198 Galley, 'Infant mortality in England 1538-2000: stability and the beginnings of change', Figure 15, p. 203.

Figure 18 **Legitimate and illegitimate stillbirth rates (SBRs) and infant mortality rates (IMR)s, England and Wales, 1905-1950**



Sources: Infant mortality rates—Registrar General, *The Registrar General's Statistical Review of England and Wales for the Year 1951, Part 1* (London, 1953), p. 5; stillbirth rates—Office of National Statistics, *Review of the Registrar General on Deaths in England and Wales, 2000, Childhood, Infant and Perinatal Mortality Statistics,* Series DH3 no. 33 (London, 2002), p. 108.

deaths were always of minor importance, but those caused by birth injuries gradually diminished. As far as interventions are concerned some, such as vaccinations for the common childhood diseases of diphtheria, whooping cough and measles, are easy to assess given that these causes of death were relatively well-defined. Other types of intervention remain more intractable and the fact that these acted in conjunction with each other may mean that it is impossible to disentangle the precise effect of any one single factor. However, two important influences on infant mortality, illegitimacy and breastfeeding, seem especially worthy of further consideration.

Figure 18 shows illegitimate stillbirth rates and IMRs during the first half of the twentieth century. As appears to have been the case in previous centuries, in 1900 the illegitimate IMR was about twice the legitimate rate. However, as was apparent during the Second World War, this differential narrowed considerably so that by 1950 the illegitimate rate had reduced to 39 with the legitimate rate being 28 (28 per cent lower). Illegitimate and legitimate stillbirth rates also declined, but the differential only narrowed slightly (from 1.36 times in 1928 to 1.31 times in 1950). There was certainly no reduction in the stigma attached to illegitimacy during the first half of the twentieth century, but it seems those maternal and environmental factors that weighed so heavily against the survival of illegitimates must have lessened. The growth of adoption, both formal and informal, especially after 1918, should also not be ruled out as a contributing factor and the impact of illegitimacy on infant mortality needs investigating in much greater detail.[199]

The other factor that has been the focus of so much discussion in this series of papers is breastfeeding. Around the beginning of the twentieth century maternal breastfeeding was promoted as the means by which infant deaths, especially from diarrhoea, could be reduced and the targeting of specific high-risk mothers was seen by many to be the key to reducing IMRs in those predominantly working-class areas that suffered the most. Useful, precise data on the extent and duration of breastfeeding are hard to discover, but Valerie Fildes thought that breastfeeding rates were very high in most working-class districts in London between 1900 and 1920, at least in the first few months of life.[200] Data about breastfeeding rates can be found in MOH reports, although these are often surveys of living infants or reported feeding methods at time of death.[201] Consequently, they are difficult to interpret. It would seem, therefore, that the initial decline in infant mortality was aided by longer periods of breastfeeding, lower levels of supplementary feeding and perhaps better hygiene, although this needs to be confirmed with additional data. However, over the course of the twentieth century, breastfeeding rates declined and artificial and supplementary feeding increased as the notion of 'scientific motherhood' gained hold. Breastfeeding rates probably reached their nadir at or about 1960, although they recovered afterwards so that now breastfeeding rates are higher even though they are not necessarily prolonged.[202] It is however difficult to discover exact data on

199 See J. Keating, *A Child for Keeps: the History of Adoption in England, 1918-45* (Basingstoke, 2008) for a general discussion of adoption in this period.

200 V. Fildes, 'Breast-feeding in London, 1905–19', *Journal of Biosocial Science* 24 (1992), pp 53-70, https://doi.org/10.1017/S0021932000006799.

201 See Greenwood, *Annual Report upon the Health of Blackburn for the Year 1908*, p. 35 for example.

202 G. Thorvaldsen, 'Was there a European breastfeeding pattern?', *History of the Family* 13 (2008), pp 283–95, here at p. 293, https://doi.org/10.1016/j.hisfam.2008.08.001. For mid-century Britain see J.W.B. Douglas, 'The extent of breastfeeding in Great Britain in 1946, with special reference to health and survival of children', *Journal of Obstetrics and Gynaecology of the British Empire*, 57 (1950), pp. 335-61. Much of the discussion of changes in breastfeeding rates during the twentieth century has focused on America; see R.D. Apple, *Mothers and Medicine: a Social History of Infant Feeding, 1890-1950* (Madison, 1987); J.H. Wolf, *Don't Kill Your Baby: Public Health*

breastfeeding rates beyond 1920, but as IMRs, and diarrhoea deaths in particular, declined MOHs appeared to be no longer concerned about this issue.[203] It must therefore have been the case that households developed both the knowledge and ability to effectively sterilise infant feeding bottles and this counteracted the negative effects of artificial feeding. Once again more quantitative and qualitative data are required to fully delineate these patterns and it is also necessary to discover the reasons why mothers were so willing to abandon breastfeeding.

In many ways more is known about infant mortality during the twentieth century than in other periods. It is certainly the case that sufficient data exists so that patterns and trends can be described in considerable detail. However, much less is known about how and why change came about and the way that many of the factors listed in Table 2 operated still remains obscure. While in some instances this may always remain the case, further progress is still possible into the causes of infant mortality decline and the following section gives some indication of how further research can be undertaken.

Issues

The issues that need to be addressed are similar to those listed at the end of the third paper in this series.[204] The 100-year confidentiality 'rule' also means that the sources readily available for the twentieth century are also similar and indeed the challenge remains to discover new ones that are able to shed light on the causes of infant mortality decline. With the broad outlines of change being well understood, it would seem that at present the greatest progress can be achieved by examining the reasons for variation between different places, within social groups and in the pace of change. Indeed, throughout the whole of the period 1538-2000 much of the focus of these series of papers has been placed on the variety of local experience. However, all local studies also need to acknowledge and account for the fact that the secular decline in infant mortality was both a national and indeed an international phenomenon. With this in mind what follows gives some indication of the types of research that can be readily undertaken.

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and the Decline of Breastfeeding in the Nineteenth and Twentieth Centuries (Columbus, OH, 2001), although both books provide little quantitative evidence of breastfeeding rates. S.M. Crowther, L.A. Reynolds and E.M. Tansey (eds) *The Resurgence of Breastfeeding, 1975-2000*, Wellcome Witnesses to Twentieth Century Medicine 35 (London, 2009), pp. xxii-xxvii discusses reasons for the decline in breastfeeding rates, while the rest of the volume addresses the reasons why rates increased after 1975.

203 The benefits of breastfeeding both for the infant and mother are well established. For a recent discussion see C.G. Victora, R. Balh, A.J.D. Barros, G.V.A. Franca, S Horton, J. Krasevec, S. Murch, M.J. Sankar, N. Walker and N.C. Rollins, 'Breastfeeding in the 21st century: epidemiology, mechanisms, and lifelong effect', *The Lancet* 387 (10,017) (2016), pp. 475-90.

204 Galley, 'Infant mortality in England, 1538-2000: stability and the beginnings of change, 1837-1910', pp. 206-9.

(1) While most places recorded increases in infant mortality in 1911 there were considerable local variations and, as Table 10 showed for Lancashire, apparently similar towns sometimes had very different experiences. An analysis of the reasons why these variations occurred should prove illuminating both with respect to the effectiveness of local sanitary measures and the precise way in which climate influenced mortality rates.

(2) It would also be useful to examine local variations in 1904 and 1906, years with excess diarrhoea deaths, along with other years such as 1921 and 1933 when the climate was challenging, but mortality did not appear to increase. It is also necessary to discover the extent to which specific improvements in infant welfare provision, such as the introduction of health visiting, affected a community's response to these climatic threats.

(3) The impact of the two world wars is worthy of further investigation. Intuitively many have assumed that these events should be associated with increases in infant mortality, but this was not the case. It is therefore desirable to examine any initiatives that were undertaken during both wars to reduce infant mortality rates (IMRs) and to discover the extent which these were directly related to the wars or merely the continuation of previous infant welfare measures.

(4) The 1930s also warrant further investigation to see whether the infant mortality decline that is evident at the national level was also apparent to the same degree in the most depressed parts of the country where unemployment rates were very high. It would also be interesting to examine whether other demographic measures such as fertility, which was low during this decade, and mortality rates at higher ages were similarly affected.

(5) Given that much of the decline in infant mortality during the first half of the century occurred within the post-neonatal component, an examination of early childhood mortality (1-4 years) should be able to indicate whether similar factors were responsible for both declines.

(6) It has been argued that direct infant welfare promotions were only partially responsible for the 'maternal awakening' that many see as key to the secular decline in infant mortality. More needs to be done to understand how issues relating to infant health and infant feeding were more widely disseminated. As a first step in this process newspapers and women's magazines could be searched for information on these topics.

(7) More needs to be discovered about infant feeding practices. Medical Officer of Health reports sometimes include details and an examination of a wider range of annual reports for the first two decades of the century would enable

a comparison to be made with the rates calculated by Valerie Fildes for London. It would also be interesting to discover exactly when maternal breastfeeding rates began to decline and how an adverse effect on IMRs was averted.

(8) Causes of death became increasingly accurate and reliable over the course of the twentieth century and, while taking into account changes in reporting practices and the adoption of the ICD classification system, a detailed analysis of these data could give an insight into exactly when certain diseases began to be controlled, although some medical knowledge is required to decipher the ever-increasing complexity of the terms that were used.

(9) An examination of the changing differential between illegitimate and legitimate IMRs should shed further light on the reasons for infant mortality decline.

(10) Additional sources, similar to those used by Alice Reid, could be searched for that give details of the socio-economic position of the mother and her infant. These might include health visitor records, archives of voluntary groups working in the field of infant welfare and hospital records.

(11) In the short term at least, MOH reports probably have the greatest potential to provide insights into the secular decline in infant mortality. These reports contain a wealth of data and, as yet, their potential has not been fully realised.