ENVIRONMENTAL FACTORS IN DIFFERENTIAL INFANT and child MORTALITY DECLINE IN ENGLAND AND WALES CIRCA 1895 TO 1910

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PATRICIA A WATTERSON

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ABSTRACT

The purpose of this research was to test the hypothesis that environmental factors made a greater contribution to the differential decline in infant mortality during the early Twentieth Century than did improvements in the standard of living.

Infant mortality levels were estimated from retrospective reports of currently married cohabiting women under 45 years of age, who were enumerated in the 1911 Census of England and Wales. They span the period from approximately 1895 to 1910. Material in the published tables are used to create two data sets, one in which the unit of disaggregation was husband's occupation and the other in which it was place of enumeration, for towns, cities and urban districts with fifty thousand or more inhabitants in 1911, and referred to both in the census reports and hereafter as the Great Towns.

Two hundred occupations or occupational groupings included sufficient couples to produce robust enough estimates, and as well as their occupation, their class and the extent to which they were urban dwellers was also known. Income level for ninety-five of the occupations was obtained from the Board of Trade Hours and Earnings Survey.

For the Great Towns it was possible to obtain directly from the census tables, or otherwise to estimate, the type of administrative local authority of the town, its poverty level, a measure of urban development and selective occupational migration. For both major groups it was also possible to control for fertility decline.

Infant mortality by father's occupation underwent an average decline of 36% from a peak level of 132 deaths per 1000 births with wide variation about the mean. Analysis of this data set suggested that the removal of poor environmental conditions was particularly important. Highly urban occupations experienced steeper declines from higher peaks than did rural ones. However, income only explained variation in the decline at very high levels although it was also likely to be associated with other possible explanatory variables, such as education.

In the Great Towns average decline in infant mortality was 35% from a peak of 146 deaths per 1000 births. In this data set the rate of urbanisation over twenty years which was used as the index for environmental effects accounted for a significant proportion of the differential decline, while measures of poverty, of either level or change explained little additional

variation. There was no evidence for concluding that selective occupational migration had distorted the urbanisation effect.

There were no strong reasons for concluding from analysis of either data set that fertility decline had an important effect on infant mortality, although it was likely to have been important to the overall decline.

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As always I take responsibility for any errors and shortcomings in this thesis.

LIST OF CONTENTS

LIST OF TABLES

LSIT OF FIGURES

Figure 8.1 - The Demographic Transition and the Contribution of Infant Deaths: England and Wales, France and Sweden.

CHAPTER 1

INTRODUCTION AND BACKGROUND TO INFANT MORTALITY IN NINETEENTH CENTURY ENGLAND AND WALES

INTRODUCTION

1.0 This thesis is concerned with the causal influences on the differential decline in infant mortality in England and Wales at the end of the nineteenth and beginning of the twentieth century. Infant mortality remained high and almost constant at about 155 deaths per 1000 births since vital registration began in 1838 and saw its final peak of 163 in 1899 after which it entered a long and sustained decline which continued beyond the period of this investigation which ends in 1910, (Figure 1) (1).

What is particularly interesting is that while infant mortality maintained a plateau for the sixty-two years since vital registration began in 1838 until the end of the Nineteenth Century, the same was not true for mortality under age 5, which had begun to decline in the 1870s. This is a major consideration which must be borne in mind when trying to determine the causal influences on infant mortality. It suggests that one of two sets of conditions prevailed. The first is that conditions which were necessary and sufficient for the fall in mortality under age 5 at this time were necessary but not sufficient for a fall in infant mortality. One may assume from this that the first decade of the Twentieth Century witnessed the arrival of those causes or

conditions which interacted with those which had allowed the decline of childhood mortality generally to have begun thirty years earlier. The second set of conditions to have prevailed would suggest that the causal influences on infant mortality were different from those on childhood mortality decline generally. We take the position that the former set of conditions is the more likely. In the search for that set of causes which allowed infant mortality in England and Wales to decline in the first decade of this century we should take account of the causes to which general mortality decline in England and Wales in the Nineteenth and Twentieth Century, and infant and child mortality in the Twentieth Century have been ascribed, as well as the findings of those who have investigated mortality decline in other European countries.

1.1 For the most part general mortality decline in England and Wales has been attributed to socio-economic, environmental and demographic factors either alone or in combination as well as influence outside these categories. McKeown and Record concluded that, in order of importance, the factors responsible for mortality decline were a rising standard of living, environmental improvements introduced in the sanitary revolution and a change in the relationship between the host and the disease organism which favoured the host

(2). Their attribution of the relative importance of causal factors is done indirectly through an analysis of mortality decline by cause of death rather than directly. This is not very satisfactory both because of the piecemeal approach and because the authors do not appear to take account of relationships between factors. In addition they rank the causal influences via a process of elimination rather than by adopting a more systematic approach.

Friedlander, Schellekans, Ben-Moshe and Keysar adopt a different and more rigorous method (3). Their analysis of life expectancy by registration district uses both census material and vital registration records and is basically three cross-sectional analyses reported together. Districts were categorised according to socio-economic type and the authors conclude that environmental and demographic variables were the most important ones for explaining differences in life expectancy in the second half of the Nineteenth Century with social stratification variables increasing in importance toward the end of this period. Their findings are consistent with those of McKeown and Record but are more useful from our point of view because of the greater specificity involved in their analysis.

Lewis-Faning, in a paper which he published in

1930 reviewed mortality in William Farr's 63 healthy districts of England and Wales during the period 1851 to 1925 (4). He pointed out that the healthy districts were those which had experienced no growth or decline in industry but were stationary in this respect. He drew attention to the need to distinguish between industrialisation and urbanisation with respect to the explanation of mortality variation. This is particularly well advised from our point of view since environmental improvements during the period of our investigation are likely to have taken place in urban contexts, which did not necessarily accompany industrial development.

Without leaving the area of general mortality but considering now the Twentieth Century we note that Benjamin attributes the greatest obstacle to healthy urban living and hence by extrapolation to life itself in the first half of the Twentieth Century to poverty, with limitation of preventive and curative medicine playing smaller roles (5). He argues that by the end of the Nineteenth Century British towns had already seen the necessary improvements in the environment in terms of, for example, sewage disposal. We would contend that these changes were not quite as sweeping as Benjamin would have us believe and that considerable variation in environmental conditions prevailed.

Webster writing on the 1930s also argues that poverty was the most important factor in the level of mortality and morbidity, stressing especially low wage or high unemployment and pointing out the failure of social intervention to ameliorate the worst effects of poverty at this time (6). The implication for the period under study therefore is related to the association between infant mortality decline and the proportion in receipt of Poor Law relief.

This is a suitable point to introduce the papers by Rodgers (1979) (7) and Preston (1975) (8) on the distribution of income as well as its level which Rodgers found to be strikingly related to life expectancy; although he used cross-sectional data from 56 less developed countries his findings are nevertheless pertinent especially since he considers mortality in three ways (life expectancy at birth and at age 5 and infant mortality). The findings of Preston are similar.

We turn now to Fox's (1979) paper which was less concerned with the causes of mortality as such than with the kind of variables by which it is useful to disaggregate mortality indices (9). All the same, parts of the paper are illuminating for our purposes, for he cites three environment linked variables in particular, housing tenure, size of dwelling and degree of overcrowding as

being useful for differentiating standardised mortality rates.

Since we turn now to what has been written about the influences on infant and child mortality specifically it is sensible to begin with fertility decline, although it is more often causality in the reverse direction which is considered. Declining fertility can have two kinds of impact on infant mortality, one demographic, the other socio-economic. With a decline in fertility one would expect that there would be fewer births to older, high parity women (Woods, 1984) (10) and therefore fewer infant deaths through congenital malformation. Such would be the demographic influence. The socio-economic effect would work by allowing food, child care or any other commodity to be shared among fewer offspring and would operate at whatever standard of living prevailed. Woods (1983) discusses this effect indirectly in a paper devoted to the relationship between fertility and standard of living (11).

Similar influences, as one would expect, have been cited for the decline of infant and child mortality as for general mortality. In discussing these we begin with the work related specifically to the period we investigate in this thesis. Preston, Haines and Pamuk (1981) associate child mortality variation (2q0, 3q0, and 5q0) with

socio-economic development accompanied by changes which improved the health advantages for urban dwellers (12). They also used the 1911 Census of England and Wales, but their research differs in a number of ways from that presented in this thesis. For example, they undertake a cross-sectional analysis rather than a direct investigation of mortality decline. Furthermore, by estimating child mortality in sub-populations for which only one explanatory variable is available they deprive themselves of the opportunity for more sophisticated analysis. By doing this they fail to take adequate account of the very mechanisms which they purport to be interested in, namely mechanisms through which other (than health measure) elements of the developmental process affect mortality. Haines (1985) also uses the 1911 Census of England and Wales to compare inequality and child mortality with the relationship in the United States in 1900 (13). By treating childhood mortality as an indicator of socio-economic well being, Haines, by implication, assumes that intervention which would reduce mortality irrespective of socio-economic position could not have taken place. Despite these criticisms, however, these analyses are useful for guiding the choice of explanatory variables.

Winter (1982) concludes that an improvement in living standards was the most important factor in

the decline in infant mortality during and following the First World War (14). He dismisses fertility decline, medical intervention, health administration and attributes the improvements in mortality to the remaining possible cause. In terms of the way he states his conclusions he appears to take a McKeown-like approach i.e. explanation through elimination. On the other hand, when he argues that during the war the labour market operated in such a way as to facilitate the decline in poverty while no housing or sanitation improvement took place due to the pressure to spend money elsewhere the logic of his argument is persuasive and therefore adds weight to his general conclusion.

Laux (1985) takes a different approach in his analysis of infant mortality (inter alia) differentials in Prussian cities in 1905 (15). Although urban/rural differences are considered the main interest is in the inter-city differentials in mortality. Laux suggests that variation is caused by two groups of factors, those related to the physical and social characteristics of urban environments and hence mainly economic, and those related to socio-cultural determinants. The author concludes that it is the socio-cultural factors and a city's location which explained variation in the causes of death primarily responsible for infant and

child mortality, that is, digestive system diseases, infectious diseases, prematurity and immaturity. However, he also found that, not surprisingly, diseases were associated with specific urban living and working conditions. Since bronchitis and pneumonia deaths formed a substantial element of overall infant mortality in the first decade of this century this finding should be borne in mind.

Later in the Twentieth Century a group of researchers headed by J. N. Morris and J. A Heady (J. N. Morris et al., 1955) undertook an inquiry into the 80,000 stillbirths and infant deaths which occurred among the 1.5 million births in 1949 and 1950. It is the results of the analysis of the infant deaths to the single, legitimate births in 1949 in England and Wales which are of particular interest here. For the researchers, in this case J. N. Morris, J. A. Heady, C. F. Stevens and C. Daly (Lancet, 5.3.1955), demonstrated that social class, region and mother's age and parity had independent effects on the neonatal and post-neonatal mortality rate (16). For all regions together the highest post-neonatal rates obtained where the mother was under 25 years, of parity 4 and over and in social classes 3, 4 or 5. When age, parity and region were considered the highest rates occurred when the mother was under 25 years, of parity 4 and over and lived in Wales at the

time of the birth (53.9 per 1000 births) or in the North (49.4 per 1000 births); overall the North tended to have high rates when various combinations of age and parity were considered for both neonatal and post-neonatal deaths. Their findings on the independent effect of region is especially useful for the research undertaken here.

Perhaps the most illuminating and useful work from our point of view is that of Sir George Newman who wrote a book in 1906 entitled Infant Mortality: a Social Problem (17). His work has the advantages of being that of a contemporary and of someone well qualified in the field in which he wrote. He was at the time lecturer in public health at St. Bartholomew's Hospital. His work covers the possible factors well, but the book has two drawbacks; in his statistical analysis he covers only counties, which are too large and heterogeneous to yield the answers in which we are interested, and because his book was published in 1906 it cannot deal with the first decade of infant mortality decline in England and Wales. It is possible, that writing when he did, he was not aware that the decline was already under way. Nevertheless he addresses himself to some important issues of that decline, namely ante-natal influences on infant mortality, married women's employment, the conditions surrounding

diarrhoea, and infant feeding. Newsholme's report (1910) as Chief Medical Officer to the Local Government Board addresses similar issues, but both men have been criticised for taking a biased view of mothering and for ignoring exogenous factors (18).

The other contemporary work of note is the Report of the Inter-Departmental Committee on Physical Deterioration which was published in 1904 (19). As the title suggests the main brief of the committee was related to physical deterioration, to determine what steps were necessary to provide the government with comparative data on it, to show its causes and to point out how it could be reduced. However, there was considerable discussion on infant mortality, which, while refuting the eugenist point of view to some extent, tended as with writers of our own time, to dwell on the role of the mother, although blaming rather than defending her.

For writers on infant mortality in England and Wales specifically we turn finally to three who have cited individual influences on infant mortality decline or variation. First there is Dyhouse (1978) who, to be strictly accurate was concerned with two influences, although they were closely interrelated (20). After a review of the contemporary material on the subject she concludes

that the two influences viz: the employment of married women and the care which working class mothers gave their children were not necessarily the main influences on infant mortality, although she points to the need for further research before an adequate explanation of the decline in infant mortality could be offered.

On the other hand, Beaver (1973) took a more positive approach to the relationship between milk supplies and infant mortality (21). He considers infant mortality in England and Wales between 1840 and 1970 and argues that it went through four well defined phases, one of which was 1900 to 1945 and very nearly encapsulates the period with which we are concerned. During this period, Beaver asserts, improvements in the quality of cows' milk played an important part in the reduction of infant mortality. However, such a general proposition is inevitably an oversimplification, as even Beaver agrees.

Dwork (1987) (22), also addresses the question of milk. She was interested mainly in the pathology of diarrhoeal disease and the role of milk in its transmission. Although she puts forward a strong case for its importance, she also points out that the scientific proof that diarrhoeal disease could be transmitted through contaminated milk did not come until the period with which she deals is

past.

Having reviewed some of the work on general and infant mortality decline or variation which is relevant to this thesis we now select those factors or variables which offer the most convincing explanation of differential infant mortality decline in England and Wales at this time, and whose role it is possible to investigate via the 1911 Census. We would assert that the factors which meet both criteria are fertility decline, poverty level, poverty decline and environmental improvement (Watterson, 1984, 1986, forthcoming 1987) (23). We have stated elsewhere that environmental variables cannot be derived from the data directly and that by necessity we must draw inferences about that improvement based on the results of analysis using proxy variables. The way in which these variables are to be constructed and the justification for their choice is more properly discussed in Chapter 6 which is devoted to the relationship between environmental improvement and infant mortality decline.

In addition we control for selective occupational migration. Our reason for doing so is closely linked to the choice of proxy variable to estimate environmental improvement, that is, urban development. Since urban development occurred through population growth which could not have

been achieved by natural increase alone it is inextricably linked to migration. In Chapter 7, therefore, we discuss the role which selective migration may have played either in distorting the effect of one or more explanatory variables, or in reducing infant mortality directly. The choice of the migration variable and its derivation will be, as with environmental improvement, discussed in the relevant chapter.

We have listed the explanatory variables which will be used to try to explain differential infant mortality decline in England and Wales. In this thesis we cannot address ourselves to the role of the milk supply in that decline. We believe that Beaver's interpretation is, as he admits, perhaps too simplistic. However, it will be excluded from the analysis due to the lack of a suitable data source from which an appropriate explanatory variable could be derived, rather than for any other reason. For while we reject Beaver's interpretation as a unicausal explanation it is likely that improvements in the milk supply did have an independent effect which was probably enhanced by interaction with other variables.

It will also be necessary to exclude from our analysis the roles of women's employment and working class child care, the factors in which Dyhouse was particularly interested. The latter is

especially difficult to assess and the major data source to be used does not allow such influences to be investigated.

1.2 The research for this thesis is justified on the basis of two sets of arguments, the first of which has already been briefly mentioned. Infant mortality levels between the beginning of vital registration in 1838 and the final peak in 1899 remained remarkably constant, usually between 150 and 155 deaths per 1000 births. Particular years showed rates higher than this and in the 1880s the overall level declined somewhat to rise again in the 1890s. In contrast child mortality at other ages under 5 started to decline earlier. The results of this research will be important, then, if the particular factors which causally influenced the start of the decline after 1899 can be identified.

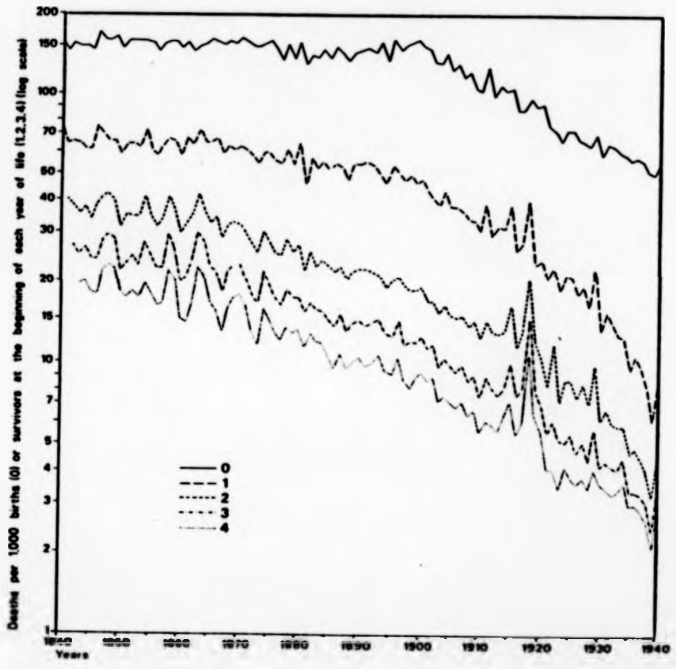
In addition, the research will aid the understanding of the contribution of infant mortality decline to that of general mortality as far as the proportion of all deaths which were infant deaths changed over the period.

1.3 In summing up we will review the form which this thesis will take. In the next chapter we state precisely the aims of the research and the particular hypotheses which will be tested as well

as indicating the data sources which will be used. Chapter 3 is devoted to the description and justification of the demographic methodology which is used. Chapter 4 analyses and discusses the role of fertility falls in the differential infant mortality decline. Chapter 5 is devoted to the importance of poverty, by examination of both cross-sectional and trend estimates. For analysis of the Great Towns data set the influence of poverty has to be estimated indirectly. The chapter therefore discusses the methodology used as well as the results of the analysis. Similarly in Chapter 6, which addresses itself to environmental improvement, the indirect measurements will be discussed before we proceed to the importance of the factor in the mortality decline. Chapter 7 deals with the role of selective occupational migration in that decline. The estimation of migration effects is particularly important, not because the period as such was one during which a great deal of migration took place, but because of the possible confounding of migration with environmental improvement. We are dependent in this analysis upon indirect estimation, both of the dependent and some of the independent variables, and there is no topic of which the is more true than environmental improvement. That variable is estimated in such a way that it is inextricably linked with migration so it is important to

isolate the two effects to the extent it can be done. The final chapter, number 8 draws together the findings of the previous four and after discussion comes to some conclusions. Reference will be made to the relation of infant to general mortality decline. In this chapter also we take the opportunity to speculate further on those influences which could not be investigated here, since what has been done in this thesis helps to identify these more precisely.

Figure 1.1 - Childhood Mortality under Age 5 by Single Years, England and Wales 1840-1940.



Notes

1. The sources for death rates by single years of age in figure 1 are: 1838 to 1870, Annual Report of the Registrar General 1870. PP 1872/xvii; 1870 to 1980, Report of the Medical Officer of Health to the Local Government Board. PP 1910/xxix; 1906 to 1940, Annual Reports of the Registrar General 1904 to 1940, London: HMSO 1906 to 1942.
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CHAPTER 2

AIMS, HYPOTHESES AND DATA SOURCES

2.1 INTRODUCTION

This chapter falls into two main parts which can again be subdivided. The first part introduces the aims of the thesis, the hypotheses which it is proposed to test and the types of conclusions to be drawn. The second part is devoted to the data sources, their description and in the case of the most important source, the 1911 Census of England and Wales, the robustness and suitability to the task.

2.2 The aims of this research are to identify whether differentials in the trends in the infant mortality decline in England and Wales which began in the first decade of this century and continued beyond the period of our investigation, can be attributed either to improved nutritional status, proxied here by general improvements in the standard of living, or to improved environmental conditions. Standard of living will be measured by income and social class in one of the two data sets which we will analyse (the Occupations data set) and by indirect measures of poverty in the other (the Great Towns data set). Urban development will be the proxy variable which will be used to measure environmental improvement in Great Towns. Since the link between urban development and environmental improvement may not be apparent, detailed discussion of the

justification for using it will be reserved for the chapter which deals specifically with the issue. Since it is infant mortality whose differential decline we seek to explain we will control for fertility change. Furthermore, in the analysis of infant mortality in the Great Towns we will control for selective migration since that analysis will be based on data derived from couples who were enumerated there in 1911 but some of whom will have resided elsewhere in earlier years. Constrained by the form of the data, which restricts analysis to the aggregate level we cannot be more specific about our aims. Nevertheless, as we argue later the research produces findings which are both original and useful.

2.2.1 We are now in a position to state formally our hypotheses. The main hypothesis states that environmental improvements had a more important effect on differential infant mortality decline in England and Wales between 1895 and 1910 than did improvements in the standard of living. The subsidiary hypothesis states that the environmental effects were enhanced by poverty declines. Environmental effects are defined here as those associated with domestic water supply, sanitation, sewage disposal and house refuse disposal.

2.2.2 We attempt to draw conclusions about differential infant mortality decline along the following lines. First, as stated in our hypothesis we will try to establish whether improvements in the standard of living or in environmental conditions were the motive force which drove infant mortality at last into an irreversible decline at the beginning of the century. In addition we examine the interaction of these two factors. Thirdly, we draw some conclusions about the relationship between declining infant mortality and increase in life expectation at birth. Finally, we speculate about the factors responsible for the proportion of variation in infant mortality decline unexplained by the research.

2.3 The major data sources which will be used are the published reports of the 1911 Census of England and Wales. The 1911 Census is unique among British Censuses in being the only one to have included questions to currently married cohabiting women not only about their fertility but about their children's mortality as well. These questions were included in the census schedule because of the concern expressed at the time about the high levels of fertility among working class people compared with that of higher social classes. Since the formulators of the questions were interested in effective fertility, i.e. net

of mortality, questions about the number of children ever born to each co-habiting couple and the number which had died were included (1). The question of estimating effective fertility via the census was first introduced in the Report of the Inter-Departmental Committee on Physical Deterioration (2). While the main concern of the committee was whether physical deterioration was inherited, and its effect on the size and strength of that body of men who would fight future wars, the report dwelt on the issue of high infant mortality, seen mainly as a consequence of the poor quality of mothering and of ignorance.

The results are tabulated in a number of ways, of differing relevance to the thesis. The two most important tables which form the basis of two data sets for analysis are those which, for women who were under 45 years old on census night, give the number of children born and dead for the 206 most common (male) occupations and those which give the same information for women enumerated in London and the other 96 towns and cities which had 50,000 or more inhabitants in 1911 (3). The data which are derived form these tables will be referred to as the Occupations set and the Great Towns sets respectively.

2.3.1 For each Occupation or Great Town in the data sets the data presentation is in a uniform

way. The number of couples, number of children born and number of children dead are disaggregated as follows: the marriage durations are 0 to 2 years, 2 to 5 years, 5 to 10 years, 15 to 20 years, 20 to 25 years and 25 to 30 years; within each duration the following ages at marriage are distinguished, 15 to 19 years, 20 to 24 years, 25 to 29 years, 30 to 34 years and 35 to 44 years. The data are also given for age at marriage for all durations, and the total number of couples, children born and children dead. In order to apply the indirect demographic technique described in Chapter 3 it is necessary to aggregate durations 0 to 2 years and 2 to 5 years. The durations 0 to 5 years, 5 to 10 years and so on are taken as 0 to 4 years, i.e. up to 5 years, 5 to 9 years i.e. 5 and up to 10 years and so on, to make them agree with the conventions for the application of the technique.

2.3.2 In addition to the tables which provide the material for the infant mortality estimates, further tables give information which is used for the indirect variables. For the Great Towns they contain data on the area (in acres), the number of houses which were inhabited, uninhabited, under construction and their total number, the number of families, the number of persons, the category of town, i.e. county borough, municipal borough or urban district, the county and registration

division which the town was in and the number of employed males and females in various occupations. For the Occupations set data for some of the explanatory variables are contained within the same tables which give the fertility and child mortality measures. They are occupation order, occupation sub-order and social class. Other materials which are used are given in the occupation volume of the census report and show the distribution of males and females in different occupations by urban and rural area. The 1891, 1901 and 1911 Census Reports were also consulted, Command Numbers 6948, 6948-I, 7222; 1523, 1826, 2174; and 6258, 6259, 6576, 6577, 7018, 7019 respectively (4).

2.3.3 Although particular steps were taken to establish the robustness of the 1911 Census data with respect to the indirect techniques used, it is appropriate to point out at this stage that its quality in more general terms was assessed by the report compilers both in terms of the coverage and with respect to the accuracy of the information given. The latter was verified by using vital registration records and the conclusion reached was that the quality of the census returns was high (5).

2.3.4 We have referred to the uniqueness of the British Censuses of 1911 for their inclusion of

questions about child mortality as well as about fertility and to the wide range in the resulting tabulations. As a consequence of these two factors the Censuses have been of interest to other researchers. The 1911 Census of Ireland has been used in work which estimates male fertility (Anderson, 1975) (6) and in the development of reproduction simulation models (Barrett and Brass, 1974) (7). That for England and Wales has been used for an analysis of fertility decline (Szreter, 1983) (8) and for infant and child mortality (Preston, Haines and Pamuk, 1981 (9); Haines, 1985 (10)).

2.3.5 Income data for occupations are derived from the Board of Trade Enquiry into the Hours and Earnings of Labour of Workpeople in Britain in 1906 (11). This survey covered a number of sectors of the economy including textile manufacture, steel making and general engineering, chemical manufacture, the railways and agriculture. As the title suggests, the professions were not covered. Furthermore, several categories of manual occupation were also omitted. In order to achieve a better distribution of incomes across social class, Guy Routh's book "Occupation and Pay in Great Britain 1906-79" (1980) provided a limited range of professional incomes, mainly in social class 1 (12).

2.3.6 Other data sources to be used in conjunction with the Occupations data set are the Annual Returns of Barrack Accommodation 1892, 1896, 1901, 1903, 1905, 1909 and 1910 and the Barrack Synopsis of Accommodation for the years 1878 and 1911 (13). These will be called upon to illustrate the housing practice and by implication the environmental differences between the British Army and the Royal Navy over the period of investigation.

2.3.7 Data sources which will be used in conjunction with the Great Towns data set to verify the suitability of the proxy variable for environmental improvement are as follows. First, there is the Internal Sanitary Survey carried out from 1893 to 1895 of non-riparian or port towns (14). Ports and riparian towns were dealt with separately owing to the special nature of the survey required (15). Unfortunately, the form of this survey differed so dramatically from that of the other towns that its results cannot be used. This is a considerable disadvantage since they were often large and important towns, knowledge of whose sanitary environments would have been extremely useful in assessing the overall improvement in sanitation.

In addition, Medical Officer of Health Annual Reports for all or part of the period 1892 to 1910

are examined for the following towns: Bath, Birkenhead, Coventry, East Ham, Edmonton, Enfield, Leyton, Liverpool, Smethwick, Southend on Sea, Walthamstow and Warrington (16).

2.4 As we have stated, Chapters 4 to 8 inclusive will deal in greater detail with the findings of the analysis. At this point, however, a short summary of the most important findings is given.

2.4.1 Infant mortality in England and Wales declined by approximately 35% during the period 1895 to 1910. The estimates from each data set are 34.67% for Great Towns and 35.36% for father's occupation. This agrees well with vital registration measures which indicate that infant mortality fell 32.52% from 1899 to 1910.

2.4.2 Fertility falls had a small independent effect on infant mortality decline in both data sets, but only where the change was at its relative highest. Hence infant mortality decline was 38% and 40% in the Great Towns and Occupations data sets respectively for the category of greatest fertility fall.

2.4.3 Poverty level rather than reduction was more important in the decline of infant mortality. Poverty reduction did not differentiate infant mortality in the Great Towns, where it could be

estimated reasonably well. Neither was overall poverty level very important in the Great Towns, with the decline going up to only 37% in the least poor towns. Only where income was very high was there a differentiation of infant mortality decline by father's occupation; where it fell 41% at incomes of 116.00 to 160.00 per year and 57% for incomes greater than 160.00.

2.4.4 Environmental improvements or conditions were much more important in explaining variations in infant mortality decline. In the Great Towns the mortality fell 40% from its peak at high urban development (environmental improvement) levels compared with 32% at lower levels. For decline by occupation the environmental effect was related to the variation in the proportion of the male working population urban resident; for rural occupations the decline was only 26% (but from a lower peak) in contrast with 35-37% for urban occupations, suggesting that towns were able to ameliorate the worst environmental conditions which had not existed as such in rural areas.

2.4.5 No apparent differential effect of selective occupational migration could be detected in the analysis for the Great Towns. Rather the decline was greatest (36%) where selective migration was less than 10% compared with 33% when migration was between 20% and 100%.

Notes

1. Office of Populations Censuses and Surveys and General Register Office, Edinburgh. 1977. Guide to Census Reports Great Britain 1801-1966. London: Her Majesty's Stationery Office. pp. 221-222. These questions were asked of 90.7% of married women in England and Wales, that is all those whose husbands were present on census night.
2. Inter-departmental Committee on Physical Deterioration. 1904. London: HMSO. Cd. 2175.
3. It was necessary to reduce this number to 200 in creating the Occupations data set. This was done by combining occupations of the same social class and occupational order and similar childbearing patterns which were numerically small, as in the case of barristers and solicitors. In addition, tabulations which aggregated occupations in an important occupational order or sub-order were omitted, as in textiles or mining, and some were revised in order to keep the occupational categories mutually exclusive, as with jewellers and watchmakers.
4. Parliamentary Papers. 1893. 1891 Census of England and Wales. Command Numbers: 6948, 6948-I, 7222.

Parliamentary Papers. 1902-1904. 1901 Census of England and Wales. Command Numbers: 1523,

1826, 2174.

Parliamentary Papers. 1912-1923. 1911 Census of England and Wales. Command Numbers: 6258, 6259, 6576, 6577, 7018, and 7019.

5. 1911 Census of England and Wales, Volume XIII, Fertility of Marriage, pp. vii-xi. London: HMSO, 1923.

6. Anderson, B. 1975. Male Age and Fertility: Results from Ireland prior to 1911. Population Index 41: 561-566.

7. Barrett, J.C. and William Brass. 1974. Systematic and Chance Components in Fertility Measurement. Population Studies 28: 473-493.

8. Szreter, S.R.S. 1983. The Decline of Marital Fertility in England and Wales c. 1870-1914: A Critique of the Theory of Social Class Differentials through an Investigation of its Historical Origins and an Examination of Data for the Constituent Male Occupations. Unpublished Ph.D. thesis, University of Cambridge.

9. Preston, S.H., M.R. Haines and E. PaMuk. 1981. Effects of Industrialisation on Mortality in Developed Countries. Pp. 233-253 in IUSSP International Population Conference Proceedings, Manila, Volume 2.

10. Haines, M.R. 1985. Inequality and Childhood Mortality: A Comparison of England and Wales, 1911 and the United States, 1900. Journal of Economic History 45: 885-912.

11. Parliamentary Papers. 1909-1913. Command numbers 4545, 4844, 5086, 5196, 5460, 5814, 6053 and 6556. London: HMSO.

12. Routh, G. 1980. Occupation and Pay in Great Britain 1906-79. London: Macmillan.

13. The Annual Returns of Barrack Accommodation gave the distribution of accommodation by rank and district. The Barrack Synopses contained inventories of accommodation by rank.

14. Local Government Board. 1896. Supplement to the Twenty-fourth Annual Report. Internal Sanitary Survey 1893-5. London: HMSO.

15. Local Government Board. 1895. Report and Papers of the Port and Riparian Survey. London: HMSO.

16. The years which the Medical Officer of Health reports cover are as shown; the full references are given in the bibliography; Bath 1901 to 1910; Birkenhead 1892 to 1910; Coventry 1897 to 1910; East Ham 1892; Edmonton 1892 to 1910; Enfield 1895 to 1896, 1900, 1911; Leyton 1892, 1907 to 1910; Liverpool 1900 to 1910; Smethwick 1895 to 1910; Southend on Sea 1902; Walthamstow 1901 to 1910; Warrintgton 1903, 1908 to 1910;

CHAPTER 3

DEMOGRAPHIC METHODOLOGY

3.0 INTRODUCTION

This chapter on demographic methodology will describe the two main techniques which will be used in the thesis, that is, the estimation of infant mortality decline and of marital fertility decline. The methods of handling other variables are so intrinsically linked to their particular analysis that their discussion is better reserved for the chapters on those topics; Understanding the results will be facilitated if they follow directly the explanation of the particular methodology used.

3.1.1 The use of indirect techniques to estimate infant mortality from retrospective reports from women on the number of children which they have ever borne and the number which have died is now well established in developing countries where appropriate questions are routinely included in census and survey schedules. It is fortuitous for this piece of research that such questions were also included in the 1911 British Census schedules, although due to the different methods of data disaggregation for the component countries, the research has concentrated on the England and Wales census reports (1).

Conventionally indirect methods of estimating infant and child mortality from retrospective

questions fall into two categories, those which use regression coefficients and those which Brass devised (2, 3). Brass was the pioneer of these methods of estimation which model the underlying processes. His logit life table system differs from regression methods in that it applies a mathematical formula to the observed rates directly, without the necessity for criteria to be applied for the selection of the correct pattern of the mortality. This method is considered to be more robust and therefore particularly suitable where there is little sound information on which to choose a pattern. It is based on the finding that logit transformation of probabilities of surviving to age (x), (life table l)(x)(values), results in a relationship between corresponding probabilities from different life tables which is closely linear. This means that theoretically only on standard life table, (although in practice two are commonly used) is required to generate estimates of child mortality in any empirical population with satisfactory accuracy. The method has one particular drawback which precludes its use in this research. It has been developed for data which are disaggregated by age of mother. In addition, the system for examining trends is based on a one parameter representation incorporating assumptions about the relationship between infant and later mortality. Since the thesis argues elsewhere that the factors affecting infant and

other childhood mortality decline were different, it follows that it would be preferable to use estimates of, and trends in infant mortality specifically.

The other group of methods, originally devised by Sullivan uses least-squares regression coefficients to fit the formula:

$$d(x) = k(i)D(i) \quad \ldots\ldots\ldots\ldots (1)$$

to data generated from model fertility distributions and the Coale-Demeny Regional Model Life Tables (4, 5). Sullivan's method allows levels of child mortality only to be estimated. Further developments by Hill and Trussell enable both levels and trends to be estimated (6). They have the particular advantage for this work in being able to make use of women's reports by duration of marriage as well as by age.

3.1.2 Indirect mortality techniques are based on a number of assumptions about nuptiality, fertility and child mortality in the population under study. It is assumed that a child's risk of dying is a function only of age and of no other factor such as birth order or mother's age. Marriage is assumed to be well defined in the study population and marriage, intercourse and childbearing are assumed to be closely linked. Duration of marriage must be accurately recorded, where it is defined as the time which has elapsed since first sexual

union, irrespective of its legal status. Mortality trends are assumed to vary in an approximately linear fashion. Finally the methods assume that fertility has been stable in the recent past (7).

3.1.3 We will now consider the strengths and weaknesses of the method used here in light of the assumptions underlying it and the data to which it will be applied. First, it has the advantage that the level misreporting by duration of marriage is usually lower than that by age and requires fewer restrictive assumptions than do age models (Hill and Trussell, 1977) (8). For example, Fernando (1985) concluded that the Feeney method provides excellent results provided that all the prerequisite conditions are met (9). These include the assumption of constant fertility, uniform age distribution, no relationship between the children's mortality and either the mortality or age of the mothers. If duration groups include all ages at marriage, as they do in the 1911 Census records for England and Wales, then reports from women in duration group 1 (0 to 4 years of marriage) are not unduly contaminated with the experience of women aged 15 to 19 years whose self selection for early childbearing is often associated with higher levels of child mortality(and may be considered to give less accurate reports than older women). Feeney (1980) suggested that with age estimates those from the age group

15 to 19 should be discarded since they tend to be higher than overall estimates in 90% of cases (10). Reports from women in higher duration groups may give better results than those from women in higher age groups. The reports from women used here are truncated at the upper age of 45 years. Thus even women married for long periods are still relatively young and their reports therefore may not be so subject to the common failure to report children born a long time ago who are now living away from the parental home. Multipliers which convert d(i) (proportions dead) to (x)q0 (death probabilities) are independent of the level of mortality, being dependent only on the risk of dying, which is negatively associated with age of onset of childbearing. Sullivan (1972) suggested that the duration model has an advantage over the age model where there may be respondent error in the number of live births since the former is about half as sensitive to parity misreporting as the latter (11).

Feeney (1980), examined the effect of changing mortality on the estimation procedure and concluded that provided the change approximates linearity then the time location estimates are independent of the rate of change (12). Examination of vital registration data on infant mortality confirm that this condition is met in this analysis. The method is also sensitive to

changes in fertility. Systematic movements in fertility in the recent past i.e. in the previous five years, affect the level but not the slope of mortality over time. Variation in the trends in fertility which alters the mean risk of exposure to dying may distort the true relationship with categories of the dependent variable but they are unlikely to have been appreciable in the present case and will certainly not have altered the rankings. This fortunate situation arises because changes in fertility are likely to have been more gradual than is often the case in developing countries, where fertility declines can sometimes occur very rapidly.

Most of the evaluation of child mortality estimation methods has been restricted to those which use reports by age rather than by marriage duration. However, Trussell (1975) concluded that overall multipliers converting proportions dead to probabilities of dying achieved by regression (used here) give a better fit than previous Brass or Sullivan methods (13). Furthermore, the reports of women from the 1911 Census are subject neither to the extent of data inaccuracy not the underestimation of deaths which, so Garenne (1982) argued, would preclude their use (14).

3.1.4 We will now discuss the data requirements for the method and details of its use. To

facilitate this discussion table 3.1 shows the necessary information as well as the resulting mortality estimates. For this method it is necessary to know the number of women in each marriage duration group, the number of their children ever born and the number who have died. Then following calculation can be made:

$$D(i)=CD(i)/CEB(i) \quad \ldots\ldots\ldots (2)$$

where

i = order of marriage duration
(1=0-4 years, 2=5-9 years and so on)

W = the number of women
CEB = the number children ever born
CD = the number of children dead.

D(i) is therefore the proportion of children dead to women in the (i)th marriage duration. It is necessary to calculate:

$$k(i)=a(i)+b(i)(P1/P2)+c(i)(P2/P3) \quad \ldots\ldots (3)$$

k is the multiplying factor which converts D(i) to (x)q0. Average parities P1, P2 P3 required for the calculation of k(i) are calculated from:

$$P(i)=CEB(i)/W(i) \quad \ldots\ldots\ldots (4)$$

They are used in the equation to represent the pattern of childbearing which has existed in the population under study. k(i) itself is not an estimate of mean exposure to risk of dying but adjusts D(i) so that the resultant (x)q0 value is in exact ages.

$$(x)q0 = k(i)D(i) \quad \ldots\ldots\ldots\ldots (5)$$

and

$$1(x) = 1 - (x)q0 \quad \ldots\ldots\ldots (6)$$

a(i), b(i) and c(i) are regression coefficients related to each family in the Coale-Demeny Regional Model Life Tables which were compiled with reference to empirical populations (15). In this research the "West" model has been chosen and reasons for the choice are discussed below. Analysis of differentials in trends in infant and child mortality decline is central to this thesis, so it was necessary to calculate the equivalent 1q0 values for each (x)q0. This was easily done by reference to Coale-Demeny Regional Model Life Tables. Since each (x)q0 can be related to the mean number of years pre-Census the calculation of these equivalent 1q0 provides a significant series. Combined with the estimates of the period in the past to which they relate the trend in infant and child mortality for each sub-population or case can be defined. Hill and Trussell use least squares regression coefficients for the estimation of these reference periods with the equation:

$$t(i) = a(i) + b(i)(P1/P2) + c(i)(P2/P3) \quad \ldots (7)$$

Tables 3.1 and 3.2 show how the input data are transformed to achieve a series of 1q0 estimates at different points in the past, where the average point as a date is calculated by deducting the appropriate t(i) value from 1911.25 (i.e. April

1911).

3.1.5 The dependent variable, which is the proportional (or percentage when multiplied by 100) decline in infant mortality was calculated using the equation:

IMRFALL=1-(1q0,t1/1q0,t(peak))....(8)

It is therefore the percentage decline in the estimated infant death probability from its peak level, whenever it occured, to that point closest in time to the 1911 Census, which for this piece of research was 1.4 years pre-Census or circa 1910. In both the Occupations and Great Towns data sets some cases have peak levels of estimated infant mortality which occurred other than at the beginning of the period. It is not the place here to discuss whether the lower levels of mortality at earlier periods were an artifact of the data or were accurate representations of the experience of the particular subgroup. In the event that earlier reports did give too low levels due to omissions of deaths, the percentage fall over a more closely measured period has also been estimated. In this case the fall from 1902 is calculated from:

MRFALL2=1-(1q0,t1/1q0,t4).....(9)

3.1.6 This section of the chapter would not be complete without some illustration of the empirical evidence which was used to justify, first of all, the choice of method, and then

secondly, the choice of "family" within the Coale-Demeny Regional Model Life Tables. To some extent the two are linked in that the right choice of family from the Coale Demeny models ameliorates the choice of method which, given other circumstances, might not have been used. Essentially, the two decisions hinge on the answers to two questions "Do the estimates accurately reflect the level of mortality" (method) and "Do the estimates correctly reflect the shape of the decline" (family). To answer the first the data in tables 3.3 and 3.4 are produced in evidence. It will be seen that in general the Census estimates are lower than the vital registration measures of infant mortality. This would be expected since the two rates are based on slightly different population. The Census estimates are for legitimate infant mortality only to women who were under age 45 at the time of the Census. On the other hand, vital registration rates include infant deaths of both legitimate and illegitimate births to mothers of all ages. Figure 3.1 shows that census estimates from women under 45 were more like the vital registration measures than those from women of all ages at Census. As far as the choice of family is concerned we can see from table 3.5 and Figure 3.2 that the English Life Table 1901-1910 l(x) values are most highly correlated with those from the West family of Coale Demeny (16, 17). Figures 3.3 and 3.4 show

that the 1910 census estimates of infant mortality (1q0) are highly correlated with the 1911 infant mortality rates from vital registration for both father's occupation and Great Town (r= +0.8554 and +0.8383, P=<0.000001 in both cases).

3.2.1 Fertility Decline

The importance of controlling for fertility decline among the women whose reports form the basis of the Occupation and Great Towns data set is related to the distinction which one would want to draw between factors which are arguably endogenous to the mother (demographic factors) and those which are exogenous (nutritional and environmental factors). Since this thesis is concerned with the relative significance of nutritional and environmental factors it is especially important that such demographic effects as can be, are controlled for. Due to the way in which the reports from currently married women enumerated in the 1911 Census are disaggregated, fertility decline is the only demographic control variable which can be used. No account could be taken of the possible effect of birth order or interval on the decline of infant mortality during the period under consideration. In summary then fertility decline is used to examine its proximate demographic effect on infant mortality decline and to distinguish between its effect and that of

other variables especially chosen to stand for income and environmental improvement. The particular method which has been employed here is devised by taking into account the predicted pattern of natural fertility and deviations therefrom. The concept of natural fertility originated from Henry (1961) (18) who stipulated it as being:

> ".....the fertility of populations which takes recourse neither to contraception nor induced abortion".

Subsequently some of the estimation problems associated with natural fertility have been discussed by Coale et al. (1975), while Knodel (1983) has pointed out the difficulties involved in determining when fertility is natural, controlled, or in an intermediate "ambiguous" category (19, 20). While its level varies with social practice such as length of breastfeeding which affects post partum amenorrhoea (Bongaarts, 1976) natural fertility has a characteristic pattern, deviations from which can be expressed mathematically and hence be used to make inferences about fertility control (21). The choice of the particular method of estimating fertility decline rests also on two decisions. Since the estimate are derived from the same data set as for mortality they must by definition refer to the same groups of women. There are, therefore, no difficulties to overcome in terms of numerators and denominators applying to different

populations. The second reason is one of necessity. No other source of occupational fertility data were routinely published for the period under investigation, although crude birth rates or general fertility rates could have been calculated for the Great Towns only for Census years. A method was required which was equally suitable for occupations and the Great Towns.

3.2.2 The calculation of the variable which will be referred to as the fertility decline control variable requires that for each case (occupation or Great Town) the number of women and their ever born children disaggregated by marriage duration. The necessity to estimate fertility decline in a population and its subgroups from retrospective parity data results in an outcome variable which can measure only relative rather than absolute changes in fertility. The estimation of this relative measure of fertility decline has itself not been free from problems which will become apparent as the description of the method proceeds. The measure requires that the number of women and their children ever born are known for each marriage duration (i). In order to demonstrate the method all women aged under 45 at the time of the Census are used as an example and the figures shown in Table 3.6. From these data the following were calculated:

$$P(i)=CEB(i)/W(i) \quad \ldots\ldots\ldots\ldots (10)$$

$$F(x)=P(i+1)-P(i) \quad \ldots\ldots\ldots\ldots (11)$$

All average parities will include any births which were conceived before marriage, and the propensity for premarital conception was occupationally selective. Average parities must hence undergo some transformation or correction to be suitable for the calculations required. This has been achieved by using the average parity change between successive marriage durations, which is free from the contaminatory effect of such selected behaviour. F(x) is therefore a measure of the difference in average parity between successive marriage durations. F2, for example, measures the average parity difference between marriage duration 2 (5 to 9 years) and marriage duration 3 (10 to 14 years) which for the sum of all women under 45 is 1.20633.

$$I(x)=F(x)/F1 \quad \ldots\ldots\ldots\ldots (12)$$

The F(x) values are standardised by dividing by F1, and are subsequently called I(x) to indicate that the result of the calculation is an index. In practice the transformation shown in the previous equation is not necessary because the relationship between I4 and I2 remain the same whether or not it is carried out, but it is useful nevertheless. I4 is the index (standardised parity) which is added between 15 to 19 and 20 to 24 years of marriage. I2 is the equivalent index for the period between 5 to 9 and 10 to 14 years of

marriage. The final control variable which will be called the fertility decline control variable, is the result of dividing I4 by I2. Thus:

FDI=I4/I2.....(13)

This represents the relationship between standardised average parities of women between their second and third and their fourth and fifth marriage durations. Before proceeding further, however, it was necessary to consider the robustness of the method and then to make comparisons where possible with empirical data. The method is suitably robust if one takes into account the following factors. Firstly, if F1 (or I1 since they are essentially the same) is discarded one can eliminate from the final variable the effects of pre-marital conceptions on period fertility to women married less than 5 years as well as the variation in the onset of fertility which would have occurred between all subgroups but more pronouncedly between occupations. Of course, each marriage duration will have been affected by some premarital conceptions in towns or more often occupations with the propensity for them, but taking the parity difference between durations eliminates their effect. The most important points to bear in mind are that the fertility decline control variable which is constructed in this way can estimate relative changes in fertility only and can say nothing about absolute change. Furthermore

the variable can estimate fertility decline which took place within a very narrow time period, i.e. between 10 and 20 years prior to the 1911 Census, and for no other period. Provided these are accepted then the measure is sufficiently robust.

3.2.3. As we have stated in the previous section, it is important to introduce some empirical evidence for our conclusion that the fertility decline measure estimated from census data reflects actual fertility accurately enough to serve as a suitable control variable. Some empirical comparison was carried out in the following way. A random sample of 20 Great Towns was drawn. The number of births for the Registration District or Districts most consistent with each town were taken for the years 1899, 1900, 1901, 1909 and 1910; 1911 was excluded due to the way in which the data in the Registrar General's Annual Reports beginning in that year were disaggregated i.e. by administrative area rather than registration district (22). Average crude birth rates for the periods 1899 to 1901 and 1909 to 1910 were calculated for the districts and the declines over the period are shown with the fertility decline indices for the selected Great Towns in table 3.7. For the 20 towns a Pearson product moment correlation coefficient was calculated. The resultant r value was +0.3098. What the table shows, however, is that Gillingham

Registration District underwent a negative decline compared with a large decline when census estimates are taken. This apparent anomaly is earlier to understand when it is remembered, first, that the Census estimates of fertility decline are taken from retrospective reports, and, second, were from women enumerated in this case in Gillingham, some of whom may have lived elsewhere in earlier years. Gillingham underwent dramatic boundary changes between 1901 and 1909 which are likely to have affected the population characteristics and hence the crude birth rates for the two periods. When Gillingham is excluded the r coefficient increases to +0.7386. We refer to this phenomenon again in the next chapter on the role of fertility decline in infant mortality decline.

Table 3.1 Number of Women, Children Ever Born and Children Dead, 1911 Census of England and Wales, Women under 45 years at Census

Marriage Duration	(i)	W(i)	CEB(i)	CD(i)	D(i)
0-4	1	1073887	974264	95674	0.09820
5-9	2	1018599	2287321	315045	0.13774
10-14	3	897103	3038967	523460	0.17225
15-19	4	608578	2764336	540692	0.19560
20-24	5	299436	1772706	393028	0.22171
25-29	6	30706	228271	56662	0.24822

Table 3.2 Infant Mortality Estimates from Children Ever Born and Dead, 1911 Census of England and Wales, Women under 45 years at Census

(i)	D(i)	k(i)	(x)	(x)q0	l(x)	t(i)	1q0
1	0.09820	1.1408	2	0.11203	0.88797	1.364	0.09213
2	0.13774	1.0035	3	0.13822	0.86178	3.533	0.10404
3	0.17225	1.0142	5	0.17470	0.82530	5.963	0.11914
4	0.19560	1.0344	10	0.20233	0.79767	8.451	0.12586
5	0.22171	1.0170	15	0.22548	0.77452	11.260	0.13179
6	0.24822	1.0039	20	0.24919	0.75081	14.523	0.13498

Table 3.3 Infant Mortality Rates from Vital Registration and 1911 Census Estimates by Registration Division

Reg. Div.	Vital Reg. 1901-5	1911 Census 1902	Vital Reg. 1906-10	1911 Census 1907	1911 Census 1910
I	140.0	131.1	116.0	104.2	86.2
II	109.0	96.5	88.9	76.4	65.1
III	111.3	100.7	90.7	79.6	68.1
IV	124.5	109.8	99.1	87.0	73.8
V	105.6	98.4	90.7	78.3	71.7
VI	138.3	126.7	118.5	105.5	95.0
VII	140.2	121.7	120.8	103.7	95.4
VIII	157.7	148.0	136.4	123.4	109.5
IX	150.3	136.4	128.1	116.3	105.2
X	151.7	137.9	132.5	119.9	108.5
XI	146.9	133.0	125.9	112.0	98.7
England & Wales	138.0	125.9	117.0	104.0	92.1

Table 3.4 Proportional Fall in 1q0 from 1911 Census Estimates and in Infant Mortality Rate from Vital Registration Data

Reg Div	Census Estimate	VR Rate	Census Fall/ VR Fall
I	0.4084	0.3168	1.29
II	0.3913	0.3012	1.30
III	0.3844	0.3212	1.20
IV	0.3728	0.3118	1.20
V	0.3010	0.1910	1.58
VI	0.2631	0.2791	0.94
VII	0.2205	0.2006	1.10
VIII	0.3177	0.2318	1.37
IX	0.2818	0.2649	1.06
X	0.2521	0.2050	1.23
XI	0.2921	0.2527	1.16

Table 3.5 l(x) Values from Coale-Demeny Regional Model Life Tables and English Life Table 1901-10

x	ELT	West	North	South	East
1	0.86878	0.87087	0.87255	0.87181	0.87083
2	0.83488	0.83900	0.83620	0.83091	0.84859
3	0.82185	0.82489	0.81397	0.81206	0.83925
4	0.81360	0.81570	0.79732	0.80203	0.83322
5	0.80755	0.80881	0.78466	0.79642	0.82892
10	0.79387	0.79185	0.75097	0.78132	0.81628
15	0.78566	0.77939	0.73375	0.77265	0.80873
20	0.77409	0.76204	0.71487	0.76006	0.79721

Table 3.6 Calculation of Fertility Decline,
All Women under 45 years at Census

Marriage Duration (years)	(i)	W(i)	CEB(i)	P(i)	(x)	F(x)	I(x)
0-4	1	1073887	974264	0.907			
5-9	2	1018599	2287321	2.246	2	1.142	0.853
10-4	3	697103	3038967	3.387	3	1.154	0.862
15-9	4	608578	2764336	4.542	4	1.378	1.029
20-4	5	299436	1772706	5.920	5	1.514	1.131
25-9	6	30706	228271	7.434			

Table 3.7 Crude Birth Rate Decline from Vital Registration and Fertility Decline from 1911 Census Estimates, Selected Great Towns

Town	% Decline in CBR	FDI
Barnsley	08.54	0.84990
Birmingham	06.59	1.05853
Blackburn	18.85	1.34632
Bradford	19.13	1.24262
Bury	12.38	1.24677
Derby	13.03	1.35746
Eastbourne	18.87	1.64072
Gillingham	-1.54	1.64596
Hornsey	31.08	1.62670
Huddersfield	14.28	1.11068
Leeds	16.10	1.27383
Newport	09.52	1.26698
Nottingham	09.62	1.12011
Portsmouth	06.83	1.10313
Salford	10.19	1.00804
Stockport	12.78	1.19893
Swindon	15.52	1.17195
Warrington	14.96	1.16876
Willesden	17.12	1.31403
Wimbledon	16.19	1.05431

Figure 3.1 Infant Mortality from Vital Registration and 1911 Census Estimates, England and Wales 1895-1910.

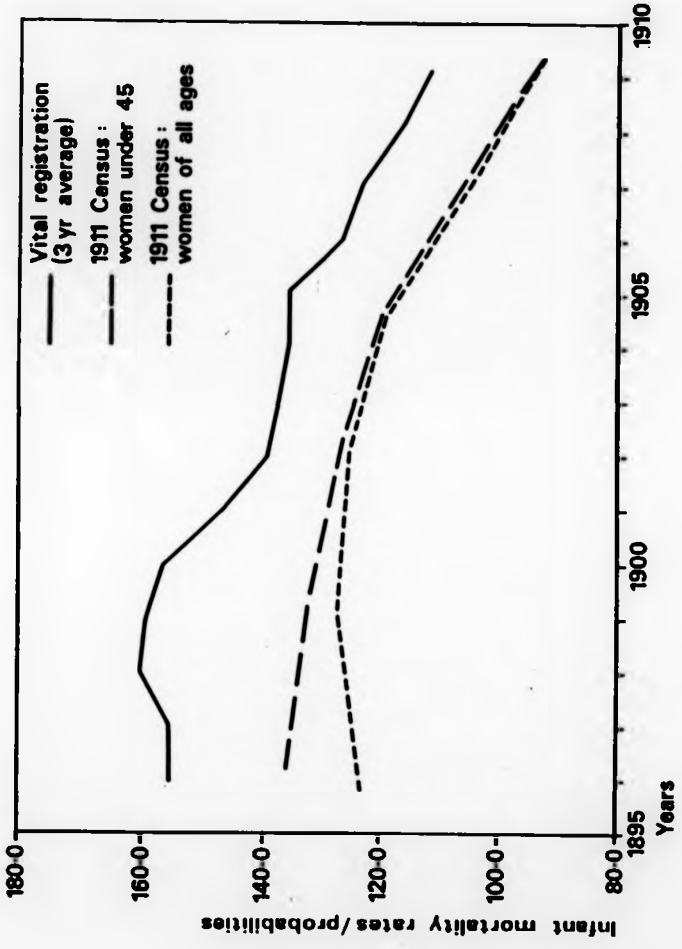


Figure 3.2 English Life Table 1901-10 compared with Coale Demeny Model Life Table Probabilities (l(x) values).

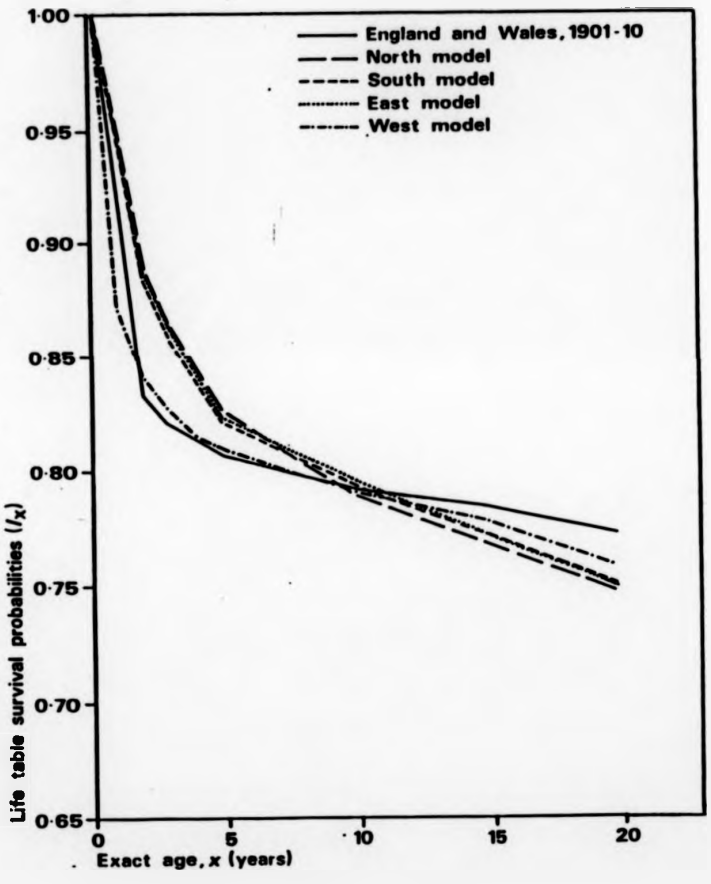


Figure 3.3 Infant Mortality in England and Wales 1911 Census Estimates by Vital Registration Rates for the Great Towns.

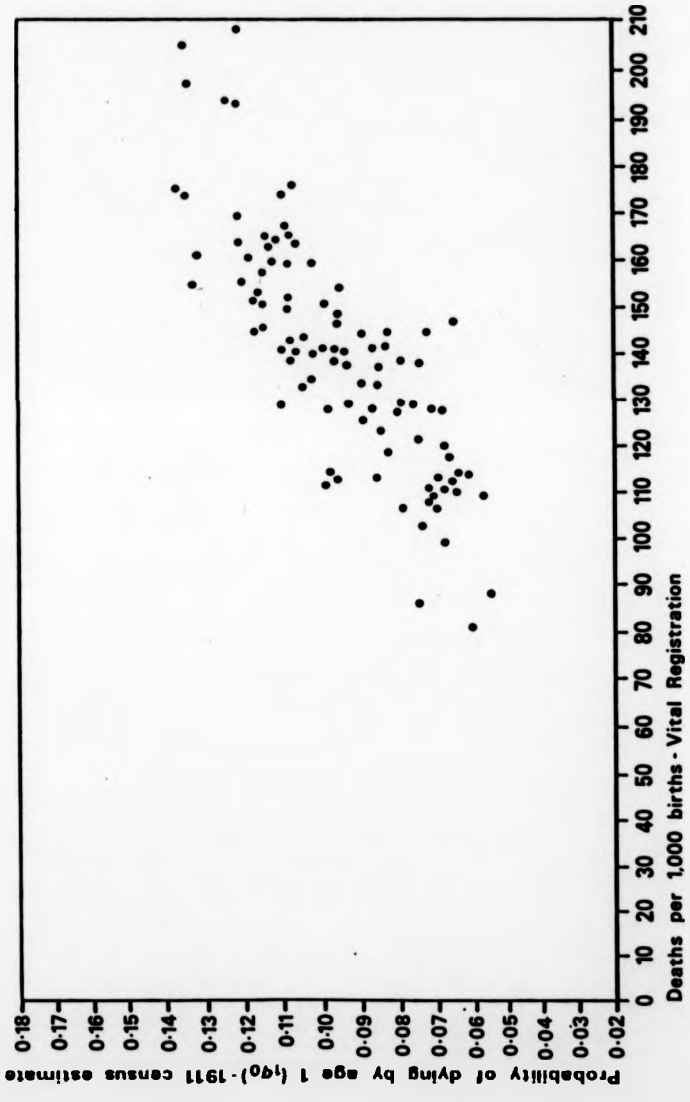
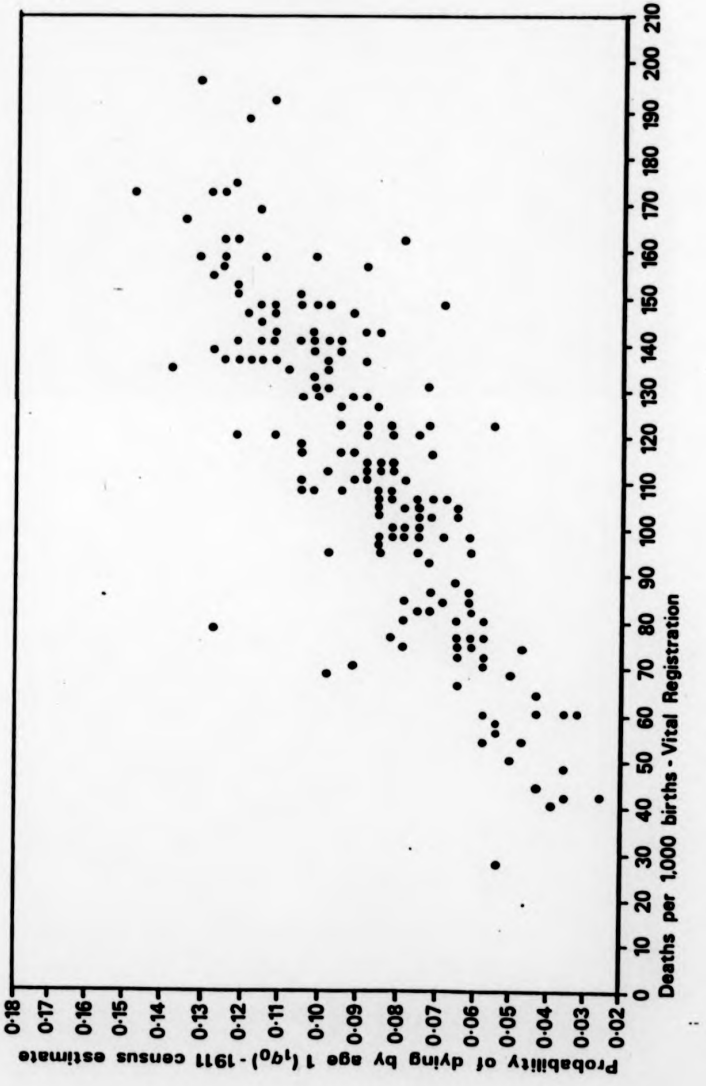


Figure 3.4 Infant Mortality in England and Wales 1911 Census Estimates by Vital Registration Rates for Father's Occupation.



Notes

1. The 1911 Census of Scotland disaggregates child mortality by mother's occupation only, while the 1911 Census of Ireland tabulates child mortality for Dublin and the major regions, neither of which are entirely satisfactory for a comparison with England and Wales.

2. Brass, William, A.J. Coale, P. Demeny, D.F. Heisel, F. Lorimer, A. Romaniuk, and E. van de Walle. 1968. The Demography of Tropical Africa. Princeton: Princeton University Press. pp. 105-140.

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4. Sullivan, J.M. 1972. Models for the Estimation of the Probability of Dying between Birth and Exact Ages in Early Childhood. Population Studies 26: 79-97.

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6. Hill, K. and T.J. Trussell. 1977. Further Developments in Indirect Mortality Estimation. Population Studies 31: 313-334.

7. United Nations Department of Economic and Social Affairs. 1983. Manual X: Indirect Techniques for Demographic Estimation. New York: United Nations. pp. 81-85.

8. Hill and Trussell loc. cit. p. 318.

9. Fernando, C. 1985. Indirect Estimation of Infant Mortality Trends: Simulation Tests on the Feeney Method. Genus 41: 65-88.

10. Feeney, G. 1980. Estimating Infant Mortality from Child Survivorship Data. Population Studies 34: 109-128.

11. Sullivan, loc. cit. p. 91.

12. Feeney, loc. cit.

13. Trussell. T. J. 1975. A Re-estimation of the Multiplying Factors for the Brass Technique for Determining Childhood Survivorship Rates. Population Studies 29: 97-107.

14. Garenne, M. 1982. Problems in Applying the Brass Method in Tropical Africa: A Case Study in Rural Senegal. Genus. 38: 119-134.

15. United Nations Department of Economic and Social Affairs. 1983. Manual X: Indirect Techniques for Demographic Estimation. New York: United Nations. pp. 81-85.

16. Data source for the English Life Table is: Supplement to the seventy-fifth Annual Report of the Registrar General for England and Wales, Part I - Life Tables. PP 1914/xiv. p. 56.

17. loc. cit. note 5;

18. Henry, L. 1961. Some Data on Natural Fertility. Eugenics Quarterly, 8: 81-91.

19. Coale, A.J., A.G. Hill and T.J. Trussell. 1975. A New Method of Estimating Standard Fertility Measures from Incomplete Data. Population Index 41: 102-209.

20. Knodel. J. 1983. Natural Fertility: Age Patterns, Levels, and Trends. Pp. 61-102 in R. A. Bulatao and R.D. Lee with P.E. Hollerbach and J. Bongaarts : Determinants of Fertility in Developing Countries, New York: Academic Press.

21. Bongaarts, J. 1976. Intermediate Fertility Variables and Marital Fertility Rates. Population Studies 30: 227-241.

21. Data sources are the Annual Reports of the Registrar General for England and Wales for the appropriate years. References are as follows: 1899 - sixty-second Annual Report PP 1900/xv 4-63; 1900 - sixty-third Annual Report PP 1901/xv 4-63; 1901 - sixty-fourth Annual Report PP 1902/xviii 4-63; 1909 - seventy-second Annual Report PP 1911/x 149-211; 1910 - seventy-third Annual Report PP 1911/xi 143-205.

CHAPTER 4

FERTILITY DECLINE AND INFANT MORTALITY DECLINE

4.0 INTRODUCTION

In this research we are not concerned, per se, with the question of whether infant mortality was causally affected by fertility decline in late Victorian and Edwardian England and Wales, or whether the reverse was true; we do note, of course, the Brass and Kabir (1977) point about their both having been influenced by other factors (1). Woods (1984) has addressed himself to this question and points out that the replacement effect on fertility of the loss of a child or children cannot be properly said to have taken place unless fertility was being controlled (2). This leads to a further question which we cannot make our major concern here, which is related to the causal explanation of fertility decline. Rather we are concerned with four particular questions about fertility in our sub-populations. They are, first, whether marital fertility decline can be estimated using the data sources at our disposal, second, whether there was any evidence of decline in those populations, third, what its distribution was, and finally, whether infant mortality decline could be explained by marital fertility decline. The first question has been addressed in our chapter on demographic methodology. It is therefore the task of the rest of this chapter to address itself to the remaining questions.

4.2 Attention should be drawn to two specific characteristics of the variable which controls for marital fertility decline in this research. The first characteristic is its strict limitation as far as the time period it applies to is concerned. The variable, which will be called the marriage duration fertility decline variable, can control for marital fertility decline which took place between 1894 and 1904 only and for no other period. Secondly, the measure is a relative one and no inference about absolute fertility change should be made. Provided that these two limitations are understood the measure can be regarded as reasonably robust and it does have certain advantages over other measures. For example, since it is derived from the same data source as that for the mortality decline estimates we can be sure that the two measures do relate to the same population. Furthermore, it is an estimate of marital fertility decline and as such is preferred to a measure based on a fall in the crude birth rate which would have the disadvantage of being sensitive to population structure. We should note, however, that while we can have confidence in the robustness of the measure, the decline estimated is based on between-cohort fertility movements which is influenced by the time pattern of change; it should be noted that the women at different marriage durations are mutually exclusive groups.

4.3 In this portion of the chapter on marital fertility decline we ought to put the data in their historical setting so that we can gain some insight into the amount of decline we would expect in England and Wales at that time. The marital fertility decline with which we are concerned took place between 1894 and 1904. The onset year is interesting in that it follows closely on 1892 which, for England and Wales, was regarded as something of a watershed by Knodel and van de Walle (1979) in marking the onset of fertility decline which they defined as the year in which marital fertility declined by an estimated ten percent from its maximum recorded level as part of a continuous decline to a much lower level (3). Table 4.1 shows the crude birth rate and the general fertility rate from 1880 to 1920; the latter showed a decline consistent with that which Knodel and van de Walle claimed (4). Thus we would expect our marital fertility decline estimates from the 1911 Census to be positively related to the decline in the general fertility rate.

We can make two competing assumptions about the course of fertility decline in England and Wales; that, pace Szreter, fertility decline began among a small group or groups, although we will not speculate here about the characteristics of such groups, and then spread either by steady diffusion or with discontinuity throughout the population

(5); alternatively we can assume that fertility decline began more or less simultaneously, in response to some factor which affected the whole population, although possibly starting from different levels and proceeding at different paces; thus it took several years before England and Wales as a whole completed the transition. This is the view which Woods and Smith (1983) take (6). The course of decline which is suggested by the 1911 Census will be discussed next.

4.4.1 Examination of marital fertility decline estimates in the 97 Great Towns rather supports the assumption that the decline was taking place simultaneously although rates of change and initial levels may have differed. The validity of this assumption is strengthened by the Brass and Kabir finding on the homogeneity of fertility decline across registration divisions. Relative fertility decline in the Great Towns, estimates of which are grouped in table 4.2 represents the particular changes in average parity additions by duration of marriage used in the index construction. The effect refers approximately to the period 1894 to 1904. An attempt was made to group the fertility decline indices so that each category contained approximately the same number of cases yet retained sensible cut off points. However, in practice this proved somewhat difficult and table 4.2 shows the categories to be

disproportionately weighted toward the central values. By definition the outliers will be contained in groups 1 and 4, with a greater percentage of the Great Towns (78.4%) in the central groups 2 and 3 than is the case for Occupations (59.0%).

4.4.2 Further examination of the fertility decline estimates of the Great Towns and Occupations data sets, this time of individual subgroups, helps to resolve the question about the course of marital fertility decline, at least as far as the two sub-populations are concerned. Not only was there a larger percentage of Great Towns in the middle fertility decline groups than for Occupations but they also had a narrower range of values, from 0.82819 to 1.64596 compared with the 0.34789 to 1.89715 for Occupations. This is consistent with the greater heterogeneity within towns than occupations, which can be thought of as more homogeneous sub-groups of the population. Some of the towns at the low end of the fertility index distribution, for example Aberdare, Barnsley and Rhondda were strongly associated with mining, while others, Middlesbrough, Sunderland and West Bromwich, were associated with iron and steel manufacture or shipbuilding, occupations which Szreter argues were late in adopting fertility control, and so probably had not embarked upon decline during this period (7). At the high end of

the distribution were Croydon, Eastbourne and Hastings, essentially middle class towns which were undergoing considerable fertility reduction during the period which the measures cover. Also at the high end and something of an anomaly here was Gillingham, which had the greatest estimated marital fertility decline among the towns. As was pointed out previously Gillingham saw no decline (actually an increase) in the crude birth rate from 1899-1901 to 1909-10 but this apparent contradiction is probably due to boundary changes (8). The 1911 Census estimates, it will be remembered, were based on the reports of women enumerated there in 1911, some of whom will have lived elsewhere in 1894. In the Occupations data set those with lowest fertility decline in the period covered included barristers and solicitors, civil and mining engineers, dentists, and merchants, all of whom had perhaps substantially completed their fertility transition, as well as dock and wharf labourers, engineering labourers and some farmers (farmers' and graziers' relatives) who had probably not embarked upon it yet. Those undergoing the greatest decline in the period included Post Office telegraphists and clerks, some textile occupations, and some non-established preachers.

Now we consider the hypothesis of diffusion of fertility decline across groups versus a

simultaneous transition for England and Wales as a whole. If there was some kind of occupational diffusion as Szreter suggests, which was not necessarily social class led, then the great range of fertility decline estimates which we have is compatible with this view. In any event we should bear in mind that Brass and Kabir found great homogeneity in fertility decline over regions and support the proposition that fertility was declining in response to change which England and Wales as a whole was undergoing (9). The Great Towns were made up of varying proportions of couples in these occupational groups and as such have greater heterogeneity within them and some degree of homogeneity between them. The narrow range of their fertility decline estimates is consistent with this idea and the proposition of Woods and Smith that England and Wales as a whole was undergoing fertility transition at this time (10).

4.5 We come now to the consideration of infant mortality falls and the extent to which their variation is explained by marital fertility decline. We would arguably expect decline in fertility to explain a reduction in infant mortality , if it meant either that there were fewer births to older women of high parity (Woods 1984), or if it meant that the same amount of food, childcare or other commodity were shared out

among fewer children (11, 12). That is, there are demographic and environmental factors involved in the fertility decline explanation for infant mortality reduction. In the event our estimates from the 1911 Census do not suggest that it had a very great independent effect (tables 4.5 and 4.6). In both the Great Towns and the Occupations data sets lower fertility decline was associated with smaller infant mortality decline and greater fertility with greater infant mortality reductions, but in the Great Towns the relationship between the two variables was not monotonic. Furthermore, in both population sub-sets there is wide variation about the mean within each category which lends further support to the idea that fertility decline was not an important factor in infant mortality reduction during the fifteen year period considered. That in the Great Towns average infant mortality fall by fertility change category varied little from the overall average, despite the fact that the peaks from which the decline was measured were greatly different by fertility groups lends support to the Brass and Kabir conclusion that both were responding to other factors.

4.6 In this chapter we have discussed the course which fertility decline took during the period of the investigation, its distribution within the population sub-groups and its association with

infant mortality decline. The conclusion so far, that is that fertility decline did not make a substantial contribution to infant mortality reduction in the fifteen year period 1895 to 1910; the point made by Brass and Kabir (1977) that they were both declining in response to the same factors is noted (13).

Table 4.1 Crude Birth and General Fertility Rates, England and Wales 1880-1920.

Year	Crude Birth Rate	General Fertility Rate
1880	34.2	149.1
1881	33.9	147.6
1882	33.8	146.2
1883	33.5	144.4
1884	33.6	144.9
1885	32.9	140.8
1886	32.8	140.4
1887	31.9	135.7
1888	31.2	132.9
1889	31.1	132.0
1890	30.2	127.9
1891	31.4	132.6
1892	30.4	128.2
1893	30.7	128.2
1894	29.6	121.2
1895	30.3	124.9
1896	29.6	121.9
1897	29.6	120.9
1898	29.3	119.1
1899	29.1	118.0
1900	28.7	115.9

Table 4.1 (continued) Crude Birth and General Fertility Rates, England and Wales 1880-1920.

Year	Crude Birth Rate	General Fertility Rate
1901	28.5	114.5
1902	28.5	114.6
1903	28.5	114.3
1904	28.0	112.7
1905	27.3	109.7
1906	27.2	109.2
1907	26.5	106.2
1908	26.7	107.6
1909	25.8	103.6
1910	25.1	100.7
1911	24.3	98.0
1912	23.9	96.6
1913	24.1	97.1
1914	23.8	96.2
1915	21.9	88.8
1916	20.9	85.2
1917	17.8	72.1
1918	17.7	71.1
1919	18.5	73.9
1920	25.5	101.7

Table 4.2 Great Towns: Number of Women Reporting by Fertility Decline Control Group

Fertility Decline Control Group	Number of Towns	%	Number of Women	%
1 - smallest	12	12.4	684152	27.5
2	41	42.3	1226953	49.4
3	35	36.1	486512	19.6
4 - greatest	9	9.3	87390	3.5
All Towns	97	100.0	2485007	100.0

Table 4.3 Occupations: Number of Women Reporting by Fertility Decline Control Group

Fertility Decline Control Group	Number of Occupations	%	Number of Women	%
1 - smallest	55	27.5	1198142	34.9
2	76	38.0	1283238	37.4
3	42	21.0	680133	19.8
4 - greatest	27	13.5	270556	7.9
All Occupations	200	100.0	3432069	100.0

Table 4.4a Ranking of Towns by Fertility Decline Control Variable: Outliers with low values.

Town	Fertility Decline Control Variable
Aberdare	0.82819
Barnsley	0.84990
West Bromwich	0.87736
South Shields	0.88203
Bootle	0.89177
Sunderland	0.92119
West Hartlepool	0.92446
Rhondda	0.92976
Blackpool	0.94012
Middlesbrough	0.94226
Liverpool	0.95820
Tynemouth	0.96703
Ipswich	1.00029
Stockton on Tees	1.00645
Salford	1.00804

Table 4.4b Ranking of Great Towns by Fertility Decline Control Variable: Outliers with high values.

Town	Fertility Decline Decline Variable
Kings Norton and Northfield	1.33462
Blackburn	1.34632
Burnley	1.34890
Darlington	1.35717
Derby	1.35746
Halifax	1.35864
Croydon	1.41599
Oldham	1.43560
Northampton	1.43671
Rotherham	1.47747
Lincoln	1.50436
Hastings	1.56196
Hornsey	1.62670
Eastbourne	1.64072
Gillingham	1.64596

Table 4.5a Ranking of Occupations by Fertility Decline Control Variable: Outliers with low values.

Occupation	Fertility Decline Decline Variable
Barristers and Solicitors	0.34789
Civil and Mining Engineers	0.59288
Clergy (Established Church)	0.62350
Merchants - Commodity undefined	0.64086
Men of the Navy and Marines	0.66944
Motor Car and Van Drivers	0.68411
Barmen	0.75921
Dock and Wharf Labourers	0.77393
Shipyard Labourers undefined	0.78680
Scavenging and Disposal of Refuse	0.81297
Dentists and Dentists' Assistants	0.81627
Labourers in Engineering Works n.o.d.	0.81775
Farmers' and Graziers' Relatives	0.82680
Builders' Labourers	0.83771
Tramway Service Drivers	0.84138

Table 4.5b Ranking of Occupations by Fertility Decline Control Variable: Outliers with high values.

Occupation	Fertility Decline Control Variable
Drapers, Linen and Mercers	1.47752
Musicians, Singers etc.	1.55784
Those retired from business	1.57067
Miscellaneous - including Students	1.57136
Caretakers and Office Keepers	1.58220
Pawnbrokers	1.59758
Waterworks Service	1.60165
Piano and Organ Makers	1.60181
Ministers and Priests (not Estab. Church)	1.62755
Post Office Telegraphists and other clerks	1.64344
Itinerant Preachers	1.64703
Cotton Workers - Carding and Blowing Room	1.65611
Nurserymen, Seedsmen and Florists	1.65925
Hosiery Makers	1.71010
Lace Makers	1.89715

Table 4.6 Great Towns: Infant Mortality by Fertility Decline

Fertility Decline Group	No. of Towns	Peak IMR	Std. Dev.	% Fall in IMR	Std. Dev.
1 - smallest	12	166.62	12.00	31.33	7.49
2	41	149.33	19.75	35.28	8.24
3	35	140.52	21.66	34.16	8.97
4 - greatest	9	129.09	19.40	38.35	10.69
All Towns	97	146.41	21.72	34.67	8.69

Table 4.7 Occupations: Infant Mortality by Fertility Decline

Fertility Decline	Number of Occupations	Peak IMR	Std. Dev.	% Fall in IMR	Std. Dev.
1 - smallest	55	136.10	29.49	33.01	12.37
2	76	130.37	18.81	34.27	10.35
3	42	132.19	19.21	37.61	11.86
4 - greatest	27	127.02	19.52	39.68	11.80
All Occupations	200	131.88	22.45	35.36	11.60

Notes

1. Brass, William and M. Kabir. 1980. Regional Variations in Fertility and Child Mortality during the Demographic Transition in England and Wales. Pp. 71-88 in J. Hobcraft and P. Rees (eds.) Regional Demographic Development. London: Croom Helm.
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4. Data source for table 4.1: Mitchell, B.R. Abstract of British Historical Statistics. Cambridge: Cambridge University Press, 1962. 29-30.
5. Szreter, S.R.S. 1983. The Decline of Marital Fertility in England and Wales c. 1870-1914: A Critique of the Theory of Social Class Differentials through an Investigation of its Historical Origins and an Examination of Data for the Constituent Male Occupations. Unpublished Ph.D. Thesis, University of Cambridge.
6. Woods, R.I. and C.W. Smith. 1983. The Decline

of Marital Fertility in the Late Nineteenth Century: The Case of England and Wales. Population Studies 37: 207-225.

7. op. cit. note 5.

8.

9. op. cit. note 1.

10. op. cit. note 6.

11. Woods 1984 p.48

12. Woods, R.I. 1983. On the Long Term Relationship between Fertility and the Standard of Living. Genus 39: 21-35.

13. op. cit. note 1.

CHAPTER 5

POVERTY AND INFANT MORTALITY DECLINE

5.1 INTRODUCTION

This chapter on the effect of variations in poverty on infant mortality decline must by definition be an important one, since it addresses directly the effect of one of the two most significant explanatory variables in this research. Before this is done, however, the estimation of poverty from the available variables in the 1911 Census tables must be described and justified. We begin, therefore, with a section on that estimation for both data sets and follow with two sections, each of which discusses, first, variations in poverty between subgroups, and then, the relationship between the poverty measures and the decline in infant mortality.

5.2.1. The estimates of poverty from the 1911 Census tables must be obtained indirectly, for there were no direct questions on the topic in that Census, nor in any subsequent British Censuses. However, it has been possible to obtain income measures for almost half the occupations from the Hours and Earnings Inquiry into the Labour of Workpeople carried out by the (then) Board of Trade in 1906 and 1907 (1). While tabulated results of the survey contained in the Parliamentary Papers are useful, it had from our point of view certain limitations. The first limitation may be inferred from its title, for

professional workers were excluded. Secondly, the survey centred its attention on large sectors of the economy, namely: the railways; agriculture; the clothing trades; other manufactures fncluding pottery, brick and glass; shipbuilding and general engineering; and the public utility services. Other sectors were excluded, notably most of the service sector, other than that mentioned, most clerical workers and some low paid occupations in occupation order XXII which contained some of the poorest, most unskilled workers. Thirdly, difficulties were encountered in trying to obtain income estimates for occupations as disaggregated in the child mortality tables in Volume XIII of the Census Report (2).

The problem of professional incomes was overcome by using those given in Guy Routh's book "Occupation and Pay in Great Britain, 1906 to 1979" (3). The incomes which he gives are for 1913 to 1914, whereas those for other occupations have been increased by a factor to take account of general increases in income to 1911. No correction was made for alterations in professional incomes between 1911 and 1913 to 1914, partly because of the period's reputation among historians for being one in which little improvement, either general or differential took place. Routh describes the period from 1906 to the outbreak of World War I as one of:

".....gently rising
prices and wage rates
.....followed by one of
mobilisation for war." (4)

Both the cost of living and wage rates were remarkably stable from 1906, the beginning of the period studied by Routh to 1915 (5, 6). Another reason for not adjusting professional incomes has to do with their levels compared with those of the working classes. Professional earnings were in the range £170 (Army Officers) to £568 (solicitors) per annum, some two and a half to eight times the overall median income (£67) and certainly above the income tax threshold of £160 per annum (7). It is unlikely, therefore, that any adjustment would have altered the relationship between professional and non-professional incomes to an extent which would have influenced the conclusions. Other wages were adjusted to make them all relate to the same year i.e. 1911. The omission of the service sector and clerical workers has not been satisfactorily resolved. Initially it was thought that estimates might be obtained from data contained in a paper by Cannan et al., read at the 1910 meeting of the British Association for the Advancement of Science (8). The attempt was eventually abandoned due to the difficulties of estimating an overall average income from the taxable and tax-free proportions. Domestic servants were also excluded since only London wage rates could be found from the sources.

The problem of matching occupations disaggregated

in the mortality tables in the Census with those used in the Earnings and Hours Inquiry was tackled thus. Broad occupational groups in the Earnings survey were disaggregated into subgroups, whose numbers and hourly wage rates were shown. It should have been possible to adjust these by an appropriate factor to bring them up to the numbers of workers in the same occupations in England and Wales in 1911. The difficulty arose because the occupations were disaggregated differently for each of the three sources: the Earnings Inquiry; the 1911 Census Occupation Tables; and the 1911 Census child mortality tables in Volume XIII on the Fertility of Marriage. Therefore for each sub-occupation within an occupation heading, disaggregated in the mortality tables, the hourly rates from the Earnings survey were multiplied by the number of respondents; the results were summed and divided by the total for each mortality table defined occupation. Thus, an average hourly rate was calculated, weighted by the number of respondents in each subgroup. An annual wage rate per occupation as defined by the mortality tables was calculated, first from a weekly rate which took into account the average number of hours worked. This weekly rate was then converted to an average annual wage, taking into account the usual number of days or weeks which would have been taken for holidays, which at that time would have been taken without pay.

The problem of not having a properly defined denominator from the Census with which to weight correctly the estimates was dealt with in two ways. First, where they could be, the estimates were compared with those given in Routh (9). Secondly, they were assigned to wage groups in the analysis of the dependent variable, to limit the effect of under- or overestimation of the wage rates.

5.3 Poverty measurement from the Great Towns data set was likewise beset with problems which had to be resolved before discussion of the variation in poverty between towns and over time, and before drawing any conclusions about the relationship between poverty measures and decline in infant mortality. Unlike occupations, direct measures from sources other than the Census, were not available, at least for a large enough number of towns to make it worthwhile. It was therefore necessary to use the data in the Census reports to construct one or more poverty variables. The following indirect measures were adopted.

5.3.1 The first measure required the grading of towns according to the proportion of the adult male workers who were poorly paid. In order for the measure to be rigorous and representative certain criteria had to be met. Firstly, in each of the Great Towns, the proportions in the

occupations chosen had to be distributed closely around the mean. This would increase the probability that the same proportion of low paid workers in two towns measured approximately the same level of poverty. The Earnings and Hours Inquiry provides information about the regional variation in hourly wages it can be inferred from this that there is sufficient clustering about the mean for biases from this source not to be a problem. Other general criteria were that the occupations had to be universally engaged in, in numbers large enough to reduce the effects of chance on the proportions in different towns. A further criterion which was more to do with the vagaries of disaggregation than inherent to the suitability of the occupations for the purpose was that they had to be identifiable in each of the 97 towns in the data set. The following occupations met these criteria: carmen, carters, carriers and so on (Occupational Order VI); costermongers, hawkers and streetsellers (Occupational Order XXII); and general labourers (Occupational Order XXII) (10, 11). This poverty variable (so named in the data set) is the sum of the number of males aged 10 years and above in each of the selected occupations, divided by the total number of working males in the same age range. Thus:

PV1 = CM + CO + GL / OM ..(14)

where CM denotes Carmen, CO denotes costmongers, GL denotes general labourers and OM denotes occupied males, and where all groups are aged 10 years or above. Despite the precautions taken in the choice of the variable it retains one major disadvantage which it was not possible to overcome. It could be argued that where a town did not have a dominant industry i.e. one in which 20% or more of working males of 10 years and over were engaged, the variable is a robust measure of poverty. However, where a dominant industry was present, with the obvious exception of coal-mining which was comparatively well-paid, there were low paid occupations within the special industry which could not be identified individually, but which depressed the number of low paid workers in the index occupations. This is particularly true of the textile trades (12, 13).

5.3.2 The second variable designed to measure poverty used the proportion of all males aged 10 years and under 15 years who were in employment. The variable is calculated thus:

PV2 = OM 10-14 Yrs/AM 10-14 Yrs..(15)

where OM again denotes occuped males and AM denotes all males. This is unfortunately a less robust poverty indicator than that which measures the proportion of low paid workers in a town. The

underlying assumption is that the proportion of young males who were employed increased with poverty, that is, young males were sent out to work as a response to familial poverty. For the variable to measure poverty rigorously there would need, in any town, to be a supply of suitable employment equal to or greater than the demand. Such a condition would depend on a number of factors: the buoyancy of the local economy; the local distribution of industry and commerce; and the male age structure (possible shortage of older men). On the other hand, it would be reasonable to expect such a variable to distinguish in a broad sense between towns in which there were moderate or high levels of poverty and those in which a large proportion of the inhabitants were free from poverty (14). For, even if all conditions above were met, it is unlikely that such young men would have been urged to find employment there not financial pressure to do so.

5.3.3 The third variable which was used as an indirect measure of poverty is arguably the most robust of the three, but one whose calculation nevertheless presented difficulties. For this variable the measure was the proportion of a town's total population who were Workhouse inmates. For pragmatic reasons it was decided to take a cross-sectional measure of poverty based on 1901. This pragmatism can also be justified on

theoretical grounds which will be discussed later. For each of the 97 Great Towns two rates were calculated, the ratio of Workhouse inmates to the total population and the ratio of inmates in all Poor Law establishments to the total population. The second ratio includes in the numerator not only workhouse inmates but also those in workhouse infirmaries, in scattered homes, cottage homes, receiving wards, casual wards and all other Poor Law establishments. The choice of this variable was based on the premise that the proportion of such persons in a town represented the level of what could be described as hard core poverty, that is, a turn of the century equivalent of the proportion of the population dependent on Department of Health and Social Security Supplementary Benefit (15). An assessment of Poor Law administration by Beatrice and Sydney Webb points out that three regimes can clearly be identified between the 1840s and the dissolution of the Poor Law in 1929 (16). The Censuses covering our period of interest fortunately fall within one of these identifiable periods. The measurement of the ratio has been restricted to one point approximately a third of the way into the period over which the infant mortality decline from its peak level took place. It is argued that this level of basic poverty would not be sensitive to economic movements in the country over the relatively short period of twenty years.

5.3.4 However, those familiar with the tabulated material on workhouse inmates in the census reports will know that the data are disaggregated by Registration District rather than Administrative Area. It was therefore necessary to find a way of converting the tabulated material into estimates of the workhouse inmate or Poor Law inmate rate for Administrative Area populations. Where the two sets of boundaries were co-terminous or where several Registration Districts together formed one administrative area there was no difficulty in arriving at the correct rate. Where the difference between the registration district and administrative population was encapsulated within one or more Civil Parishes, then adjustment was also relatively straightforward and the number of inmates in a given registration district was adjusted by a factor which was equal to the proportion of the registration district total population which fell within the administrative area. Where the administrative boundaries cut across even Civil Parishes the estimate was reached by adjusting the number of inmates by a factor equal to the administrative area population divided by that in the relevant Registration District (17). From those rates two further rates were estimated. Since the original data on the inmates was from the 1901 Census, the boundaries which were in force at the time were used to estimate the required rates. In addition new

measures were created by raising the 1901 rate by the proportional increase which would have taken place if the population in 1901 had been contained within boundaries obtaining in 1911 (i.e. 1901 population based on 1911 boundaries). Where there were no boundary changes the two rates were the same. The number of boundary changes between the two Censuses was not inconsiderable, however, affecting 45 of the 97 Great Towns. We have then four ways in which to estimate poverty based on workhouse inmates or inmates of all Poor Law establishments. They are:

WIPR01=WI 1901/TP 1901...(16)

WIPR11=C(WI 1901/TP 1901)..(17)

PLPR01=PLI 1901/TP 1901..(18)

PPLR11=C(PLI 1901/TP 1901)..(19)

where WI denotes workhouse inmates, TP denotes total population, PLI denotes all inmates of Poor Law establishements and where C is an adjustment factor which represents the increase in the rate if the number of inmates (workhouse and all Poor Law establishments) had increased in the same proportion as the 1901 population based on 1911 boundaries. These additional rates were estimated and their inter-relationship determined. This was carried out as check on whether boundary changes between 1901 and 1911 had dramatically altered the characteristics of the towns. The rates were

highly correlated and the regression linear manner so one, the 1901 workhouse inmate rate, was selected as the contribution to an overall rate to be described below.

5.3.5 As we have said there were no direct questions on poverty or living standards in the household schedules of the 1891, 1901 and 1911 Censuses of England and Wales. Arguably an index based on the proportion of Poor Law relief recipients in a town is the closest to a contemporary measure of the proportion of a similar population in receipt of Department of Health and Social Security Supplementary Benefit, and hence the most easily interpreted. One might expect, and empirically this proved to be correct, that the three measures of poverty which has been chosen would not be highly correlated. That this should be so was not unreasonable for the period. The differences in poverty between towns may be attributed to the following factors. First, the number of low paid workers would have depended partly on the industrial structure of the town and partly on its regional location and its position in the urban hierarchy. E. H. Hunt (1973) points out that even agricultural wages were bid up in counties close to large industrial manufacturing towns (18). Youth employment would similarly have varied according to industrial structure and local employment practice as well as the family

requirement for it (19). Even the Poor Law rate, arguably the most robust of the three poverty indicators used will be influenced by the Poor Law Board's ability to respond to local needs. Since the analysis is of overall poverty and its relationship with infant mortality decline a combined measure incorporating the three poverty variables was devised (20).

First, each poverty variable was converted to a standard score using the formula:

$$z = (x - \bar{x}) / sd(x) \quad \ldots\ldots (20)$$

where $sd(x)$ and $\bar{x}$ are the standard deviation and mean values of x respectively. It follows that after transformation each variable has a mean value of 0 (zero) and a standard deviation of 1. A summation of the three scores to estimate an overall poverty score then gives them equal weight. The formula for this overall measure is:

$$ZPOVALL = ZPOV1 + ZPOV2 + ZPOV3 \quad \ldots\ldots (21)$$

While individual standardised poverty scores may be normally distributed this does not necessarily follow for the summed score (ZPOVALL). Grouping of the individual values of this variable to relate to infant mortality decline was carried out so that the number of towns could be distributed, if not evenly, at least reasonably so across the groups. Two total standardised measures were constructed, and although both of them are derived

from 1901 values of the component variables one set has been adjusted to take account of what the population and variable values would have been if the 1911 boundaries had obtained in 1901. The overall declines in infant mortality have been measured from their peak levels whenever those peaks occurred. This is important to bear in mind since for some towns the pattern of infant mortality resembled an inverted J-shape with the peak occurring around 1902. In addition therefore infant mortality decline from 1902 (based on t4) to 1910 has been estimated, as a check on the analyses by overall decline.

5.4 EXTENT OF INFANT MORTALITY DECLINE BY POVERTY LEVEL IN THE GREAT TOWNS

Following the above account of the methodology for estimating independent poverty variables we now consider how poverty was associated with infant mortality decline. The discussion of methodology has centred on the construction of variables which measure poverty level rather than poverty change. The reason for this is twofold. First, historians of the period (Bowley 1937), Nowell-Smith (1964), Thompson, (1979), do not portray it as one in which much improvement in living standards, either differentiated or general took place, although the improvement which did occur was probably of a diffuse nature (21, 22, 23).

5.4.1 This historical view is borne out by the analysis of infant mortality decline by changes in one of the poverty variables. Unfortunately this analysis of poverty change over the period 1891 to 1911 could be carried out for only 32 towns owing to the population threshold criterion (50,000 inhabitants) which determined whether a town could be distinguished separately in the census tabulations. The variable differentiated on those towns with less than 20% decline in poverty but does so both in terms of the peak levels of infant mortality and the decline (table 5.3).

The next table (5.4) differentiates the Great Towns by poverty decline over the shorter period between 1901 and 1911. It is strictly somewhat paradoxical to try to explain infant mortality decline over an average period of 15 years by poverty decline over the last two-thirds of that period. However, as we have stated historians do not consider that the period was one of much differential improvement in living standards and the exercise is perhaps justified, especially if we examine poverty decline over the two periods in conjunction. For the ten year period, as one might expect, there was less overall decline in poverty, and there was even less variation in the percentage decline in infant mortality. On the other hand for poverty decline over the shorter period, towns which fell into the extreme

categories had lower peak levels than the mid range towns and than the overall average. Contrary to the longer period, however, towns with the greatest declines had the lowest peak levels too. This would appear improbable until we remember that there is now poverty information on 61 towns compared with the 32 for the 1891 to 1911 period. Neither tabulation offers any strong evidence for the proposition that an improvement in living standards as measured by the proportion of men in the selected low-paid occupations was a determinant in the reduction of infant mortality in the fifteen years prior to 1911.

5.4.2 Next we consider the extent to which poverty level at some point in the period, in this case in 1901, was associated with falls in the infant death rate. The year 1901 is useful as a marker both because of its position near the beginning of our period but also because it offers a fuller range of poverty measures than could be estimated if 1891 were used instead. A description of the methodology and the choice of explanatory variables has already been given. The relationship between the standardised workhouse inmate rate and infant mortality decline is shown in table 5.5. At first sight the table demonstrates little, but its value is in the negative information which it conveys. It shows that this measure of poverty differentiates neither peak levels of infant

mortality nor the declines. If anything poorer towns experienced slightly larger falls than the rest, but the difference is so small that we cannot draw the conclusion that there was other than a chance relationship.

Tabulation of infant mortality decline by poverty level measured by the total standardised score increases understanding of the relationship but even here the variation in falls between different poverty levels remains slight. With scores based on 1901 boundaries first (table 5.6) there is a slightly greater improvement in infant mortality in towns with the lowest poverty scores.

With the same measure and the period 1902 to 1910 (table 5.7) this relationship is maintained although, of course, declines are rather smaller. In this second case the less poor towns also had lower levels of infant mortality in 1902 than did other towns.

For the total standardised poverty measures based on 1911 boundaries there is a small change from the configuration for the 1901 ones. The difference between the least poor towns and the rest is a little greater both with respect to infant mortality decline and to peaks. Again over the period 1902 to 1910 the least poor towns had larger declines than the rest (table 5.9).

The one consistent feature of these different tabulations of infant mortality by poverty level is that whatever the measure and period over which decline is considered, the lowest poverty level is negatively related to infant mortality decline. Although not sufficient on its own to support our hypothesis these findings are at least consistent with that hypothesis.

5.5 For the examination of the role of poverty in differential infant mortality decline in the 200 most common occupations we have two indicators of living standards, social class and average annual income. Neither of the measures is without its disadvantages. They are therefore used in conjunction to protect against misinterpretation. Earlier in the chapter the sources for income data and the inevitable bias towards working class occupations in the Board of Trade inquiry were described. Even with supplementation from secondary data there are 95 occupations for which no income data could be obtained. Social class has the disadvantage of not being a measure of income alone, based as it was on an occupational classification; it was a composite measure of income, education and, in 1911 at least, general standing in the community. It is likely that for the period investigated education was differentiated along social class lines, with those of higher education in social class 1. This

class also contained persons with very high incomes. There were some social class 1 occupations, however, which may have required neither higher education as a prerequisite nor were rewarded with high income but were thus classified because of their general status in the community. Railway clerks serve as an example of the phenomenon. Notwithstanding Szreter's well founded criticisms of the origins of the social classification it was nevertheless the case that in 1911 income and social class were highly correlated. Families in social class 1 with high incomes would have had disposable resources beyond that needed for the supply of basic requirements such as food. The additional income would have been spent to a considerable extent on better housing and on medical care. Furthermore, it could be argued that such families, because of their higher educational levels, were able to make better use of their incomes. These, then, are the disadvantages of using social class as a proxy for living standards. By controlling for income within class we can come closer to identifying the independent effect of income.

5.5.1 A tabulation (table 5.10) of infant mortality peaks and falls by social class and income will therefore be the focus of discussion. A number of points become apparent when the data are displayed in this way. First there is the

undoubted relationship between social class and income, with average income increasing as one approaches social class 1. Next, infant mortality decline is differentiated more by social class than by income, thus suggesting either that education was the more important component of the social class effect, or that their interaction was more important than their independent effects. In social classes with occupations in more than one income group decline becomes greater with income except for the highest income group. In social classes 3, 4 and 5 peak levels of infant mortality also increase with income, and unlike the declines this holds across all income levels. It is encouraging to note that in general, within social class, occupations for which average incomes could not be obtained had peak levels of infant mortality, as well as declines which were on average very close to the performance over all occupations.

At this stage of the analysis there are a number of competing explanations for the differences in infant mortality decline across social class and income groups. First, it might be concluded that income has an independent effect upon infant mortality decline but not until a certain income threshold was reached. A second explanation is that income and education had small independent but larger interactive effects on the decline.

Finally, since differences in the declines are greater between social classes than between income groups it might be inferred that education is a more important differentiating factor than income.

The analysis of infant mortality by other explanatory variables may suggest the refutal or qualification of these explanations which will be reconsidered in later chapters.

Table 5.1 England and Wales 1891 to 1911: Measures of Poverty from 1911 Census Data

Poverty Variable	No. Towns	Mean	Std. Dev.	Skewness
% Low paid occ. males 1891(1891)	61	9.57	3.23	0.47
% Low paid occ. males 1891(1911)	32	9.65	3.29	0.41
% Low paid occ. males 1901(1901)	79	7.49	2.27	0.02
% Low paid occ. males 1901(1911)	67	7.36	2.36	0.08
% Males 10-14 occ. 1901(1911)	70	22.30	8.60	0.78
W I 1901/1000 pop(1901)	97	4.48	1.73	0.89
W I 1901/1000 pop(1911)	97	4.58	1.69	1.02
Total P L Popn 1901/1000(1901)	97	5.49	2.26	0.74
Total P L Popn 1901/1000(1911)	97	5.59	2.20	0.88
% Low paid occ. males 1911	97	5.49	1.75	0.23
% Males 10-14 occupied 1911	97	17.97	8.86	1.33

Notes: 1. dates in brackets refer to the year for which the boundaries on which the rates are based, apply. 2. occ. denotes occupied, W I workhouse inmates and P L Poor Law

Table 5.2 England and Wales 1891 to 1911:
Poverty Change in Great Towns
Measured by Census Data

Poverty Variable	No. Towns	Mean %	Std. Dev.%	Skewness
1891-1911				
Fall in % low paid occ. males(1911)	32	39.59	19.72	0.22
Fall in % low paid occ. males(obsd)	61	36.74	20.20	0.24
1901-1911				
Fall in % low paid occ. males(1911)	67	24.71	15.66	-0.41
Fall in % low paid occ. males(obsd)	79	24.51	14.86	-0.53
Fall in % males 10-14 occ. (1911)	70	16.50	14.68	-0.23

Note: (i) the bracketed information shows whether boundaries which applied at the time (obsd) or those for 1911 were used.

(ii) occ. = occupied

Table 5.3 Great Towns: Infant Mortality

by Poverty Decline 1891 to 1911

Poverty Decline	No. Towns	Peak IMR	% fall in IMR
>=60%	4	151.41	32.74
40-59%	11	149.69	34.72
20-39%	12	154.36	34.20
<20%	5	138.99	32.50
All Towns	97	146.41	34.67

Note: 1) Decline in poverty based on proportion of occupied males in low paid occupations.

2) Data missing for 66 cases due to population thresholds not met in 1891.

Table 5.4 Great Towns: Infant Mortality by Poverty Decline 1901 to 1911

Poverty Decline	No. Towns	Peak IMR	s.e.	% Fall in IMR	s.e.
>40%	8	133.05	6.5	36.54	3.48
30-39%	19	147.21	5.5	36.84	1.77
20-29%	17	154.31	4.5	32.25	1.75
10-19%	10	144.61	7.2	31.06	2.41
<10%	9	139.56	5.7	34.55	3.16
Not Known	34	147.50	3.9	35.33	1.66
All Towns	97	146.41	0.00	34.67	0.00

Table 5.5 Great Towns: Infant Mortality by Standardised Workhouse Inmate Rate (1910 and 1911 Boundaries)

Workhouse Inmate Rate	No. Towns	Peak IMR	s.e.	% Fall in IMR	s.e.
>1.0	13	146.88	5.77	36.78	1.52
-1.0 to +1.0	72	145.79	2.46	34.40	1.08
<-1.0	12	149.62	8.23	34.03	2.61
All Towns	97	146.41	0.00	34.67	0.00

Table 5.6 Great Towns: Infant Mortality by Total Standardised Poverty Score (1901 Boundaries)

Total Poverty Score	No. Towns	Peak IMR	s.e.	% Fall in IMR	s.e.
>1.0	17	159.48	5.19	33.54	1.90
-1.0 to +1.0	33	145.20	2.89	32.43	1.33
<-1.0	20	139.78	5.39	37.49	2.01
Not Known	27	144.57	4.50	36.03	1.88
All Towns	97	146.41	0.00	34.67	0.00

Table 5.7 Great Towns: Infant Mortality 1902 to 1910 by Total Standardised Poverty Score (1901 Boundaries)

Total Poverty Score	No. Towns	1902 Level IMR	% Fall in IMR from 1902
>1.0	17	143.86	26.42
-1.0 to +1.0	33	132.90	26.20
<-1.0	20	126.46	30.95
Not Known	27	130.24	29.05
All Towns	97	132.75	28.01

Table 5.8 Great Towns: Infant Mortality
by Total Standardised Poverty Score
(1911 Boundaries)

Total Poverty Score	No. Towns	Peak IMR	% Fall in IMR
>1.0	16	158.66	33.79
-1.0 to +1.0	32	144.66	32.27
<-1.0	19	138.00	38.28
Not Known	30	147.07	35.43
All Towns	97	146.41	34.67

Table 5.9 Great Towns: Infant Mortality 1902 to 1910 by Total Standardised Poverty Score (1911 Boundaries)

Total Poverty Score	No. Towns	1902 Level IMR	% Fall in IMR from 1902
>1.0	16	143.86	26.42
-1.0 to +1.0	32	132.55	26.00
<-1.0	19	127.36	31.29
Not Known	30	129.84	28.87
All Towns	97	132.75	28.01

Table 5.10 Occupations: Infant Mortality by Social Class and Income Group.

Social class		Average annual income (£)								
		up to 67	68 -80	81 -95	96 -115	116 -160	>160	All income groups	Income not known	Known and unknown income
1	fall	-	52.41	-	46.70	53.67	57.27	55.43	48.80	51.67
	peak	-	124.20	-	115.05	113.88	108.43	111.00	108.24	109.43
2	fall	-	44.26	38.49	-	-	-	42.33	35.58	38.05
	peak	-	134.10	111.38	-	-	-	126.50	126.08	126.11
3	fall	-	33.57	37.23	38.44	18.02	-	37.50	34.85	35.48
	peak	-	132.02	136.96	137.85	152.23	-	136.00	122.63	132.53
4	fall	28.52	29.94	32.51	22.79	-	-	29.61	35.40	32.33
	peak	122.06	143.83	151.32	152.11	-	-	141.20	130.01	135.94
5	fall	26.26	28.12	19.60	-	-	-	26.22	29.45	27.02
	peak	150.91	152.84	161.62	-	-	-	152.50	152.67	152.53
6	fall	26.98	29.59	28.09	15.76	-	-	27.53	-	27.53
	peak	155.51	148.82	155.43	122.21	-	-	149.38	-	149.38
7	fall	-	-	-	21.73	-	-	21.73	22.84	22.56
	peak	-	-	-	155.13	-	-	155.13	148.02	149.80
8	fall	20.74	-	-	-	-	-	20.74	-	20.74
	peak	96.26	-	-	-	-	-	96.26	-	96.26
All social classes	fall	26.19	32.42	34.63	30.64	41.39	57.27	33.90	36.97	35.36
	peak	138.64	141.39	141.70	138.77	126.66	108.43	137.40	125.77	131.88

Source: estimated from 1911 Census of England and Wales, Volume XIII Fertility of Marriage, Part 2, Table 30 (London: HMSO, 1923).

Note: in 1911 the social classes were defined thus - I - middle and upper classes (mainly the professions), II - intermediate, III - skilled labour, IV - intermediate between III and V, mainly semi-skilled labour, V - unskilled labour, VI - textile workers, VII - miners, VIII - agricultural labourers.

Notes

1. The full title is: Enquiry by the Board of Trade into the Earnings and Hours of Labour of Workpeople of the United Kingdom. The report is contained in British Parliamentary Papers, Command Numbers 4545, 4844, 5086, 5196, 5460, 5814, 6053 and 6556 (London: His Majesty's Stationery Office, 1909-1913).
2. For example the way in which the textiles are dealt with.
3. Routh, G. 1980. Occupation and Pay in Great Britain, 1906-79. London: Macmillan. pp. 63, 99-101, 106-107, 112-113;
4. op cit. p. 137.
5. Bowley, A. L. 1937. Wages and Income in the United Kingdom since 1860. Cambridge: Cambridge University Press. p. 121;
6. Routh pp. 134-135.
7. Routh p. 63
8. Cannan, E., A.L. Bowley, F.Y. Edgeworth, H.B. Lees Smith and W.R. Scott. 1910. The Amount and Distribution of Income (other than wages) below the Income Tax Exemption Limit in the United Kingdom. ! British Association for the Advancement of Science. Report of Meeting number 80, Sheffield, England. 170-199.

9. op. cit. pp. 99-103.

10. See for example Hours and Earnings Enquiry, Cd. 6556, p. 236;

11. Routh pp. 106-107.

12. See Hours and Earnings Enquiry, Cd. 4545, p. 26;

13. Routh pp 99,106, 112-113.

14. Hunt, E.H. 1981. British Labour History, 1815-1914. London: Weidenfeld and Nicolson. pp. 9-17.

15. In this comparison those who experienced hard core poverty both then and now could be defined as those so poor that they were dependent on the state for their very existence.

16. Webb, S. and B. Webb. 1910. English Poor Law Policy. London: Longmans, Green and Company. p.263;

17. In order to carry out the exercise described here a series of large scale Ordnance Survey Diagrams which showed both Registration District and Administrative Area boundaries were consulted. The particular diagrams referred to, all published by the Ordnance Survey Office, Southampton, were as shown in the table below.

County	Period Covered	Revised to	Publication Year
Berkshire	1867-1878	19.7.1899	1900
Brecknockshire	1875-1888	9.11.1899	1900
Cheshire	1871-1875	28.3.1900	1900
Cornwall	1857-1884	15.9.1899	1900

County	Period Covered	Revised to	Publication Year
Derbyshire	1874-1882	24.10.1899	1900
Devonshire	-	9.12.1909	1910
Durham	-	26.2.1900	1900
Essex	1862-1876	2.11.1900	1900
Glamorganshire	-	1.5.1908	1908
Gloucestershire	1873-1883	11.11.1899	1900
Hampshire	1894-1897	2.3.1907	1907
Hertfordshire	1865-1879	6.12.1899	1900
Kent	1858-1872	14.3.1900	1900
Lancashire	1888-1893	6.12.1899	1900
Leicestershire	1881-1886	11.9.1899	1900
Lincolnshire	1883-1887	26.9.1899	1900
Middlesex			1888
Monmouthshire	1877-1882	13.2.1900	1900
Norfolk	1879-1886	18.1.1910	1910
Northamptonshire	1882-1886	9.12.1899	1900
Northamptonshire	1898-1900	3.11.1909	1909
Northumberland	1894-1879	1.9.1906	1906
Nottinghamshire	1876-1884	23.9.1899	1900
Oxfordshire	1872-1880	24.8.1899	1900
Somersetshire	1882-1888	3.11.1899	1900
Staffordshire	1875-1886	31.12.1899	1900
Suffolk (E & W)	1876-1885	5.11.1909	1909
Surrey	1861-1871	8.2.1900	1900
Sussex (E & W)	1869-1875	3.1.1900	1900
Warwickshire	1882-1886		1900
Wiltshire	1873-1884	6.9.1899	1900
Worcestershire	1881-1888		1900
Yorkshire:			
East Riding	1888-1893	21.8.1899	1900
North Riding	1888-1893	29.8.1899	1900
West Riding	1888-1893	24.11.1899	1900

18. Hunt, E.H. 1973. Regional Wage Variation in Britain 1850-1914. Oxford: Clarendon Press. pp. 28-30;

19. Hunt, E.H. British Labour History pp. 15-16.

20. Webb, S. and B. op. cit. pp. 153-154;

21. Bowley, op. cit. pp. 27-28;

22. Nowell-Smith, Simon. (ed.) 1964. Edwardian England 1901-1914. London: Oxford University Press.

23. Thompson, P. 1979. The Edwardians. London: Paladin. pp.27-42.

CHAPTER 6

ENVIRONMENTAL IMPROVEMENT AND INFANT MORTALITY DECLINE

6.0 INTRODUCTION

It is upon the analysis and interpretation of variations in environmental improvements during our period that the important conclusions we want to draw depend. The subject needs careful treatment, because in the analysis of both data sets, but especially of the Great Towns our findings come from indirect estimation. First, no British Census until 1951 asked questions about the kinds of amenities which were the key to the environmental improvement which we want to consider (1). A suitable surrogate measure must therefore be identified from the tabulations in the census reports. Next, we must demonstrate that the measure is a true surrogate for those environmental improvements which are subsumed under the hypothesis. Finally, it will be necessary to show how far, for the Great Towns, the relationship between infant mortality decline and the environment surrogate was a causal one. This chapter can then quite naturally be divided into three major subheadings, each dealing with one of the topics.

6.2.1 The absence of direct questions on environmental conditions in British Censuses before 1951 leaves a number of avenues which may be explored to the same end, demonstrating the link or otherwise between infant mortality and

environmental improvement. A review of local government and environmental legislation can point the way.

Prior to our period but nevertheless with important implications for it, was the Municipal Corporations Act of 1835. The newly created municipal boroughs were defined by the Act as:

> ".....legal personification of the local community, represented by a council, elected by, acting for, and responsible to inhabitants of districts." (2)

Their main responsibilities at this time were not with public health as such, but they included public baths and washhouses, along with libraries, museums, bridges, highways and others (3).

In 1848 the Public Health Act created the General Board of Health as a central authority with power to create local boards if either of two conditions were met. These were petition by ratepayers and a rise in the (crude) death rate above 23 deaths per 1000 population (4). It created some places as sanitary boroughs, some of which became urban and rural sanitary authorities, while others became local health districts. These had the responsibility for the provision of sewerage and drainage, of water, management of streets, the maintenance of burial grounds and the regulation of offensive trades (5).

The 1866 Sanitary Act gave rural sewer authorities, which, since 1865, had been the local vestries, all the sewerage, cleansing and water supply powers which the urban boards of health had, including powers of inspection and compulsion as far as the regulation of houses and places of work were concerned (6).

In 1869 the Royal Sanitary Commission inquired into the administration of sanitary laws. Its recommendation of a strong central body for administrative purposes was not taken up by government and in 1871 the Local Government Board was created which took over the public health functions of the Poor Law Board (7). In the following year the Public Health Act created urban sanitary authorities from municipal boroughs and rural sanitary authorities from rural Boards of (Poor Law) Guardians with a Medical Officer of Health to be appointed in each authority (8). The Public Health Act of 1875 brought further powers to urban authorities, those of street cleansing and refuse removal, the provision of water supply, the prohibition of cellar dwellings, the registration of common lodging houses and the restriction of offensive trades. Other powers included those making regulations to prevent disease, a concept rather modern for the period (9).

Power was given to local authorities to purchase slum areas and undertake reconstruction schemes by the Artisans' and Labourers' Dwellings Improvements Acts of 1875 and 1879 although no powers were granted to develop land (10). Some integration of public health and local government powers was achieved under a further Municipal Corporations Act passed in 1882 (11).

The most notable legislative changes from our point of view, however, were the passing of the Local Government Acts of 1888 and 1894 (12, 13). The former defined an administrative county as that area for which a county council is elected, but excluded county boroughs which was what municipal boroughs so defined under the Municipal Corporations Act of 1882 became. This Act created a dual system of local government under which the (then) very large towns were to be known as county boroughs, whose councils had the general authority for the administration of local government services. Outside the county boroughs power was shared between county councils on the one hand and urban and rural sanitary authorities on the other (14). This distinction is particularly important in terms of how one might infer from a town's designation, other characteristics such as its age or industrialisation.

Sanitary authorities, whether urban or rural,

finally became District Councils under the second of these two important Local Government Acts in 1894 (15).

We have seen that, during the sixty years or so which precede the period under consideration, the number of different authorities with public health and environmental responsibilities was gradually extended and those bodies became more like the traditional British local government units, indeed, remained so until 1929. Yet at the same time a clear distinction was drawn between on the one hand County Boroughs, which were empowered with all local government responsibilities and other authorities which shared responsibilities with the county within whose boundaries they were contained. Among this set of non-autonomous authorities were municipal boroughs, in existence since 1835, and Urban District and Rural District Councils, which were created as such in 1894. We might infer then that areas with Urban District Councils were not large industrial centres with high density housing near the town centre or wherever else that the major manufacturing took place (16). More probable was that they were either new centres of manufacture in their own right or else became the suburbanised dormitories for those who worked but not lived in nearby large cities. This theme will be developed further in the following sections.

6.2.2 We turn now to the consideration of a suitable surrogate measure for environmental improvement which can be obtained not only from the 1911 Census Reports but also one or more previous censuses so that change over time can be taken into account. It is the tradition of British census reports to devote considerable space to materials covering area, houses, and occupants. For each of the 97 Great Towns and other administrative units several measures are given in the 1911 Census reports (17). They include area (in acres); the number of inhabited houses; the number of uninhabited houses; the number of houses under construction; the total of the previous categories; the total population and the number of families enumerated.

If we consider these variables in terms of the implications of the previous paragraphs then it is clear that some of them can be more appropriately used to create suitable surrogate measures than others. Some measure of population density is required which can also be obtained from at least one previous census. We are not interested here in cross-sectional variations in density between towns but in variations in its change over time. It is on the question of how the additional population was housed that the choice of measure depends.

Increased density would have been achieved through natural increase, through migration or through some combination of the two (18, 19). It is that increase attributable to migration which would be most likely to result either in increased building rates or else in an increase in the overcrowding of existing dwellings. What is required then is a variable which measures the increase in the number of dwellings rather than the number of inhabitants of a given town compared with that ten or twenty years earlier. We have noted that some of the census reports provide information about houses in more than one form. The increase in the number of inhabited houses per acre has been chosen as the most suitable measure of urban development. It has been chosen for the following reasons. First, the total number of houses per acre included vacant dwellings and those under construction, which would have had a distorting effect. Buildings under construction per acre might theoretically have been useful but in general their rates were too low and not sufficiently differentiated to have been of practical use. Arguably vacant dwellings reflect decay rather than renewal in urban development terms and hence provide a negative surrogate measure of what is actually required. However, the increase in inhabited houses provides a measure of those dwellings added since the last census in which people were actually living.

The variable can be said to provide a direct measure of that aspect of urban development which is related to the age of the housing stock. If a town had undergone a building revival and therefore a large increase in the inhabited house rate it would contain a larger proportion of more recent dwellings than at the previous census. It is reasonable to assume, therefore, that the additional houses if not inherently more soundly constructed, which was probably true as well, provided better shelter by virtue of their relative newness.

6.2.3 In addition, however, it is necessary to establish the link between new dwelling construction and the environmental improvement usually associated with it, whose causal relationship with infant mortality decline we are trying to determine. This is rather more difficult to do since we are relying here on material describing environmental conditions which is both extant and readily available. While there are indications that statistics were routinely collected, the way in which they were reported and commented upon, by, for example, local Medical Officers of Health, varies considerably. Furthermore, the Medical Officer of Health reports to the Local Government Board dealt only intermittently rather than routinely with these issues on a national basis. What must be done then

is to provide as many small bodies of data as can be assembled from the sources available.

In some of the Great Towns local Medical Officers of Health described environmental conditions in their annual reports quantitatively or quasi-quantitatively. Table 6.3 is a review of infant mortality decline, urban development indices, and information on three important facets of the environmental conditions with which we are concerned (20). The criterion for a town's inclusion in the table is based purely on data availability and not on the outcome of a sampling routine, desirable though such a procedure would have been (21). Some of the towns clearly do not support in an individual way the hypotheses either that urban development indices are reliable indicators of environmental improvement or that infant mortality decline was positively associated with urban development, although this remains true when all 97 towns are taken together.

If we deal first with the relationship between urban development and environmental conditions a number of points emerge. It is generally the case that those towns which had the most favourable environmental conditions in or close to 1910 had high urban development rates, based on the increase in density of inhabited houses per unit area. There are exceptions to this general

picture, however, such as the persistence of the practice of disposing of house refuse on to a tip (i.e. tipping) in Edmonton as late as 1910 (22). On the question of the relationship between infant mortality decline and urban development, two towns in particular have individual relationships contrary to the overall one. In East Ham infant mortality decline was barely greater than the mean despite an increase in housing density of more than fourfold, while Smethwick had a decline 7% below the mean with a comparatively high urban development rate. There is no obvious explanation for East Ham's experience. As a rapidly growing area near London, and therefore with probability of migration from the clerical classes, in addition to a favourable record in terms of environmental services it would be expected to have a larger decline in infant mortality. The case of Smethwick suggests but does not confirm the importance of house refuse removal and disposal. However, further support is lent to this idea by Coventry, where although it was reported as:

"....a water closet town...."

by 1897, and completed the sewer network by 1910 there was no destructor before 1910 (23). Here the Medical Officer of Health's comments are particularly illuminating. Apparently the presence of flies was especially troublesome in those areas of the town which lay close to the area where the

tipping was carried out and the Medical Officer of Health recommended a destructor for the treatment of house refuse, pointing out the probability of flies being disease vectors (24).

The material shown in Table 6.4 which is compiled from some of the towns included in the Internal Sanitary Survey of 1893 to 1895 is much more difficult to interpret, but with careful examination provides some useful support for the hypothesis of environmental improvement as a factor in infant mortality decline (25). As is frequently the case with material which is collected for purposes other than specific research it is less than ideal. The 16 towns shown in the table form only a proportion of those in the whole survey although they were the only Great Towns to be included. Unfortunately, Southend on Sea is the only town with a high urban development index while the remaining 15 towns had indices within a rather narrow range. The survey assessed the towns on 5 environmental characteristics: the housing of the poor; the water supply; sewerage; excrement disposal; and house refuse disposal. Despite the shortcomings in the data so described tests found a statistically significant relationship to exist between the water closet provision and peak level infant mortality and its proportional fall in the expected direction ($P < 0.05$). While we accept on the one hand that the

material which we have been able to produce to demonstrate the link between urban development and environmental improvement has been more scant than would have been ideal we submit that it is sufficient to draw conclusions about their relationship. We conclude that those towns which had high urban development indices tended to have good environmental conditions in 1910 in terms of water closet provision, sewage disposal and house refuse disposal, and that therefore urban development is a suitable surrogate for environmental improvement. Urban development indices tended to be higher in towns where all three of these components of the environment had been improved by 1910.

6.3 INFANT MORTALITY DECLINE IN THE GREAT TOWNS

6.3.1 In our review of public health legislation from 1835 to 1894 we concluded that because urban districts had been so created in 1894 rather than as county boroughs they were likely to be newer, more suburban, and less strongly associated with heavy manufacturing than the latter were. That is they had become towns, sometimes quite large ones, or suburbs, through the urbanisation of rural and semi- rural areas. The average infant mortality falls and peak levels shown in table 6.1 therefore lend some initial support to the environmental explanation of its decline. The greatest contrast

is seen between the county boroughs and urban districts for both peaks and falls. Since urban districts tended to be newer than county boroughs it is logical that they would have been less likely to have the worst environmental conditions, whose removal we argue was so important for infant mortality fall. On the other hand, they grew more rapidly than county boroughs so, by virtue of new housing construction, had better environmental conditions than the older county boroughs. That this was so it borne out by the average urban development indices for county borough, municipal boroughs and urban districts which were 1.403, 2.216 and 2.755 respectively.

6.3.2 We are now in a position to look at infant mortality decline by urban development. Towns were grouped by urban development index initially with boundaries the better to understand the relationship between the two variables. The initial grouping in indices is tabulated in table 6.2. There appears to be a curvilinear relationship between urban development and decline in infant mortality. Beyond a 2.5 increase in the density rate additions to infant mortality decline are small. There is however a steady increase in decline from the groups with the least urban development upward. What we might infer from this relationship is that when towns raised their housing density from one and a half to two times

between censuses infant mortality decline was close to the mean for all Great Towns. When densities were more than doubled increase in decline continued but only very modestly. A critical threshold of urban development had to be surpassed before infant mortality decline was greater than the mean, but beyond that threshold there were diminishing returns when viewed solely in these terms. At some rate of urban development it might be concluded that either it was so pervasive that it affected the whole town or else it was accompanied by improvements in other condition(s) which augmented the original effect.

6.4 INFANT MORTALITY DECLINE BY FATHER'S OCCUPATION

In general it is not possible to apply the kind of analysis which we have used in the Great Towns to infant mortality by father's occupation, because we have not been able to estimate change over time in the independent variables in a rigorous way. Instead we propose to consider change in infant mortality by independent variables which measure cross-sectional differences for selected groups of occupations. The occupations have been chosen where environmental conditions vary while income is held constant, or where environmental conditions are held constant and income varies.

6.4.1 we examine particular groups of occupations which, although not able to offer rigorous support or refutal of the hypotheses, can nevertheless give indications for the eventual conclusions. First we take the armed services, a graph of whose infant mortality declines are shown in Figure 6.1. The four occupational groups present dramatic decline and the officers of both services in particular had terminal infant mortality levels which were very low even in comparison with the professions. Despite the small number of occupations to consider two patterns emerge. The officers of both services had low levels of infant mortality in 1910 and started from lower peaks. That is one configuration. The other is the steepness of the decline in both army groups, especially at early points in the period. Now the former pattern is not surprising, if one allows for the greater education and income of army and navy officers compared with the men of those services. That there should have been a difference between the services is less obvious. Some explanation probably lies in the difference in housing practice adopted by the respective services authorities. The Army provided married quarters for soldiers and non-commissioned officers as well as commissioned officers, from at least 1878, at which time as examination of Army barrack books has shown, lavatories and washhouses were provided although they were then on a shared

basis (26). The standards of these quarters were improved by the end of the nineteenth century, however, so that typical quarters had one large and one small bedroom, a living room, a scullery with bath and hot and cold water, as well as a sink which had only a cold water supply, and a water closet in the yard outside. In contrast to this the Navy provided no quarters at all for married men of non-officer grade until after 1946 (27). We might reasonably infer that ceteris paribus, in this case income, social class, marriage and fertility patterns, that the differences in infant mortality can be explained by the improved environmental conditions which the married quarters afforded. As to their fertility patterns, they had similar age at marriage fertility distributions as revealed by the t(i) indices for each five year marriage duration.

6.4.2 The railway workers represented a group distributed among a number of class and income groups but with one feature in common, the provision of housing by the railway companies. Railway clerks had an estimated infant mortality rate of 59 per 1000 in 1910 compared with a peak of 124.2 per 1000. For 1910 railway workers in social class III had estimated levels between 72 and 84 per 1000, while for those in social classes IV and V the range was 85 to 105 per 1000. They all tended to have moderate rather than high peak

levels of infant mortality and were not well paid (Figure 6.2). It has not been possible to consult railway company records as to their housing but we can learn something of the typical experience from railway historians. McKenna points out that:

> "From the earliest days the companies used housing policy as a means of staff control and for the preservation of company loyalty." (28)

By the 1840s, well before the period in question housing had started to become more planned. In 1848 the Eastern Counties Railway Company built 300 hoses for workers when it moved its engine works to Stratford in East London (29). Three years later the Great Western Railway built 300 cottages on land provided by the the company (30). By 1897 the Midland Railway Company owned 2199 workers cottages (Bagwell, 1963) (31). Although he does not tell us the period to which he refers McKenna points out that the Great Northern Railway built an estate of 226 brick and slate houses which he describes as

> "...plumbed and flushed.." (32)

In other railway towns, notably Crewe and Wolverton, railway company provision extended to shops, school rooms and churches (33). Except for what McKenna writes about Peterborough we cannot be certain that the other houses provided by the railway companies had water closets and other amenities but it seems unlikely that Peterborough was an exception. Furthermore, it is significant

that the practice of providing workers' houses was not restricted to one or two companies. We therefore have secondary evidence which suggests that railway company housing provision was both widespread, if not universal, and of high sanitary standards for the period even if the original policy had been less than entirely altruistic.

6.4.3 There are occupations, which although little may be known about the accompanying housing and environmental conditions, nevertheless provide evidence that the latter were more important for the decline in infant mortality than were improvements in living standards. Two groups of occupations in particular while having some common characteristics on the one hand, had dramatically different income levels, yet similar patterns of infant mortality decline (although different levels). They were the miners and the agricultural labourers. Miners in general did not live in the kinds of poor urban environments which we have argued were, inter alia, responsible for high peaks of infant mortality and small declines. In fact, a large proportion of them (30%) lived in rural districts, with only 20% living in Great Towns. Their average incomes, at £112.00 per annum, were well above the median of £67.00 per annum. Agricultural labourers for the most part lived in areas designated as rural districts (81%), although a small percentage (7.5%), did

live in small towns of under 10,000 inhabitants. Their incomes were between £48.00 and £50.00 per year. We have here two groups of occupations with widely differing income levels and yet with similarities in their environments, that is low density rural areas. Their infant mortality measures are shown in graph form in Figure 6.3 where the difference in level yet similarity in trend is amply demonstrated. It cannot reasonably be argued that in this case there was a clear relationship between income and decline. On the other hand, if, as we have suggested, the improvement of poor urban environments was a major factor in differential infant mortality decline, then their rural environments and small declines in infant mortality compared with the average experience is consistent with our hypothesis.

Table 6.1 Great Towns: Infant Mortality
by Local Administration

Local Authority	No. Towns	Peak IMR	s.e.	% Fall in IMR	s.e.
London	1	145.68		40.82	
County Borough	70	150.87	2.4	32.98	9.6
Municipal Borough	14	138.26	6.6	36.72	2.5
Urban District	12	131.12	6.1	41.64	2.4
All Towns	97	146.41	0.0	34.67	0.0

Table 6.2 Great Towns: Infant Mortality by Urban Development 1891 to 1911

Increase in Housing Density	No. Towns	Peak IMR	% Fall in IMR
less than 1.5	61	154.44	31.81
1.5 to 1.99	20	137.54	36.56
2.0 to 2.49	6	126.62	41.47
2.5 to 3.99	7	127.60	44.07
>=4.00	3	125.82	44.84
All Towns	97	146.41	34.67

Table 6.3 Great Towns: Comparison of Urban Development Indices with Sanitary and House Refuse Disposal Conditions and Practices

Town	% Fall in IMR	Urban Dev. Index	Water Closet Provision	Sewage Disposal	House Refuse Disposal
Bath	52.22	1.12	not known	water carriage system in 1901	1901
Birkenhead	45.02	1.39	2721 privy middens in 1893 (330 in 1910)	-	1893
Coventry	33.25	1.80	WC town by 1897	Final portion sewered 1910	1910
East Ham	36.48	4.42	-	Sewage disposal works by 1892	1892
Edmonton	52.51	2.63	99% provision by 1904	99% connected by 1904	none-see note a
Enfield	44.98	1.89	-	at least partly sewered by 1900	none - see note b
Leyton	51.92	2.04	-	partly sewered by 1892	1907 but probably before 1900
Liverpool	36.76	1.16	-	-	Still tipping in 1900
Smethwick	27.36	2.08	>2000 in 1897 inc. to 100% by 1910	Sewage Disposal works by 1895	
Southend	45.90	4.92	-	partly sewered in 1902	1902
Walthamstow	46.57	2.60	virtually 100% by 1902	dual system by 1892	1892
Warrington	28.38	1.37	100 WCs only added between 1903 and 1910	-	1903

Table 6.4a Infant Mortality, Housing Density Increase and Environmental Conditions included in the Internal Sanitary Survey

Town	Peak IMR	% Fall in IMR	Housing Density Increase	Dwellings of the Poor
Dudley	159.40	16.65	1.20	Fair
Gt. Yarmouth	138.13	32.59	1.18	Poor
Hastings	101.37	34.67	1.12	Fair/poor
Ipswich	123.47	34.62	1.36	Poor
Lincoln	130.72	43.41	1.52	Good/fair
Norwich	143.28	30.71	1.25	Fair
Salford	174.74	33.03	1.18	Fair
Southend on Sea	147.29	45.90	4.92	Fair
South Shields	153.86	29.79	1.37	Poor
Stockport	186.63	39.89	1.43	Fair/Satis.
Stoke on Trent	171.15	20.08	1.24	Good
Sunderland	162.61	25.21	1.23	Poor
Tynemouth	147.41	23.70	1.53	Poor
Walsall	147.44	20.88	1.39	Fair/poor
Warrington	163.01	28.38	1.37	Usually good
Wigan	173.65	22.62	1.27	Poor

Source: Local Government Board Internal Sanitary Survey 1893 to 1895

Table 8.4b Infant Mortality, Housing Density Increase and Environmental Conditions for Great Towns in the Internal Sanitary Survey

Town	Water Supply	Sewerage	Excrement Disposal	Refuse Disposal
Dudley	Mostly good	Good	5% WCs	Ineff.
Gt. Yarmouth	Fair	Fair/good	Mostly WCs	Satis.
Hastings	Mostly good	Satis.	WCs universal	Fair/ good
Ipswich	Fair/ good	Unsatis.	Mostly midddens	Poor
Lincoln	Poor	Satis.	Mostly WCs	Satis.
Norwich	Good	Poor	Mostly WCs	
Salford	Satis.	Fair	35% WCs	Good
Southend on Sea	Satis.	Fair/ good	Mostly WCs	Ineff.
South Shields	Good	Fair	6% WCs	Good
Stockport	Poor	Unsatis.	Mostly middens	Poor
Stoke on Trent	Good	Fair/ good	9% WCs	Unsatis.
Sunderland	Good	Fair/ good	21% WCs	Fair
Gt. Yarmouth	Fair/ poor	Satis.	Mostly pail middens	Fair
Walsall	Satis.	Fair	Mainly WCs	Fair
Warrington	Good	Fair/ good closets	Mostly pail	Fair/ good
Wigan	Fair	Satis. others mostly pail	12% WCs, good	Fair/

Note: satis. = satisfactory, unsatis. = unsatisfactory
ineff. = inefficient

Table 6.5 Occupations :Infant Mortality by Percentage Male Workers Urban Resident

% Urban	No.	Peak IMR	s.e.	% Fall in IMR	s.e.
up to 20%	7	91.01	0.002	26.21	0.025
21% to 80%	42	131.16	0.004	35.20	0.020
81% to 90%	51	127.42	0.003	36.83	0.017
over 90%	100	137.31	0.002	35.68	0.010
All Occupations	200	131.88	0.002	35.36	0.008

Figure 6.1 Infant Mortality Decline in Selected Occupations: The Armed Services.

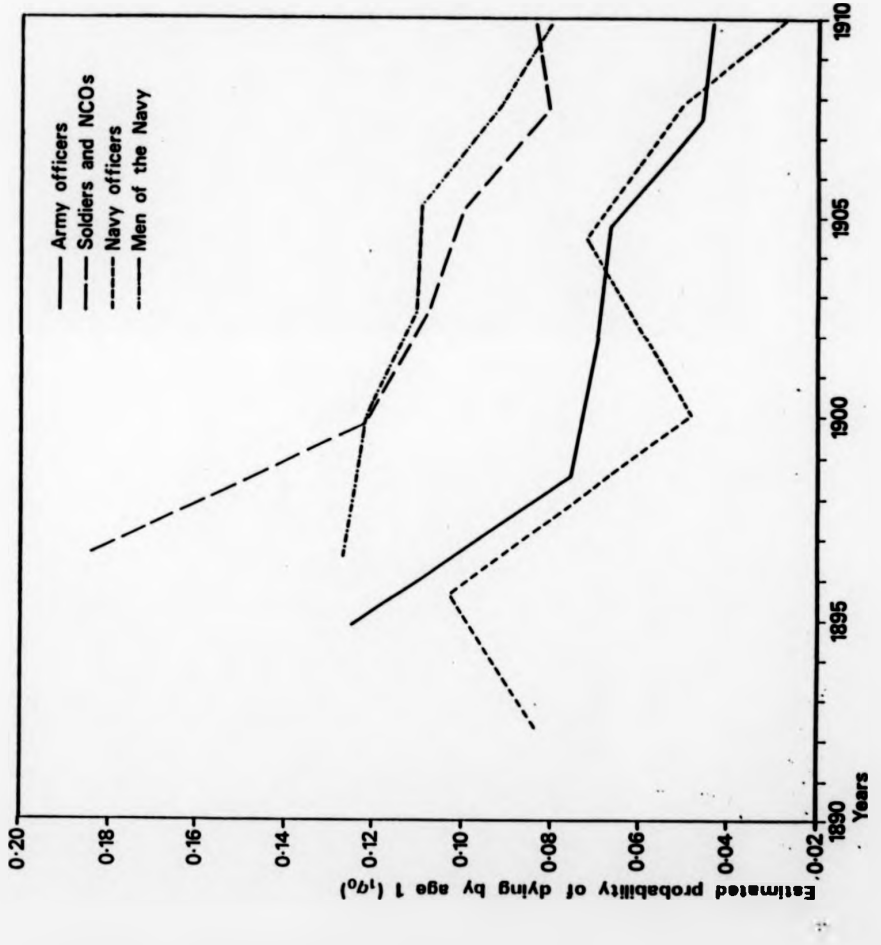


Figure 6.2 Infant Mortality Decline in Selected Occupations: Railway Workers

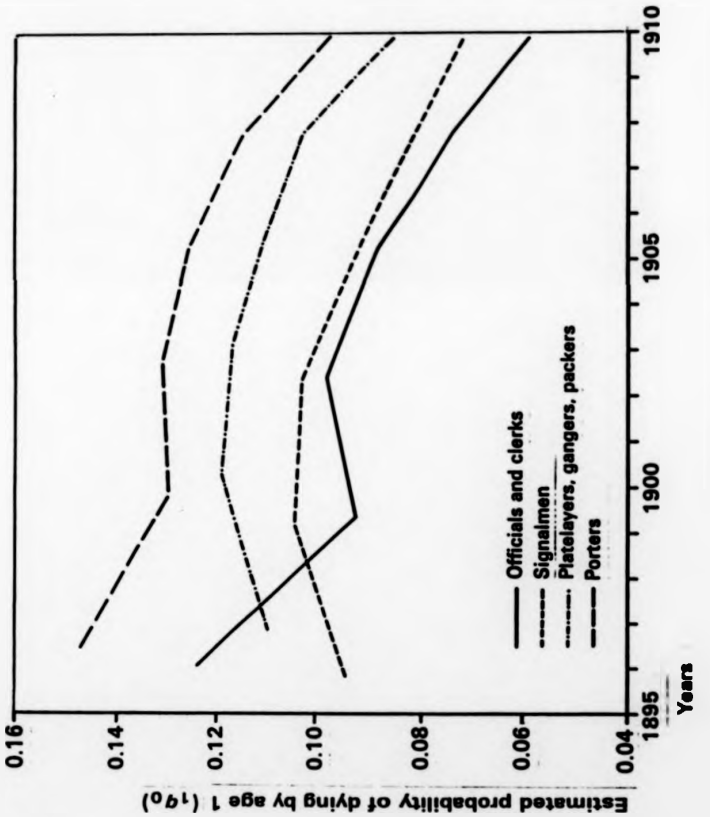
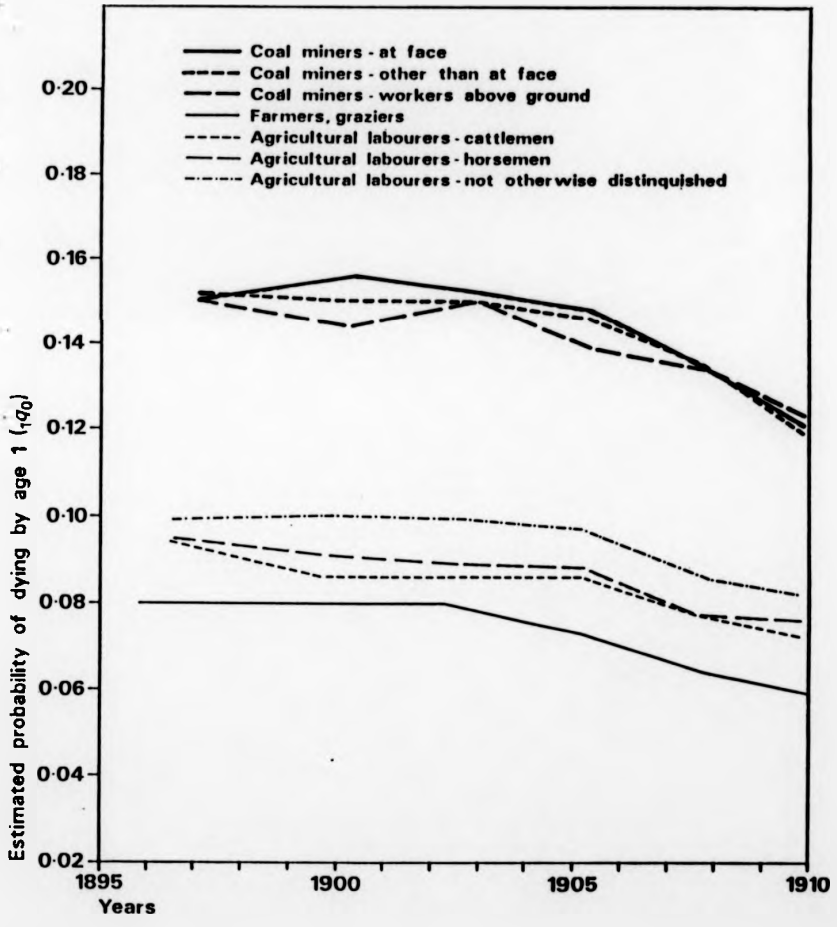


Figure 6.3 Infant Mortality Decline in Selected Occupations: Mining and Farming.



Notes

1. From 1951 only did British Census schedules include questions on the presence of housing amenities which would have been useful here. See Office of Population Censuses and Surveys and General Register Office, Edinburgh. 1977. Guide to Census Reports Great Britain 1801-1966. London: Her Majesty's Stationery Office. pp. 38-39.
2. Smellie, K.B. 1946. A History of Local Government. London: George Allen and Unwin. pp. 38-39.
3. Smellie, op. cit. p. 40.
4. Freeman, T.W. 1968. Geography and Regional Administration 1830-1968. London: Hutchinson. p. 69.
5. Freeman, op. cit. p. 69.
6. Flinn, M.W. 1968. Public Health Reform in Britain. London: St. Martin's Press. p. 47.
7. Wilson, N. 1946. Municipal Health Services. London: George Allen and Unwin. p. 9.
8. Wilson, op. cit. p. 9.
9. Freeman, op. cit. p. 71.
10. Smellie, op. cit. p. 92.
11. Smellie, op. cit. pp. 40-41.

12. Vesey-Fitzgerald, J.V. and M.G. Gairy. 1888 The Local Government Act 1888, Statutes, containing Statute Law of New County Councils with explanatory notes. London: Waterlow Brothers and Layton. pp. 162-163.
13. Smellie, op. cit. pp. 50-51.
14. Smellie, op. cit. p. 51
15. Smellie, op. cit. pp. 50-51.
16. Waller, P.J. 1983. Town, City, and Nation England 1850-1914. Oxford: Oxford University Press. pp. 2-4.
17. 1891 Census of England and Wales, Divisional Volumes, Table 4. PP 1893-4/cv; 1901 Census, County Volumes, Tables 1 and 9, 1911 Census, Volume Table 8, PP 1912-13/cxi.
18. Baines, D. 1985. Migration in a Mature Economy. Emigration and Internal Migration in England and Wales, 1861-1900. Cambridge: Cambridge University Press. p. 219.
19. Tranter, N. 1985. Population and Society 1750-1940. London: Longman. pp. 37-38, 43-44.
20. For this information see note 14, Chapter 2.
21. The original intention had been to select some towns from each of the following four categories: high peak 1q0 and high decline; high peak 1q0 and low decline; low peak 1q0 and high decline; low peak 1q0 and low decline. Due to the poor availability of extant Medical Officer of Health reports this plan had regrettably to be abandoned.

22. Medical Officer of Health, Edmonton. Annual Report - 1910. 1911. Tottenham: Crusha and Son.

23. Medical Officer of Health, Coventry. Annual Report - 1910. 1911. Coventry: Curtis and Beamish.

24. Medical Officer of Health, Coventry. Annual Report - 1906. 1907. Coventry: Curtis and Beamish.

25. Local Government Board. 1896. Supplement to the Twenty-fourth Annual Report. Internal Sanitary Survey 1893-95. London: Her Majesty's Stationery Office.

26. Barrack Synopsis 1878. War Office, London. p. 10. Barrack Synopsis 1911 War Office, London. pp. 50-51.

27. Parliamentary Papers. 1946. House of Commons Parliamentary Debates. London: His Majesty's Stationery Office. 420 H.C. Deb. 4 March to 22 March 1946. Columns 555-556.

28. McKenna, F. 1980. The Railway Workers 1840-1970. London: Faber and Faber. pp. 50-51.

29. Allen, C.J. 1955. The Great Eastern Railway. London: Ian Allan. p. 17.

30. McKenna, op. cit. p. 51.

31. Bagwell, P.S. 1963. The Railway-men: The History of the National Union of Railwaymen. London: Allen and Unwin. p. 36;

32. McKenna, op. cit. p. 51.

33. Head, Sir F.B. 1968. Stokers and Pokers or the London and North Western Railway, The Electric Telegraph and The Railway Clearing-House. Newton Abbot: David and Charles Reprints. p. 110.

CHAPTER 7

SELECTIVE MIGRATION AND INFANT MORTALITY DECLINE

7.1 INTRODUCTION

This chapter examines the effect which migration may have had on the differential decline of infant mortality. It is important that this issue is addressed in order

that the extent to which it may have obscured the effect of the explanatory variables can be assessed. The general view of historians of the period is that migration was not significant. The Edwardian period is rather portrayed as one which saw relatively little migration in the same way that it saw little differential alleviation of poverty. Yet is is obvious that some movements which were differentiated geographically did take place. A number of those towns which had crossed the 50,000 population threshold by 1911 and thus enjoyed the description of "Great Town" did so principally through immigration rather than through natural increase, such were their population growth rates. Baines (1985), however, suggests that population growth in cities was largely due to natural increase, and points out that where fertility was high the contribution of migration would have been even smaller (1). Net outmigration was certainly very low between 1891 and 1900, but increased substantially during the next decade, while natural increase remained fairly constant between 1871 and 1910 (2).

Migration, where it did occur, is, therefore, inextricably linked with urban development. Since this research takes urban development, whose measurement was described in a previous chapter, as an explanatory variable, the need to examine the interrelationships of infant mortality decline with migration is clear. There are two kinds of migration which could have influenced that decline. There is migration which is selected according to some variable or factor which is measurable for the population under study and that which is undifferentiated by any known factor. The work which is described here uses aggregate data and the discussion must be largely confined, therefore, to overtly selective migration. The chapter will be divided into two main sections, one which discusses the way in which migration was estimated and one which discusses and interprets the relationship between migration and infant mortality decline.

7.2 ESTIMATION OF MIGRATION

If it were the case that urban development was a spurious factor in the explanation of infant mortality decline during the period and that it was migration which had a causal relationship with the decline then it must follow that the two were strongly correlated. A method of establishing whether this was so is therefore required.

Furthermore since we are restricting ourselves to overtly selective migration we must make some assumption about the variables with respect to which it was selected. Was it, for example, age, occupation, income or marriage duration or some other factor which determined whether a family would migrate or not. In this research we assume that occupation would have been a determining factor. The following method of estimating occupationally selective migration was adopted. We already know which occupations were associated with the highest falls in infant mortality. From these occupations three were chosen which were so universal that they were followed in all of the Great Towns, irrespective of any industrial or other occupational speciality. For example, it is known that all armed forces occupations displayed spectacular falls in the infant mortality of their offspring. The parents, however, were concentrated in a few of the Great Towns, such as Devonport and Portsmouth (3). National and local government officers, commercial and business clerks and bankers and bank clerks were finally chosen to represent universal, high decline occupations, the migration of whose members could have had a significant influence on the mortality decline which is the focus of this research. The measure, called the selective migration index, was constructed as follows:

HDOCC1901=(G1901+B1901+C1901)/OM1901..(22)

where G1901 denotes the number of national and local government officers in 1901, B1901 denotes the number of bankers and bank clerks in 1901, C1901 denotes the number of commercial and business clerks in 1901 and OM1901 the number of occupied males in 1901. All terms on the right of the equation refer to males aged 10 years and over. A similar equation was constructed for the year 1911. The selective migration index (SMI) is as follows:

SMI = HDOCC1911/HDOCC1901.....(23)

It would have been possible to estimate migratory behaviour over the twenty year period from 1891 to 1911. The shorter period from 1901 was deliberately chosen however. Had the longer period been taken as the reference period very few towns with rapid urbanisation rates could have had the their selective migration estimated in this way due to the population sizes in 1891. The corollary of rapid urbanisation for some towns was failure to meet the critical threshold for definition as a Great Town at earlier censuses. Even when migration is estimated over ten years a number of rapidly growing towns, such as Wimbledon in Surrey, Acton, Ealing, Edmonton and Enfield in Middlesex, and Barnsley, Dewsbury and Wakefield in the West Riding of Yorkshire failed to meet the population criterion in 1901 and hence are accorded missing values in Appended Table 7.

7.3 THE EXTENT OF MIGRATION

7.3.1 SELECTIVE MIGRATION

The mean proportion of occupied males in the high decline occupations chosen to control for migration was 0.0827 in 1901 and 0.0963 in 1911. There was wide variation around these mean values, the standard deviations being 0.0476 and 0.0589 respectively. On the other hand, the mean increase in the proportions in those occupations in each of the Great Towns was just over 10%, the average value of the index being 1.1348 with most of the values clustered around the mean. It might be helpful to look at a few example. Hornsey, for instance, had 0.3409 of its employed males in those occupations in 1901, four times the mean proportion, but this had only increased to 0.3607 by 1911. Its overall fall in infant mortality was 51%. Wallasey increased its proportion from 0.2335 to 0.2616 over the same period, while its infant mortality decline was 49%. Southport, experienced an increase in its proportion of those workers from 0.0670 to 0.1265, and therefore had an SMI of 1.8884 but underwent an overall fall in infant morality of 32%, just short of the average for all towns. In Reading the proportion of workers in the selected occupations was more than halved from 0.0786 to 0.0379, while its infant mortality fall by 40% overall. This sample of a small number of

cases demonstrates that there is a case for inferring that while the presence of members of a particular occupation in a town may have significantly contributed to that town's infant mortality levels, the change in the proportion of such members did not contribute to the decline.

Tables 7.1 and 7.2 show mean falls in infant mortality for different values of the selective migration index. There is no evidence from the tables that migration explained any part of the mortality fall. If anything the tables suggest that migration had a negative effect on infant mortality decline. Standard error values do not invalidate this view.

Mean infant mortality declines by 1901 proportions of those in high decline occupations used to measure selective occupational migration are given in Table 7.3. We might infer from this and from observations in an earlier paragraph that initial proportions of a town's employed men in such occupations were more important than their change over time, adding further support to the proposition that migration, at least that which was occupationally selected, did not make a major contribution to infant mortality decline in our period.

Table 45 in the fertility of marriage volume of

the 1911 Census gives data on the number of couples, number of children born, and the number of children dead by husbands' and wives' places of birth and place of enumeration. From these have been estimated infant mortality levels in 1910 and various points in the past. Those who were born in London and enumerated in Great Towns, (figure 7.1) i.e. had emigrated to them, showed a greater improvement in infant mortality than those born and enumerated entirely in London. In itself this information does not help us to draw a conclusion, but together with the evidence on selective migration tends to support the argument that it was the nature of the towns to which people migrated rather than the characteristics of the migrants which was more important for mortality decline. However we can see that migrants had lower peak levels of infant mortality than life time London dwellers which somewhat weakens this proposition.

The situation is not clarified very much when we consider the infant mortality trends of those born and enumerated in the Great Towns. They had peak levels of infant mortality higher than life time London dwellers and underwent an average decline which at 28% was considerably smaller than the overall average for all those enumerated in Great Towns. There are two points which it is important to bear in mind in interpreting this table. First,

in this category fall all 97 Great Towns irrespective of their growth over time. We cannot therefore draw any conclusion, based in this tabulation alone, about the contribution which urban growth may have made. Furthermore, the tabulations are based on the sum of individual couples enumerated in the Great Towns. Those which had very large population (for example over 100,000 inhabitants) made large contributions to the aggregate levels of infant mortality. In other words, since their contribution is approximately proportional to the size of their populations, the table cannot tell us anything about the the contribution of individual towns irrespective of size, in contrast to the way they are dealt with in the rest of the analysis. It would be inappropriate therefore to place much importance on these tabulations on their own, largely because of their inability to differentiate in this way.

A further check which we apply to the data is to look at the patterns of infant mortality decline in towns close to London with different growth rates due to migration. In the unlikely event that migration had been solely responsible for differential decline, then a different pattern of decline would be expected to emerge. First, the decline would have features related to the timing. We would expect the steepest declines to have taken place during the years of most rapid

expansion. In addition, the migrants' place of origin would be expected to have higher infant mortality levels in 1910 compared with their destinations. Figure 7.2 illustrates that neither of these situations obtained. Waller (1983) points out that, inter alia, the towns of Leyton and West Ham underwent their greatest growth between 1871 and 1881, East Ham and Walthamstow between 1881 and 1891 and Ilford between 1891 and 1901 (4). It is unfortunate that retrospective census estimates cannot cover the 1871 to 1881 decade, but for the other four towns there is no particular evidence of migration having affected the timing of decline. As to the second point, East Ham and West Ham had terminal infant mortality levels close to that of London, higher in the latter case.

While we cannot control for migration which was undifferentiated by an identifiable variable or factor we should not conclude this discussion without at least some reference to it. By necessity our overall conclusions must be based on the analysis of the effect of those variables which can be identified, proxied if necessary, and quantified. We have no way of estimating the infant mortality pattern of those people who, ceteris paribus, migrated versus those who did not. It would be false, however to, assume that its effect was absent or negligible. Simon (1984) found that contemporary migrants in the United

States contributed more to the economy through taxes and so on than they took out through, for example, social security benefits (5). Such a finding is consistent with other characteristics of people who migrate. We may conclude that the effect of undifferentiated migration is unknown.

It is reasonable to close this chapter with the conclusion that selective occupational migration did not have an independent effect on infant mortality decline in England and Wales during the fifteen prior to the 1911 Census. Any interactive effect which it may have had with either poverty level or urban development will be discussed in a later chapter.

Table 7.1 Great Towns: Infant Mortality
by Selective Migration
(Decline measured from peak to 1910)

Selective Migration	No. Towns	Peak IMR	s.e.	% Fall in IMR	s.e.
up to 1.00	4	131.10	9.00	34.69	2.48
1.00 to 1.09	31	148.09	3.91	36.34	1.39
1.10 to 1.19	25	145.12	3.69	31.85	1.75
1.20 to 1.99	20	153.11	4.74	32.52	1.51
Migration status not Known	17	140.97	6.35	38.32	2.76
All Towns	97	146.41	0.00	34.67	0.00

Table 7.2 Great Towns: Infant Mortality by Selective Migration (Decline measured from 1902 to 1910)

Selective Migration Index	No. Towns	1902 Level IMR	s.e.	% Fall in IMR from 1902	s.e.
up to 1.00	4	123.85	11.03	30.61	1.65
1.00 to 1.09	31	133.90	4.23	29.46	1.14
1.10 to 1.19	25	134.30	3.97	26.39	1.50
1.20 to 1.99	20	138.76	3.67	25.87	1.19
Migration Status not Known	17	123.42	6.62	29.66	2.22
All Towns	97	132.75	0.00	28.01	

Table 7.3 England and Wales 1895 to 1910

Infant Mortality Decline

by Occupations used to control

for Selective Occupational Migration

Proportion High Decline Occupations 1901	No. Towns	% Fall in IMR (from peak)
up to 0.05	12	29.36
0.06 to 0.10	53	32.99
0.11 to 0.15	7	39.17
0.15 to 0.20	5	39.34
0.21 to 0.35	3	50.35
Data missing	17	38.32
All Towns	97	34.67

Figure 7.1 Infant Mortality in the Great Towns by Selected Birthplace and Place of Enumeration.

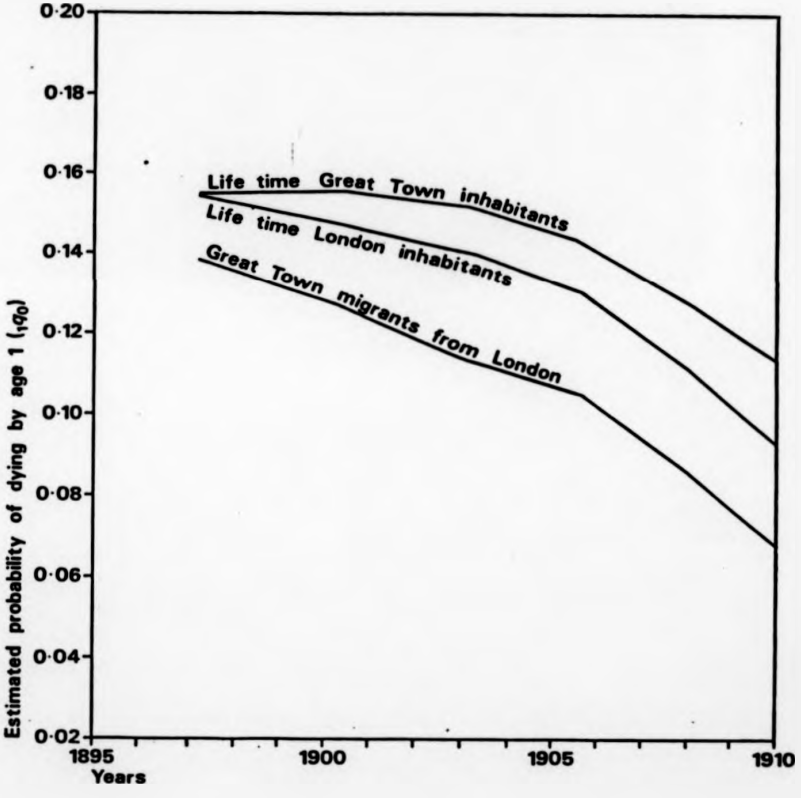
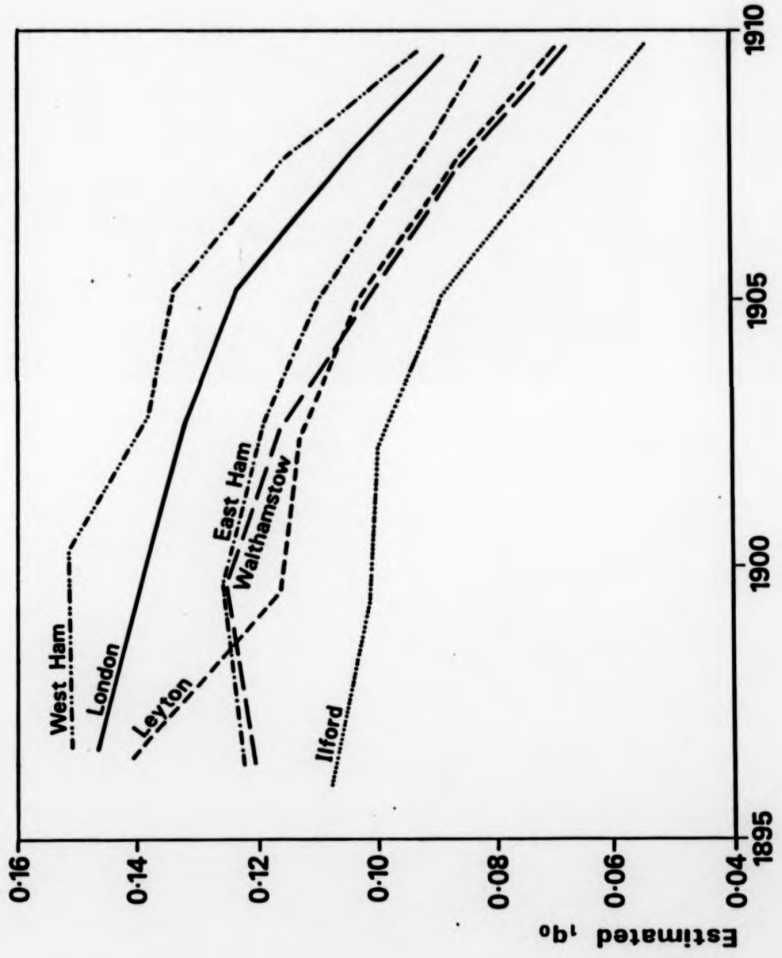


Figure 7.2 Infant Mortality in London and Selected Great Towns.



Notes

1. Baines, D. 1985. Migration in a Mature Economy. Emigration and Internal Migration in England and Wales, 1861-1900. Cambridge: Cambridge University Press. p. 219.

2. Tranter, N. 1985. Population and Society 1750-1940. London: Longman. pp. 37-38, 43-44.

3. 1911 Census of England and Wales, County Volumes: Table 35.

4. Waller, P.J. 1983. Town, City and Nation - England 1850-1914. Oxford: Oxford University Press. p. 3.

5. Simon, J.L. 1984. Immigrants, Taxes and Welfare in the United States. Population Development Review 10: 55-69.

CHAPTER 8

DISCUSSION AND CONCLUSION

8.1 In this final chapter we draw together the findings of the previous four with a view to interpreting their relative importance for differential infant mortality decline in England and Wales at the beginning of this century. By way of summing up we examine how far we can quantify the independent and interactive effects of the two factors which we have investigated. In addition we discuss the findings in terms of the decline in mortality at older ages, at the same time speculating further on the variables or factors which might throw some light on the residual variation in the differential decline.

8.2.1 The interactive effects of the explanatory variables are best explained with the Great Towns as units. For it is in the Great Towns data set that a more rigorous measure of environmental improvement can be defined. First we consider the relationship of fertility decline and urban development together with infant mortality decline (Table 8.1). We have already pointed out that urban development had an independent effect on that decline, shown in this table by the row marginals. Towns with an urban development level of 2 had a mean decline in infant mortality which was 7.72 percentage points greater than towns at level 1. Fertility decline on its own had an independent effect of approximately the same order (7.02%) but with a more extended it has

comparatively few towns at the extremes. When the two variables are considered together, however, urban development has the greater impact. Where fertility decline was lowest, now urban development effect was apparent. At higher levels of fertility decline the urban development effect increased from 7.86 percentage points to 11.11 percentage points. When disaggregated in this way towns with the higher mean declines were those with the greatest fertility decline and higher urban development levels (42.06%). Although the differences are slight, towns in the second lowest fertility fall groups had higher infant mortality declines than those in the next highest groups, at both urban development levels. Within the lower urban development group fertility decline had virtually no independent effect, while within the higher group there was a sharper distinction between the lowest fertility decline group and the other which showed negligible variation.

These relationships are consistent with expectations about the interactive effects of the two variables. It is logical to infer that while the greater independent effect was urban development this was enhanced in towns where mean fertility decline was high by an environmental rather than the demographic impact referred to in Chapter 4. We suggest that this operated through the child's opportunity to have a greater share of

food and child care, whatever the family's prevailing standard of living, which helped to protect against death from water or faecal borne disease. However, some of the apparent fertility association with mortality decline comes from the tendency for urban development and fertility fall to go together in the towns. The statistical basis for concluding that fertility had an independent effect is, therefore, slight.

8.2.2 We consider now the interactive effect of urban development and poverty on infant mortality decline. We have suggested already in Chapter 5 that it was level of poverty rather than change which differentiated infant mortality decline; it is level, therefore, which will be discussed (Table 8.2). At urban development level 1 poverty level differentiated the mortality declines little. At the higher urban development level, however, the picture is different. Where poverty was estimated as being moderate or high infant mortality falls were below the mean for the category, while where it was low the decline was slightly above the mean. The higher infant mortality declines at low poverty levels when poverty is the only explanatory variable are a consequence of the larger differentials within the higher urban development group.

To summarise, it appears that in towns where urban

development was low the prevailing poverty level did not contribute toward infant mortality decline. Rapidly growing towns with good environmental improvement had a beneficial effect on infant mortality decline. This effect was enhanced where there was relative freedom from poverty. It is possible, of course, that the urban development was different in kind where there was greater poverty from that which took place in the richer towns. The strong negative association between urban development and poverty should be noted. Thus only one of sixteen towns with high poverty was more developed compared with fourteen of nineteen with low poverty. If there were no difference in the kind of urban development which took place between town of different poverty levels, then it may be that poverty inhibited the beneficial effects of urban improvements.

8.2.3 The pattern of infant mortality decline by both selective occupational migration and urban development is more difficult to interpret (Table 8.3). Infant mortality has been shown in two ways: from its peak, whenever that occurred; and from its 1902 level. The latter was chosen here because, for data reasons, a suitable index of selective occupational migration could be constructed for the period from 1901 to 1911 only. Migration and level of infant mortality are positively related, whether the peak or that in

1902 are taken. Migration is, however, negatively related to the mortality decline from 1902, while no association appears to exist between migration and decline from peak. These relationships are contrary to those one would expect if the former had contributed to the fall in infant mortality.

At the lower levels of urban development migration and infant mortality decline are inversely associated, although the deviations from the mean value are small. Where urban development was greater the picture is less clear. For falls in infant mortality from 1902 only, selective migration does not differentiate the decline. For falls from the peak levels the declines in infant mortality are erratic, with above average falls in the second lowest migration and the status unknown groups. The example of towns whose migration status could not be measured is not inconsequential. Estimates could not be made because these towns fell below the 50,000 population threshold in 1901, and so by definition grew rapidly in the decade 1901 to 1911. Had data been available they would probably have reflected an influx of families headed by workers in the high infant mortality decline occupations chosen to index migration, but for the moment that cannot be established. Although it would have been useful to know how much migration there had been to those towns which were below the 50,000 population

threshold in 1901, the available evidence does not suggest that it would have been substantial. It is clear that urban development had a much greater independent effect on infant mortality decline than did selective occupational migration, it is doubtful whether the apparent direct and indirect influences of the latter occurred other than by chance.

8.3 The review of interactive effects of the explanatory variables on infant mortality decline by father's occupation is more difficult owing to co-linearity in the variables. First we consider the relationship between fertility decline and the variables representing poverty and environment, namely, income and the proportion of the working population which was urban resident. Next we look at the joint impacts of poverty and the environment on infant mortality decline and then the interaction of explanatory variable effects, using the subsets of occupations which have already been discussed in Chapter 6.

8.3.1 Fertility fall on its own appears to have a more consistent although modest influence on infant mortality decline than does urban/rural residence on its own. By contrast there is no differentiation of infant mortality decline for occupations with more than 20% of members urban resident. For essentially rural occupations

however, the decline in infant mortality is almost 10 percentage points below the mean (Table 8.4). This suggests that urban occupations were able to benefit from changes or improvements which were not available to rural dwellers. The interactive effects of these variables is somewhat in doubt, the greatest declines taking place in occupations which were neither wholely urban nor rural but which did have the greatest fertility declines. Within particular urban resident or fertility decline groups infant mortality decline does not change monotonically with the other variables; the sub-group which had an infant mortality decline of 44% may have been in a special category, with suburban and hence environmental improvement, steep fertility declines and perhaps also high incomes.

8.3.2 The breakdown by both income and fertility decline is given in Table 8.5. The former demonstrates greater differentials in infant mortality decline. When fertility decline is held constant infant mortality decline increases for income groups generally with two notable exceptions, where fertility decline is at its lowest and annual income is between £116 and £160, and where fertility decline is greatest and income is between £96 and £115. These subgroups contain only one occupation, however. On the other hand, except where income approaches twice the median

there are only two groups with infant mortality declines appreciably above the mean, and these are at the steeper end of the fertility decline continuum. Within income groups, there is little to suggest that fertility decline and infant mortality decline are positively associated. Furthermore, since the highest fall of all takes place where income is above £160 per annum but fertility decline is low we may reasonably conclude that it was the increase in living standards through income rather than smaller families (a greater share of low income) which contributed to infant mortality decline but only in the light of previous evidence when environmental improvement was likely to exceed the norm.

8.3.3 Again no clear relationship emerges from the joint Table 8.6 of infant mortality decline by income and urban/rural residence. At incomes above £116 per year, infant mortality decline is large, irrespective of place of residence, except for that occupation which was highly urban with an average income between £116 and and £160. It would appear that high income could generally compensate for the poor urban environment in many towns where there was not improvement over the period.

8.3.4 It is salutory to remind ourselves of the relationship which emerged when particular

subgroups of occupations were examined. In the previous chapter, for example, we showed the effects of improving environment with income held constant by looking at infant mortality decline in the armed services. However, a variation in income in a similar environment yielded little differentiation in infant mortality decline.

8.4 Here are the major conclusions from the analysis of both data sets.

8.4.1. First, the factors which were not found to be influential in infant mortality decline in England and Wales from 1895 to 1910:

(i) Fertility decline had little independent and only small interactive effects on the decline.

(ii) Selective occupational migration was not found to be important.

(iii) Income as such was not important unless it was either very high, £116 per annum or above, or unless at lower levels the income was linked to secure employment.

8.4.2 These factors were found to be important:

(i) Place of residence was important, for infant mortality decline was considerably below the

average in rural areas. In urban areas the size of the decline was related to the quality of the environment.

(ii) Environmental improvement proxied by urban development had the greatest independent effect on the decline in infant mortality.

(iii) The environmental effect was enhanced in places of lower poverty.

8.5 While the fall in infant mortality in England and Wales was important for its own sake, especially in conjunction with the associated public health, childcare and other issues, there was another important consequence of its decline. That has to do with the relationship between infant deaths and deaths at all ages in the population. Figure 8.1 plots for England and Wales, France and Sweden the gross reproduction rate (GRR) against the expectation of life at birth e0 with m, the mean of the age-specific fertility distribution, standardised at 29. The isolines shown represent the proportion of all deaths which are infant deaths under combinations of these two conditions. In England and Wales it appeared that during a period which saw an increase of about five years in life expectation at birth the population also underwent a transition in the proportion of deaths which were

to those below age 1. From 1891 to 1911 under the prevailing gross reproduction rate and life expectation, the proportion of deaths which were infant deaths fell from 0.2 to between 0.15 and 0.10. This came from a combination of decline in the infant mortality level and in the gross reproduction rate. That is, the number of infant deaths vis a vis births was declining while at the same time the relative number of births fell. For two points in the past (1861 and 1911) the infant mortality level on its own explains 64.8% to 87.1% (see Watterson, 1987) of the variation in life expectation at birth, thus suggesting that the decline in the former was important for increase in the latter and illustrated by Figure 8.1 (2).

Prior to its decline, high infant mortality was the focus of concern of the eugenists who were worried about the future supply of soldiers. While much of that concern was related to physical condition the probable size of that future supply cannot have escaped their notice. Parenthetically, it was odd that less concern was expressed about the future supply of mothers.

8.6 Finally we return to the main objective, the answer to the question of why infant mortality in England and Wales failed to decline until the beginning of the Twentieth Century although mortality at other ages under age 5 which had

started to decline in the 1870s (Woods and Hinde, 1987) (1). It is likely that the sanitary revolution had progressed sufficiently by the 1870s for childhood mortality above age 1 to decline if one accepts that some childhood diseases were becoming less virulent.

The decline of infant mortality compared with that of childhood mortality above age 1 is better understood if the former is first examined in terms of its diarrhoeal and non-diarrhoeal components (Woods, Watterson and Woodward, forthcoming) (3). The gradual and irreversible decline of non-diarrhoeal infant mortality which began in the 1880s resembled the death rate from all causes of those aged 1, while diarrhoeal infant mortality rose during the 1890s and the two components declined together after 1899. It would be logical to assume that the sanitary revolution was by no means complete by the beginning of the twentieth century. Considerable variation did still exist in the provision of water closets, in sewage removal and disposal and in the treatment of household refuse. The climate during several hot dry summers in the 1890s had a catalytic effect in places of high density and poor sanitary conditions, the consequence of which was an increase in diarrhoeal infant mortality. This effect appeared to have weakened by 1911, another year with a hot dry summer. The most probable

explanation for the weakened effect of climate on diarrhoeal infant mortality was the enhancement of environmental improvements which had already taken place by the introduction of a number of personal health service measures under the aegis of medical officers of health around the turn of the century. The most important of these was the introduction of health visitors. A range of six large towns and cities surveyed began to employ health visitors during the period 1893 to 1909 to visit new-born infants, give advice on feeding and on domestic hygiene, particularly the care and cleaning of infant feeding implements and the storage and preparation of cows' milk. Their ability to carry out this work effectively was likely to have been improved by the passing of the Notification of Births Act 1907, which required that the medical officer of health be notified of a birth within forty-eight hours of its taking place, in addition to, and not instead of the normal vital registration requirements (Watterson, forthcoming) (4).

The decline in total infant mortality, then, can be more fully understood by reference to the level of its diarrhoeal component during the 1890s and decline thereafter. An explanation of the earlier and more gradual national decline in non-diarrhoeal infant mortality, while beyond the brief of research reported here can, nevertheless,

be commented upon. Its similarity with childhood mortality at higher ages, especially with that of those aged 1, suggests that factors which could affect all those under age 5, rather than the very young, including infants around the age of weaning, were important. These would include the increase in female literacy which predated the infant mortality decline but coincided with that for ages 1 to 4 years (5). Other factors were also likely to have been influential. Speculation on what these were must be tentative but if we bear in mind the points made by Lewis-Faning in 1930 about the independence of urbanization from industrialization with respect to Farr's healthy districts, then improvements in the housing environment brought about by urbanization would feature on the list of probable factors, although further research would be required to investigate this proposition (6).

By way of conclusion we recall a point made in chapter one concerning the causal influences on infant versus other early childhood mortality. We assumed then that the conditions which were necessary and sufficient for mortality at other ages under 5 to fall were necessary but not sufficient for the decline of infant mortality. It is useful to relate that point to our main conclusion. What we have shown is that environmental factors were more important in the

differential decline in infant mortality during the last half of the 1890s and in the 1900s than poverty level, although absence of poverty enhanced that effect. In addition, it was also probable that the conditions which were necessary and sufficient for all mortality from particular causes under age 5 allowed decline to take place from the 1870s onwards, but that other changes which were specific to infant mortality only began to take place in the late 1890s and in the 1900s. These were changes which were particularly important in terms of their capacity to bring about a reduction in diarrhoeal infant mortality, those which were at the forefront of personal health service provision. In that way the decline in all mortality can be thought of as an integrated whole instead of differentiated components.

Table 8.1 Infant Mortality by Fertility Decline and Urban Development

Fertility Decline Index	Urban Development Index: 1 N	1 Peak IMR	1 Fall from Peak	2 N	2 Peak IMR	2 Fall from Peak	Both Levels N	Both Levels Peak IMR	Both Levels Fall from Peak
1 - smallest decline	7	168.85	31.26	5	163.49	31.44	12	166.62	31.33
2	30	155.26	33.17	11	133.15	41.03	41	149.33	35.28
3	21	151.33	30.16	14	124.29	40.16	35	140.51	34.16
4 - largest decline	3	134.25	30.95	6	126.51	42.06	9	129.09	38.35
All Great Towns	61	154.44	31.81	36	132.81	39.53	97	146.41	34.67

Table 8.2 Infant Mortality by Urban Development and Selective Migration

SELECTIVE MIGRATION INDEX	URBAN DEVELOPMENT INDEX: 1						2						Both Levels					
	N		IMR Level		Fall from		N		IMR Level		Fall from		N		IMR Level		Fall from	
	Peak	1902	Peak	1902	Peak	1902	Peak	1902	Peak	1902	Peak	1902	Peak	1902	Peak	1902	Peak	1902
1 - least	2	3	134.00	128.20	33.66	29.52	2	1	128.19	110.78	35.72	33.87	4		131.10	123.85	34.69	30.61
2	23	27	154.37	136.82	34.25	29.16	8	4	130.03	114.19	42.35	31.49	31		148.09	133.90	36.34	29.46
3	16	20	151.60	138.72	30.37	25.07	9	5	133.60	116.61	34.46	31.68	25		145.12	134.30	31.85	26.39
4 - greatest	15	17	154.67	139.97	31.48	24.93	5	3	148.42	131.89	35.64	31.15	20		153.11	138.76	35.52	25.87
Migration Status not known	5	7	171.29	139.46	25.39	22.77	12	10	128.34	112.18	43.71	34.49	17		140.97	123.41	38.32	29.66
All Great Towns	61	74	154.44	140.22	31.81	26.49	36	23	132.81	136.58	39.53	32.89	97		146.41	132.75	34.67	28.01

Table 8.3 Infant Mortality by Poverty Level and Urban Development

Poverty Level	URBAN DEVELOPMENT INDEX								
	1			2			Both Levels		
	N	Peak IMR	Fall from Peak	N	Peak IMR	Fall from Peak	N	Peak IMR	Fall from Peak
High	15	159.60	34.01	1	141.56	30.51	16	158.66	33.79
Moderate	23	145.89	31.72	9	141.52	33.65	32	144.66	32.27
Low	5	159.23	32.40	14	130.42	40.38	19	138.00	38.28
Poverty status not known	18	159.55	29.91	12	128.34	43.71	30	147.07	35.43
All Great Towns	61	154.44	31.81	36	132.81	39.53	97	146.41	34.67

Note: Urban Development Index, 1 = up to 1.5 fold increase in density from 1891 to 1911, 2 = greater than 1.5 fold increase in density from 1891 to 1911.

Table 8.4 Occupations: Infant Mortality
by Proportion Male Working
Population Urban Resident
and Fertility Decline

		Proportion Urban				
Fertility Decline		<=20%	21%-80%	81%-90%	>90%	All Urban Distributions
1	Fall	22.02	33.31	37.45	32.14	33.01
Smallest	Peak	94.32	136.35	129.62	144.12	136.10
	N	3	17	11	24	55
2	Fall	29.32	31.24	36.62	34.44	34.27
	Peak	88.54	129.87	128.99	136.48	130.37
	N	4	14	24	34	76
3	Fall	-	39.94	36.36	39.05	37.61
	Peak	-	115.25	124.78	136.42	132.19
	N	-	3	10	29	42
4	Fall	-	44.38	37.23	37.92	39.68
Greatest	Peak	-	128.35	121.11	128.92	127.02
	N	-	8	6	13	27
All	Fall	26.21	35.20	36.83	35.68	35.36
Decline	Peak	91.01	131.16	127.42	137.31	131.88
Groups	N	7	42	51	100	200

Table 8.5 Occupations - Infant Mortality by Fertility Decline and Annual Income.

Fertility Decline		Income per Annum (£) Up to 67	68-80	81-95	96-115	116-160	>160	Total Known Income	Not Known	All Income Groups
	Fall	25.00	30.90	29.07	24.86	18.02	56.73	32.41	33.85	33.01
1-smallest	Pk	146.72	153.73	147.52	161.23	152.23	101.49	140.56	129.87	136.10
	N	12	5	6	2	1	6	32	23	55
	Fall	27.50	32.04	34.97	26.23	53.07	62.27	33.33	35.64	34.27
2	Pk	122.25	139.37	139.02	137.43	113.88	105.98	133.82	125.36	130.37
	N	9	15	18	3	2	1	45	31	76
	Fall	26.97	33.18	34.61	50.47	-	54.11	35.86	40.61	38.52
3	Pk	156.51	142.97	140.72	126.61	-	124.87	141.24	125.33	132.32
	N	3	4	8	2	-	1	18	24	42
	Fall	-	34.12	48.87	15.75	-	58.60	37.68	40.86	39.68
4-greatest	Pk	-	135.09	148.18	122.21	-	136.07	136.52	121.42	127.02
	N	-	6	2	1	-	1	10	17	27
All Fertility Decline Groups	Fall	26.19	32.42	34.63	30.64	41.39	57.27	36.97	37.36	35.36
	Pk	138.64	141.39	141.70	138.77	126.66	108.43	125.76	125.75	131.88
	N	24	30	31	8	3	9	105	95	200

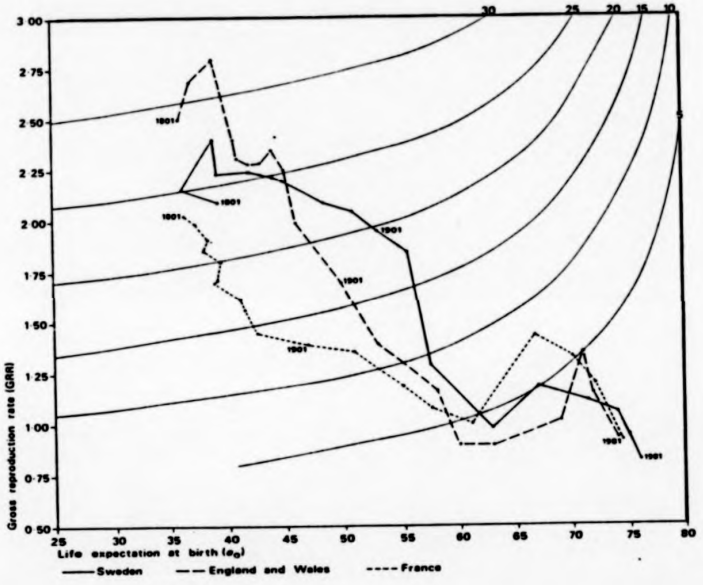
Table 8.6 Occupational Infant Mortality

by Annual Income and Proportion

Male Working Population Urban Resident

Income Group (£ per Annum)		Proportion Urban <=20%	21%-80%	81%-90%	>90%	All Urban Groups
up to 67	Fall	25.17	26.23	26.54	26.30	26.19
-	Peak	95.26	155.62	135.47	155.09	138.64
-	N	4	3	8	9	24
68-80	Fall	-	30.33	35.63	31.52	32.42
-	Peak	-	142.60	129.37	146.68	141.39
-	N	-	5	8	17	30
81-95	Fall	-	32.70	30.10	36.01	34.63
-	Peak	-	137.10	145.10	141.76	141.70
-	N	-	4	5	22	31
96-115	Fall	-	21.73	22.79	35.56	30.64
-	Peak	-	155.13	152.11	130.16	138.77
-	N	-	1	2	5	8
116-160	Fall	-	44.13	62.02	18.02	41.39
-	Peak	-	117.58	110.18	152.23	126.66
-	N	-	1	1	1	3
>160	Fall	-	60.42	56.00	54.11	57.26
-	Peak	-	114.67	101.39	124.87	108.43
-	N	-	3	5	1	9
Total Known Income	Fall	25.17	35.78	35.71	32.99	36.97
	Peak	95.26	137.94	129.85	144.29	125.76
	N	4	17	29	45	95
Not Known	Fall	27.61	34.81	38.38	38.96	37.36
	Peak	85.36	126.55	124.07	128.79	125.75
-	N	3	25	22	55	105
All Income Groups	Fall	26.21	35.20	36.08	35.68	35.36
	Peak	91.01	131.16	127.42	137.31	131.88
	N	7	42	51	100	200

Figure 8.1 - The Demographic Transition and the Contribution of Infant Deaths: England and Wales, France and Sweden.



Notes

1. Woods, R.I. and P.R.A. Hinde. 1987. Mortality in Victorian England: models and patterns. Journal of Interdisciplinary History, 18: 27-54;
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3. Woods, R.I., P.A. Watterson and J.H. Woodward. The causes of the rapid infant mortality decline in England and Wales, 1861-1921. Population Studies (under referee, will probably be published in 1988).
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6. Lewis-Faning, E. 1930. 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: 121-153.

APPENDIX I

GREAT TOWNS ADMINISTRATIVE DETAILS

TOWN	LOCAL AUTHORITY	COUNTY	REGISTRATION DIVISION
ABERDARE	UD	GLAM	11
ACTON	UD	MIDDX	3
ASTONMANOR	MB	WARKS	6
BARNSLEY	MB	WEST YORKS	9
BARROW IN FURNESS	CB	LANCS	8
BATH	CB	SOMERSET	5
BIRKENHEAD	CB	CHES	8
BIRMINGHAM	CB	WARKS	6
BLACKBURN	CB	LANCS	8
BLACKPOOL	CB	LANCS	8
BOLTON	CB	LANCS	8
BOOTLE	CB	LANCS	8
BOURNEMOUTH	CB	SOUTHANTS	2
BRADFORD	CB	WEST YORKS	9
BRIGHTON	CB	E. SUSSEX	2
BRISTOL	CB	GLOUCS	6
BURNLEY	CB	LANCS	8
BURY	CB	LANCS	8
CARDIFF	CB	GLAM	11
COVENTRY	CB	WARKS	6
CROYDON	CB	SURREY	2
DARLINGTON	MB	DURHAM	10
DERBY	CB	DERBS	7
DEVONPORT	CB	DEVON	5
DEWSBURY	MB	WEST YORKS	9
DUDLEY	CB	WORCS	6
EALING	MB	MIDDX	3
EASTBOURNE	CB	E. SUSSEX	2
EAST HAM	MB	ESSEX	4
EDMONTON	UD	MIDDX	3
ENFIELD	UD	MIDDX	3
GATESHEAD	CB	DURHAM	10
GILLINGHAM	MB	KENT	2
GLOUCESTER	CB	GLOUCS	6
GREAT YARMOUTH	CB	NORFOLK	4
GRIMSBY	CB	LINCS	7
HALIFAX	CB	WEST YORKS	9
HANDSWORTH	UD	STAFFS	6
HASTINGS	CB	E. SUSSEX	2
HORNSEY	MB	MIDDX	3
HUDDERSFIELD	CB	WEST YORKS	9
ILFORD	UD	ESSEX	4
IPSWICH	CB	E. SUFFOLK	4
KINGS NORTON AND NORTHFIELD	UD	WORCS	6
KINGSTON ON HULL	CB	EAST YORKS	9
LEEDS	CB	WEST YORKS	9
LEICESTER	CB	LEICS	7
LEYTON	UD	ESSEX	4
LINCOLN	CB	LINCS	7

TOWN	LOCAL AUTHORITY	COUNTY	REGISTRATION DIVISION
LIVERPOOL	CB	LANCS	8
LONDON	CAP.	LONDON	1
MANCHESTER	CB	LANCS	8
MERTHYR TYDFIL	CB	GLAM	11
MIDDLESBROUGH	CB	N. YORKS	9
NEWCASTLE ON TYNE	CB	NTHUMB	10
NEWPORT	CB	MONMTH	11
NORTHAMPTON	CB	NORTHANTS	3
NORWICH	CB	NORFOLK	4
NOTTINGHAM	CB	NOTTS	7
OLDHAM	CB	LANCS	8
OXFORD	CB	OXON	3
PLYMOUTH	CB	DEVON	5
PORTSMOUTH	CB	SOUTHANTS	2
PRESTON	CB	LANCS	8
READING	CB	BERKS	2
RHONDDA	UD	GLAM	11
ROCHDALE	CB	LANCS	8
ROTHERHAM	CB	WEST YORKS	9
ST. HELENS	CB	LANCS	8
SALFORD	CB	LANCS	8
SHEFFIELD	CB	WEST YORKS	9
SMETHWICK	CB	STAFFS	6
SOUTHAMPTON	CB	SOUTHANTS	2
SOUTHEND ON SEA	MB	ESSEX	4
SOUTHPORT	CB	LANCS	8
SOUTHSHIELDS	B	DURHAM	10
STOCKPORT	CB	CHES	8
STOCKTON ON TEES	MB	DURHAM	10
STOKE ON TRENT	CB	STAFFS	6
SUNDERLAND	CB	DURHAM	10
SWANSEA	CB	GLAM	11
SWINDON	MB	WILTS	5
TOTTENHAM	UD	MIDDX	3
TYNEMOUTH	CB	NTHUMB	10
WAKEFIELD	MB	WEST YORKS	9
WALLASEY	MB	CHES	8
WALSALL	CB	STAFFS	6
WALTHAMSTOW	UD	ESSEX	4
WARRINGTON	CB	LANCS	8
WEST BROMWICH	CB	STAFFS	6
WEST HAM	CB	ESSEX	4
WEST HARTLEPOOL	CB	DURHAM	10
WIGAN	CB	LANCS	8
WILLESDEN	UD	MIDDX	3
WIMBLEDON	MB	SURREY	2
WOLVERHAMPTON	CB	STAFFS	6
YORK	CB	EAST YORKS	9

APPENDIX II

GREAT TOWNS - INFANT MORTALITY VARIABLES

TOWN	PEAK LEVEL IMR	FALL IN IMR FROM PEAK	1902 LEVEL IMR	FALL IN IMR FROM 1902
ABERDARE	174.28	27.186	174.28	27.19
ACTON	130.58	33.458	130.58	33.46
ASTON MANOR	150.40	27.753	148.15	26.66
BARNSLEY	192.18	35.638	154.67	20.03
BARROW IN FURNESS	154.75	39.767	131.68	29.21
BATH	143.71	52.223	102.21	32.82
BIRKENHEAD	172.78	45.017	145.20	34.57
BIRMINGHAM	153.87	28.544	153.28	28.27
BLACKBURN	172.61	29.616	165.15	26.44
BLACKPOOL	167.87	44.761	125.27	25.98
BOLTON	155.05	30.164	145.19	25.42
BOOTLE	162.43	37.826	150.21	32.77
BOURNEMOUTH	122.79	48.074	93.43	31.76
BRADFORD	166.08	36.127	139.53	23.97
BRIGHTON	122.75	40.212	116.71	37.12
BRISTOL	122.41	32.105	118.34	29.77
BURNLEY	197.01	24.755	175.73	15.64
BURY	159.32	23.531	141.12	13.67
CARDIFF	135.75	35.433	125.52	30.17
COVENTRY	129.14	33.251	124.29	30.65
CROYDON	117.37	40.130	97.83	28.17
DARLINGTON	135.61	37.025	126.23	32.35
DERBY	127.26	31.055	119.70	26.70
DEVONPORT	138.22	36.724	132.73	34.11
DEWSBURY	169.51	22.648	151.71	13.57
DUDLEY	159.40	16.650	149.51	11.14
EALING	107.53	37.385	98.92	31.93
EASTBOURNE	128.66	56.871	82.96	33.11
EAST HAM	123.92	36.483	118.10	33.35
EDMONTON	135.84	52.510	117.33	45.02
ENFIELD	129.54	44.982	109.61	34.98
GATESHEAD	153.36	28.189	149.82	26.49
GILLINGHAM	121.49	37.131	110.95	31.16
GLOUCESTER	146.34	34.304	115.83	17.00
GREAT YARMOUTH	138.13	32.592	127.96	27.24
GRIMSBY	163.45	40.398	141.24	31.03
HALIFAX	141.27	29.249	130.65	23.50
HANDSWORTH	114.02	35.748	110.78	33.87
HASTINGS	101.37	34.675	91.07	27.29
HORNSEY	118.68	50.657	88.78	34.04
HUDDERSFIELD	160.47	40.880	126.90	25.24
ILFORD	106.24	52.146	96.61	47.38
IPSWICH	123.47	34.624	123.47	34.62
KINGS NORTON AND NORTHFIELD	110.31	37.522	103.87	33.65
KINGSTON UPON HUL	149.48	31.957	141.32	28.03
LEEDS	159.42	29.030	146.45	22.74
LEICESTER	138.92	25.957	134.35	23.44
LEYTON	140.23	51.922	109.65	38.51
LINCOLN	130.72	43.406	130.72	43.41
LIVERPOOL	180.24	36.757	161.75	29.53
LONDON	145.68	40.815	131.06	34.21

TOWN	PEAK LEVEL IMR	FALL IN IMR FROM PEAK	1902 LEVEL IMR	FALL IN IMR FROM 1902
MANCHESTER	170.77	35.276	156.38	29.32
MERTHYR TYDFIL	204.58	42.868	166.21	29.68
MIDDLESBROUGH	166.67	18.342	162.62	16.31
NEWCASTLE UPON TYNE	153.49	32.406	142.12	27.00
NEWPORT	142.36	35.684	136.05	32.70
NORTHAMPTON	130.27	30.084	114.84	20.69
NORWICH	143.28	30.709	141.47	29.82
NOTTINGHAM	139.16	16.348	139.16	16.35
OLDHAM	171.10	28.089	164.98	25.42
OXFORD	130.94	45.746	95.59	25.68
PLYMOUTH	141.56	30.510	133.08	26.08
PORTSMOUTH	135.83	39.814	129.32	36.78
PRESTON	180.68	23.821	168.73	18.43
READING	117.60	39.566	100.40	29.21
RHONDDA	166.63	33.283	160.13	30.58
ROCHDALE	164.19	33.589	139.01	21.56
ROTHERHAM	142.13	24.133	139.12	22.49
ST. HELENS	168.91	28.998	153.03	21.63
SALFORD	174.74	33.026	168.01	30.34
SHEFFIELD	156.98	23.876	150.55	20.62
SMETHWICK	132.58	27.357	132.11	27.10
SOUTHAMPTON	122.20	34.018	114.63	29.66
SOUTHEND ON SEA	147.29	45.896	104.21	23.53
SOUTHPORT	136.08	32.150	122.21	24.45
SOUTH SHIELDS	153.86	29.787	143.10	24.51
STOCKPORT	186.63	39.886	159.27	29.56
STOCKTON ON TEES	159.42	31.213	141.26	22.37
STOKE ON TRENT	171.15	20.082	171.15	20.08
SUNDERLAND	162.61	25.208	157.46	22.76
SWANSEA	157.71	30.150	148.81	25.97
SWINDON	105.83	32.590	97.92	27.14
TOTTENHAM	125.34	43.083	116.78	38.91
TYNEMOUTH	147.41	23.696	137.54	18.22
WAKEFIELD	149.31	21.412	143.50	18.23
WALLASEY	130.85	48.475	110.73	39.11
WALSALL	147.44	20.883	146.32	20.28
WALTHAMSTOW	124.00	46.573	114.53	42.15
WARRINGTON	163.01	28.379	147.60	20.90
WEST BROMWICH	156.36	26.394	148.73	22.62
WEST HAM	149.65	40.221	136.78	34.60
WEST HARTLEPOOL	168.87	37.123	137.29	22.66
WIGAN	173.65	22.620	173.65	22.62
WILLESDEN	116.81	41.272	109.02	37.08
WIMBLEDON	123.60	49.701	102.12	39.12
WOLVERHAMPTON	148.46	35.020	141.32	31.74
YORK	137.80	38.041	119.66	28.65

APPENDIX III - GREAT TOWN POVERTY VARIABLES

TOWN	WORKHOUSE INMATE RATE	PERCENT. LOW PAID WORKERS	PROPORTION MALES 10 14 EMPLOYED
ABERDARE	3.27	NK	NK
ACTON	2.73	NK	NK
ASTON MANOR	3.98	3.450	.28
BARNSLEY	1.83	NK	NK
BARROW IN FURNESS	3.94	5.060	.19
BATH	7.08	6.890	.20
BIRKENHEAD	5.91	10.740	.18
BIRMINGHAM	4.93	NK	NK
BLACKBURN	5.25	NK	.41
BLACKPOOL	1.96	NK	NK
BOLTON	3.80	7.870	.39
BOOTLE	4.04	NK	.19
BOURNEMOUTH	2.61	4.540	.17
BRADFORD	3.75	5.600	.38
BRIGHTON	11.11	7.300	.18
BRISTOL	6.03	NK	NK
BURNLEY	3.88	5.390	.43
BURY	4.65	8.010	.36
CARDIFF	4.55	8.330	.15
COVENTRY	6.27	3.970	.24
CROYDON	2.31	9.640	.14
DARLINGTON	2.97	NK	NK
DERBY	4.40	7.220	.22
DEVONPORT	4.30	7.720	.11
DEWSBURY	1.73	NK	NK
DUDLEY	4.99	7.670	.26
EALING	2.75	NK	NK
EASTBOURNE	4.06	NK	NK
EAST HAM	3.01	9.550	.13
EDMONTON	6.03	NK	NK
ENFIELD	6.04	NK	NK
GATESHEAD	4.40	9.710	.17
GILLINGHAM	6.95	NK	NK
GLOUCESTER	3.75	8.100	.21
GREAT YARMOUTH	10.19	13.430	.13
GRIMSBY	2.91	8.670	.17
HALIFAX	3.15	5.680	.42
HANDSWORTH	4.99	2.950	.21
HASTINGS	3.83	8.870	.15
HORNSEY	6.02	2.870	.09
HUDDERSFIELD	3.01	5.990	.30
ILFORD	4.20	NK	NK
IPSWICH	4.17	6.250	.21
KINGS NORTON AND NORTHFIELD	3.12	5.950	.22
KINGSTON UPON HULL	5.22	9.450	.16
LEEDS	2.28	7.660	.27
LEICESTER	4.78	4.560	.31
LEYTON	3.01	5.690	.14
LINCOLN	3.01	6.180	.15
LIVERPOOL	7.38	NK	NK
LONDON	6.66	9.860	.15

TOWN	WORKHOUSE INMATE RATE	PERCENT. LOW PAID WORKERS	PROPORTION MALES 10 14 EMPLOYED
MANCHESTER	6.82	NK	NK
MERTHYR TYDFIL	3.26	5.110	.28
MIDDLESBROUGH	4.16	9.230	.15
NEWCASTLE UPON TYNE	4.02	NK	NK
NEWPORT	3.18	9.340	.15
NORTHAMPTON	4.08	3.470	.27
NORWICH	6.50	NK	NK
NOTTINGHAM	5.14	7.090	.27
OLDHAM	5.86	7.660	.38
OXFORD	5.27	7.330	.16
PLYMOUTH	5.68	12.950	.13
PORTSMOUTH	3.60	NK	NK
PRESTON	5.51	8.770	.35
READING	5.57	7.560	.23
RHONDDA	1.38	1.160	.34
ROCHDALE	5.33	6.780	.38
ROTHERHAM	3.33	8.210	.26
ST HELENS	5.70	6.870	.26
SALFORD	6.33	10.270	.26
SHEFFIELD	5.27	NK	NK
SMETHWICK	3.12	6.770	.29
SOUTHAMPTON	8.34	9.280	.17
SOUTHEND ON SEA	3.85	NK	NK
SOUTHPORT	3.04	NK	NK
SOUTH SHIELDS	4.79	NK	NK
STOCKPORT	4.34	7.880	.33
STOCKTON ON TEES	4.37	7.310	.17
STOKE ON TRENT	.93	NK	NK
SUNDERLAND	4.31	7.830	.16
SWANSEA	4.45	10.140	.16
SWINDON	3.89	NK	NK
TOTTENHAM	6.03	7.950	.15
TYNEMOUTH	4.19	6.460	.16
WAKEFIELD	3.07	NK	NK
WALLASEY	5.90	7.450	.13
WALSALL	3.69	4.380	.25
WALTHAMSTOW	3.01	8.690	.14
WARRINGTON	4.34	11.500	.28
WEST BROMWICH	5.05	6.750	.26
WEST HAM	3.01	12.390	.18
WEST HARTLEPOOL	6.26	5.910	.14
WIGAN	1.87	NK	.26
WILLESDEN	1.85	6.990	.12
WIMBLEDON	5.98	NK	NK
WOLVERHAMPTON	6.75	6.460	.21
YORK	5.36	6.520	.15

Notes:
(1) Workhouse Inmates per 1000 population
(2) Percentage low paid workers,
NK denotes data missing
(3) Males 10-14 employed,
NK denotes data missing

APPENDIX IV - GREAT TOWNS

URBAN DEVELOPMENT, FERTILITY DECLINE AND SELECTIVE MIGRATION VARIABLES

TOWN	(1)	(2)	(3)	(4)
ABERDARE	1.41	1.19	.83	NK
ACTON	2.33	1.55	1.04	NK
ASTON MANOR	1.15	.99	1.08	.87
BARNSLEY	1.49	1.24	.85	NK
BARROW IN FURNESS	1.54	1.35	1.06	1.42
BATH	1.12	1.07	1.31	1.13
BIRKENHEAD	1.39	1.23	1.14	1.05
BIRMINGHAM	1.15	1.02	1.06	1.10
BLACKBURN	1.23	1.09	1.35	1.15
BLACKPOOL	2.68	1.32	.94	NK
BOLTON	1.34	1.12	1.14	1.14
BOOTLE	1.49	1.21	.89	1.20
BOURNEMOUTH	1.87	1.43	1.27	1.04
BRADFORD	1.22	1.10	1.24	1.21
BRIGHTON	1.21	1.09	1.26	1.16
BRISTOL	1.38	1.12	1.18	1.19
BURNLEY	1.34	1.12	1.35	1.09
BURY	1.15	1.06	1.25	1.17
CARDIFF	1.52	1.11	1.01	1.14
COVENTRY	1.80	1.48	1.22	1.17
CROYDON	1.82	1.34	1.42	1.13
DARLINGTON	1.65	1.31	1.36	NK
DERBY	1.37	1.10	1.36	1.09
DEVONPORT	1.80	1.20	1.24	1.07
DEWSBURY	1.08	1.01	1.32	NK
DUDLEY	1.20	1.07	1.27	1.33
EALING	2.85	2.02	1.25	NK
EASTBOURNE	1.71	1.25	1.64	NK
EAST HAM	4.42	1.45	1.09	1.10
EDMONTON	2.63	1.41	1.10	NK
ENFIELD	1.89	1.38	1.29	NK
GATESHEAD	1.48	1.16	1.07	1.14
GILLINGHAM	2.00	1.32	1.65	NK
GLOUCESTER	1.31	1.07	1.25	1.19
GREAT YARMOUTH	1.18	1.10	1.20	1.23
GRIMSBY	1.48	1.17	1.13	1.02
HALIFAX	1.10	1.03	1.36	1.22
HANDSWORTH	2.39	1.37	1.27	.93
HASTINGS	1.12	.99	1.56	1.03
HORNSEY	2.05	1.23	1.63	1.06
HUDDERSFIELD	1.23	1.16	1.11	1.06
ILFORD	8.08	2.07	1.24	NK
IPSWICH	1.36	1.15	1.00	1.11
KINGS NORTON AND NORTHFIELD	3.21	1.48	1.33	1.24
KINGSTON UPON HULL	1.42	1.16	1.12	1.08
LEEDS	1.30	1.08	1.27	1.19
LEICESTER	1.43	1.12	1.24	1.23
LEYTON	2.04	1.29	1.17	1.07
LINCOLN	1.52	1.20	1.50	1.05
LIVERPOOL	1.16	1.05	.96	1.07
LONDON	1.05	1.00	1.14	1.09

TOWN	(1)	(2)	(3)	(4)
MANCHESTER	1.28	1.12	1.15	1.35
MERTHYR TYDFIL	1.35	1.17	1.17	1.25
MIDDLESBROUGH	1.64	1.19	.94	1.15
NEWCASTLE UPON TYNE	1.16	1.06	1.09	1.05
NEWPORT	1.64	1.25	1.27	.99
NORTHAMPTON	1.33	1.08	1.44	1.23
NORWICH	1.25	1.10	1.26	1.21
NOTTINGHAM	1.29	1.13	1.12	1.14
OLDHAM	1.20	1.11	1.44	1.04
OXFORD	1.26	1.11	1.10	1.07
PLYMOUTH	1.58	1.20	1.10	1.25
PORTSMOUTH	1.44	1.23	1.10	1.05
PRESTON	1.16	1.07	1.28	1.12
READING	1.41	1.11	1.24	.48
RHONDDA	1.94	1.38	.93	1.58
ROCHDALE	1.34	1.13	1.14	1.08
ROTHERHAM	1.60	1.19	1.48	1.16
ST HELENS	1.40	1.17	1.12	1.14
SALFORD	1.18	1.05	1.01	1.08
SHEFFIELD	1.40	1.14	1.22	1.25
SMETHWICK	2.08	1.33	1.23	1.15
SOUTHAMPTON	1.40	1.11	1.21	1.04
SOUTHEND ON SEA	4.92	2.18	1.14	NK
SOUTHPORT	1.44	1.14	1.16	1.89
SOUTH SHIELDS	1.37	1.10	.88	1.02
STOCKPORT	1.43	1.21	1.20	1.24
STOCKTON ON TEES	1.22	1.08	1.01	1.14
STOKE ON TRENT	1.24	1.02	1.11	NK
SUNDERLAND	1.23	1.10	.92	1.12
SWANSEA	1.23	1.13	1.20	1.05
SWINDON	1.93	1.22	1.17	NK
TOTTENHAM	1.90	1.36	1.17	1.04
TYNEMOUTH	1.53	1.46	.97	1.10
WAKEFIELD	1.25	1.10	1.14	NK
WALLASEY	2.61	1.52	1.30	1.12
WALSALL	1.39	1.09	1.26	1.20
WALTHAMSTOW	2.60	1.29	1.33	1.18
WARRINGTON	1.37	1.15	1.17	1.04
WEST BROMWICH	1.23	1.07	.88	1.15
WEST HAM	1.39	1.07	1.03	1.07
WEST HARTLEPOOL	1.71	1.10	.92	1.22
WIGAN	1.27	1.12	1.04	1.05
WILLESDEN	2.64	1.34	1.31	1.02
WIMBLEDON	2.42	1.42	1.05	NK
WOLVERHAMPTON	1.26	1.05	1.25	1.08
YORK	1.27	1.06	1.11	1.27

Notes:

(1) denotes housing density increase 1891 to 1911

(2) denotes housing density increase 1901 to 1911

(3) denotes fertility decline (duration) index

(4) denotes selective migration index, NK denotes data missing

APPENDIX V - OCCUPATIONS SOCIO-ECONOMIC VARIABLES

OCCUPATION	SOCIAL CLASS	OCC. ORD.	ANNUAL INCOME
PO TELEGRAPHISTS AND OTHER PO CLERKS	1	1	NK
POSTMEN	4	1	NK
POST OFFICE MESSENGERS	4	1	NK
OTHER CIVIL OFFICERS CLERKS	1	1	116
POLICE	4	1	NK
POOR LAW SERVICES	2	1	NK
MUNI PARISH ETC. OFFICERS	2	1	NK
ARMY OFFICERS	1	2	170
SOLDIERS AND NCOS	4	2	NK
NAVY OFFICERS	1	2	NK
MEN OF THE NAVY AND MARINES	4	2	NK
CLERGY OF ESTD CHURCH	1	3	206
MINISTERS PRIESTS OTHER RELS	1	3	206
BARRISTERS AND SOLICITORS	1	3	553
LAW CLERKS	1	3	NK
PHYSICIANS SURGEONS	1	3	395
DENTISTS AND DENTISTS ASSTS	1	3	368
SCHOOLMASTERS TEACHERS ETC.	1	3	NK
AUTHORS EDITORS ETC.	1	3	NK
CIVIL AND MINING ENGINEERS	1	3	292
PAINTERS, SCULPTORS AND ARTISTS	1	3	NK
ARCHITECTS	1	3	NK
MUSICIANS, SINGERS ETC.	2	3	NK
ACTORS	2	3	NK
PERFORMERS ETC.	2	3	NK
DOMESTIC INDOOR SERVANTS	3	4	NK
DOMESTIC COACHMEN AND GROOMS	4	4	NK
DOMESTIC MOTOR CAR DRIVERS	3	4	NK
DOMESTIC GARDENERS	4	4	NK
GAMEKEEPERS	3	4	NK
COLLEGE CLUB SERVICES	3	4	NK
HOSPITAL, INSTITUTE AND BENEVOLENT SOCIAL SERVICE	2	4	NK
CARETAKERS AND OFFICER KEEPERS	4	4	NK
MERCHANTS COMMODITY UNDEF	1	5	NK
BROKERS AGENTS FACTORS	1	5	NK
COMMERCIAL TRAVELLERS	1	5	NK
ACCOUNTANTS	1	5	NK
AUCTIONEERS APPRAISERS ETC.	1	5	NK
COMMERCIAL AND BUSINESS CLERKS	1	5	96
BANKERS AND BANK CLERKS	1	5	165
INSURANCE OFFICE CLERKS	1	5	NK
INSURANCE AGENTS	1	5	NK
RAILWAY OFFICIALS AND CLERKS	1	6	76
RAILWAY ENGINE DRIVERS, STOKERS AND CLEANERS	3	6	91

OCCUPATION	SOCIAL CLASS	OCC. ORDER	ANNUAL COME
RAILWAY GUARDS	3	6	79
RAILWAY SIGNALMEN	3	6	71
RAILWAY POINTSMEN AND LEVEL CROSSING MEN	4	6	67
RAILWAY PLATELAYERS, GANGERS AND PACKERS	5	6	59
RAILWAY LABOURERS (NOT CONTRACT)	5	6	58
RAILWAY PORTERS	5	6	57
LIVERY STABLE KEEPRS, COACH AND CAB PROPRIETORS	2	6	NK
COACHMEN (NOT DOMESTIC) AND CABMEN	5	6	NK
HORSEKEEPERS, GROOMS	5	6	NK
MOTOR CAR AND VAN DRIVERS	3	6	NK
CARMEN, CARRIERS ETC.	5	6	63
TRAMWAY SERVICE DRIVERS	3	6	83
TRAMWAY SERVICE CONDUCTORS	3	6	72
TRAMWAY SERVICE OTHERS	3	6	76
MERCHANT SERVICE:			
NAVIGATION	2	6	NK
ENGINEERING DEPT	2	6	NK
COOKS ETC.	2	6	NK
BARGEMEN, LIGHTERMEN AND WATERMEN	5	6	61
DOCK AND WHARF LABOURERS	5	6	NK
HARBOUR DOCK ETC. OFFICIALS	4	6	77
COALHEAVERS AND COAL PORTERS	5	6	NK
MESSENGERS (NOT RAIL OR GOVT)	5	6	NK
FARMERS AND GRAZIERS	2	7	NK
FARMERS AND GRAZIERS:			
(SONS AND OTHER RELATIVES)	2	7	NK
FARM BAILIFFS AND FOREMEN	3	7	NK
SHEPHERDS	4	7	52
FARM LABOURERS - CATTLE	8	7	51
FRAM LABOURERS - HORSES	8	7	50
FARM LABOURERS - OTHERS	8	7	47
NURSERYMEN, SEEDSMEN AND FLORISTS	4	7	NK
MARKET GARDENERS	4	7	NK
OTHER GARDENERS (NOT DOMESTIC)	4	7	NK
FISHERMEN	4	8	NK
COAL AND SHALE MINERS:			
AT FACE	7	9	112
BELOW GROUND	7	9	NK
ABOVE GROUND	7	9	NK
MINE OWNERS AGENTS AND MANAGERS	1	9	NK

OCCUPATION	SOCIAL CLASS	OCC. ORD.	ANNUAL INCOME
IRON MINERS AND QUARRIERS	7	9	NK
STONE MINERS AND QUARRIERS	4	9	NK
COAL AND COKE MERCHANTS AND DEALERS	2	9	NK
PIG IRON MAKERS	5	10	86
PUDDLING FURNACE WORKERS	5	10	91
STEEL SMELTERS AND FOUNDERS	4	10	98
TIN PLATE MAKERS	4	10	106
OTHER IRONFOUNDERS	3	10	94
IRONFOUNDRY LABOURERS	5	10	71
BLACKSMITHS AND STRIKERS	3	10	71
ERECTORS, FITTERS AND TURNERS	3	10	95
METAL MACHINISTS	3	10	77
OTHER ENGINEERING LABOURERS	5	10	58
BOILERMAKERS	3	10	91
ELECT APPLIANCE MAKERS AND FITTERS	3	10	93
ELECTRICIANS UNDEFINED	3	10	NK
TOOLMAKERS	3	10	111
CUTLERS AND SCISSOR MAKERS	3	10	NK
WIRE DRAWERS, WORKERS AND WEAVERS	4	10	81
TINPLATE GOODS MAKERS	4	10	NK
BRASS AND BRONZE WORKERS	4	10	81
SHIP PLATERS AND RIVETTERS	3	10	128
SHIPWRIGHTS	3	10	92
SHIPYARD LABOURERS	5	10	55
RAILWAY COACH AND WAGON MAKERS	3	10	NK
CYCLEMAKERS	3	10	90
MOTOR CAR CHASSIS MAKERS AND MECHANICS	3	10	NK
COACH AND CARRIAGE MAKERS	3	10	86
WHEELWRIGHTS	3	10	77
IRONMONGERS AND HARDWARE DEALERS	2	10	NK
GOLD AND SILVERSMITHS ETC.	2	11	91
WATCH AND CLOCKMAKERS	2	11	78
PIANO AND ORGAN MAKRES	3	11	94
DEALERS IN PRECIOUS METALS, JEWELLERY ETC.	2	11	NK
BUILDERS	1	12	126
BUILDERS LABOURERS	5	12	65
CARPENTERS AND JOINERS	3	12	94
BRICKLAYERS	3	12	95
BRICKLAYERS LABOURERS	5	12	62
MASONS	3	12	91
MASONS LABOURERS	5	12	59
PLASTERERS	3	12	96

OCCUPATION	SOCIAL CLASS	OCC. ORD.	ANNUAL INCOME
PAINTERS AND DECORATORS	3	12	90
PLUMBERS	3	12	94
GASFITTERS	3	12	95
NAVVIES AND RAILWAY CONTRACT LABOURERS	5	12	57
PAVIOURS AND ROAD LABOURERS	5	12	79
CABINET MAKERS	3	13	88
FRENCH POLISHERS	3	13	84
UPHOLSTERERS	3	13	88
FURNITURE DEALERS	2	13	NK
SAWYERS AND WOOD CUTTERS	4	13	65
COOPERS, HOOPMAKERS AND BANDERS	4	13	81
DEALERS AND MERCHANTS IN TIMBER ETC.	2	13	NK
BRICK AND PLAIN TILE MAKERS	5	14	68
PLASTER AND CEMENT MAKERS	5	14	75
EARTHENWARE AND CHINA MAKERS	4	14	80
GLASS MAKERS	4	14	90
MANUFACTURING CHEMISTS	4	15	76
CHEMISTS AND DRUGGISTS	1	15	314
OIL MILLERS AND OIL CAKE MAKERS	5	15	69
GREASE SOAP AND MANURE MAKERS	5	15	72
INDIARUBBER AND GUTTA PERCHA MAKERS	5	15	67
TANNERS AND CURRIERS	4	16	73
SADDLERS AND WHIP AND HARNESS MAKERS	3	16	73
PRINTERS HAND COMPOSITORS	3	17	101
OTHERS IN PRINTING	3	17	92
TEXTILE WORKERS (COTTON):			
CARD AND BLOWING ROOM WORKERS	6	18	70
SPINNERS	6	18	86
WINDERS AND WARPERS	6	18	85
WEAVERS	6	18	73
TEXTILE WORKERS (WOOL):			
SPINNERS	6	18	69
WEAVERS	6	18	70
OTHERS	6	18	66
HOSIERY MAKERS	6	18	79
LACE MAKERS	6	18	99
TEXTILE WORKERS (UNDEFINED):			
BLEACHERS AND PRINTERS	6	18	89
DYERS	6	18	64
CALENDERERS AND FINISHERS ETC.	6	18	64
DRAPERS AND MERCERS	2	18	NK

OCCUPATION	SOCIAL CLASS	OCC. ORD.	ANNUAL INCOME
OTHER DEALERS IN TEXTILES	2	18	NK
TAILORS	3	19	79
CLOTHIERS AND OUTFITTERS	2	19	NK
BOOT AND SHOE MAKERS	3	19	68
BOOT AND SHOE DEALERS	2	19	NK
WIGMAKERS AND HAIRDRESSER	3	19	NK
MILKSELLERS AND DAIRYMEN	2	20	NK
CHEESEMONGERS, BUTTERMEN AND GROCERS	2	20	NK
BUTCHERS	2	20	NK
FISHMONGERS, POULTERERS AND GAME DEALERS	2	20	NK
MILLERS AND CEREAL FOOD MAKERS	4	20	64
CORN SEED ETC. MERCHANTS AND DEALERS	2	20	NK
BREAD AND BISCUIT MAKERS	2	20	77
BAKERS AND CONFECTIONERS	2	20	NK
TEA COFFEE AND CHOC DEALERS	2	20	NK
GREENGROCERS AND FRUITERERS	2	20	NK
TOBACCONISTS	2	20	NK
BREWERS	4	20	66
COFFEE AND EATING HOUSE KEEPERS	2	20	NK
LODGING AND BOARDING HOUSE KEEPERS	2	20	NK
INN AND HOTEL KEEPERS AND PUBLICANS	2	20	NK
BARMEN	4	20	NK
WAITERS (NOT DOMESTIC)	3	20	NK
GAS WORKS SERVICE	4	21	82
WATERWORKS SERVICE	4	21	74
ELECTRICITY SUPPLY	4	21	81
SCAVENGERS AND DISPOSERS OF REFUSE	5	21	65
GENERAL SHOPKEEPERS	2	22	NK
PAWNBROKERS	2	22	NK
COSTERMONGERS, HAWKERS AND STREET SELLERS	5	22	NK
GEN LABOURERS	5	22	NK
ENGINE DRIVERS AND STOKERS (NOT RAIL)	4	22	NK
RETIRED FROM BUSINESS	2	23	NK
PENSIONERS	2	23	NK
PRIVATE MEANS	1	23	NK
OTHERS, INCLUDING STUDENTS	2	23	NK
ITINERANT PREACHERS ETC.	2	3	NK
SCIENTISTS	1	3	NK

Notes: (1) OCC. ORD. denotes occupational order;

(2) Annual Income, NK denotes data missing.

APPENDIX VI - OCCUPATIONS:

INFANT MORTALITY VARIABLES (1)

OCCUPATION	PEAK LEVEL IMR	FALL IN IMR FROM PEAK
PO TELEGRAPHISTS AND OTHER PO CLERKS	88.13	39.26
POSTMEN	125.27	43.60
POST OFFICE MESSENGERS	136.35	47.00
OTHER CIVIL OFFICERS CLERKS	110.18	62.02
POLICE	141.58	50.86
POOR LAW SERVICES	100.19	37.02
MUNI PARISH ETC. OFFICERS	123.82	54.36
ARMY OFFICERS	124.22	65.63
SOLDIERS AND NCOS	182.89	54.74
NAVY OFFICERS	91.69	70.12
MEN OF THE NAVY AND MARINES	126.27	36.82
CLERGY OF ESTD CHURC	83.73	57.02
MINISTERS, PRIESTS OTHER RELS	136.07	58.60
BARRISTERS AND SOLICITORS	93.75	60.10
LAW CLERKS	122.84	48.70
PHYSICIANS, SURGEONS	105.98	62.26
DENTISTS AND DENTISTS ASSTS.	128.12	52.63
SCHOOLMASTERS, TEACHERS ETC.	106.48	51.04
AUTHORS, EDITORS ETC.	95.18	42.20
CIVIL AND MINING ENGINEERS	93.31	59.98
PAINTERS, SCULPTORS AND ARTISTS	131.86	59.70
ARCHITECTS	73.43	36.13
MUSICIANS, SINGERS ETC.	130.12	44.15
ACTORS	150.76	34.41
PERFORMERS ETC.	139.29	31.59
DOMESTIC INDOOR SERVANTS	118.64	44.57
DOMESTIC COACHMEN AND GROOMS	93.57	23.05
DOMESTIC MOTOR DRIVERS	97.33	37.25
DOMESTIC GRADENERS	89.55	30.68
GAMEKEEPERS	75.48	26.48
COLLEGE CLUB SERVICES	130.14	41.550
HOSPITAL, INSTITUTE AND BENEVOLENT SOCIAL SERVICE	116.75	34.900
CARETAKERS AND OFFICER KEEPERS	137.62	31.040
MERCHANTS, COMMODITY UNDEFINED	87.08	40.440
BROKERS, AGENTS, FACTORS	103.82	46.710
COMMERCIAL TRAVELLERS	106.36	43.980
ACCOUNTANTS	99.49	46.990
AUCTIONEERS, APPRAISERS ETC.	113.69	49.810
COMMERCIAL AND BUSINESS CLERKS	115.05	46.700
BANKERS AND BANK CLERKS	85.81	45.010
INSURANCE OFFICE CLERKS	109.35	43.210
INSURANCE AGENTS	134.00	41.090
RAILWAY OFFICIALS AND CLERKS	124.20	52.400
RAILWAY ENGINE DRIVERS, STOKERS AND CLEANERS	117.64	29.350

OCCUPATION	PEAK LEVEL IMR	FALL IN IMR FROM PEAK
RAILWAY GUARDS	126.17	33.150
RAILWAY SIGNALMEN	103.52	30.560
RAILWAY POINTSMEN AND LEVEL CROSSING MEN	125.48	22.360
RAILWAY PLATELAYERS, GANGERS AND PACKERS	118.74	28.180
RAILWAY LABOURERS (NOT CONTRACT)	130.97	19.560
RAILWAY PORTERS	146.54	33.710
LIVERY STABLE KEEPERS, COACH AND CAB PROPRIETORS	128.28	42.660
COACHMEN (NOT DOMESTIC) AND CABMEN	127.50	33.630
HORSEKEEPERS, GROOMS	142.03	34.620
MOTOR CAR AND VAN DRIVERS	125.25	29.750
CARMEN, CARRIERS ETC.	143.82	23.660
TRAMWAY SERVICE DRIVERS	132.42	47.960
TRAMWAY SERVICE CONDUCTORS	158.34	42.160
TRAMWAY SERVICE OTHERS	135.30	34.360
MERCHANT SERVICE:		
NAVIGATION	154.60	27.090
ENGINEERING DEPT	169.07	34.130
COOKS ETC.	121.15	29.800
BARGEMEN, LIGHTERMEN AND WATERMEN	156.65	22.760
DOCK AND WHARF LABOURERS	183.36	33.190
HARBOUR DOCK ETC. OFFICIALS	142.58	27.500
COALHEAVERS AND COAL PORTERS	154.51	27.630
MESSENGERS (NOT RAIL OR GOVT)	151.66	33.490
FARMERS AND GRAZIERS	80.20	26.730
FARMERS AND GRAZIERS:		
(SONS AND OTHER RELATIVES)	87.89	27.250
FARM BAILIFFS AND FOREMEN	87.98	28.830
SHEPHERDS	92.24	38.440
FARM LABOURERS - CATTLE	93.72	23.410
FARM LABOURERS - HORSES	95.01	20.580
FARM LABOURERS - OTHERS	100.05	18.220
NURSERYMEN, SEEDSMEN AND FLORISTS	113.61	40.930
MARKET GARDENERS	114.19	28.820
OTHER GARDENERS (NOT DOMESTIC)	111.74	35.840
FISHERMEN	128.10	21.650
COAL AND SHALE MINERS:		
AT FACE	155.13	21.730
BELOW GROUND	151.89	21.740
ABOVE GROUND	149.61	18.140
MINE OWNERS, AGENTS AND MANAGERS	139.49	61.170

OCCUPATION	PEAK LEVEL IMR	FALL IN IMR FROM PEAK
IRON MINERS AND QUARRIERS	142.57	28.630
STONE MINERS AND QUARRIERS	137.45	25.720
COAL AND COKE MERCHANTS AND DEALERS	136.96	40.450
PIG IRON MAKERS	157.01	14.800
PUDDLING FURNACE WORKERS	166.23	24.400
STEEL SMELTERS AND FOUNDERS	167.32	28.000
TIN PLATE MAKERS	136.90	17.580
OTHER IRONFOUNDERS	149.82	26.250
IRONFOUNDRY LABOURERS	173.83	16.010
BLACKSMITHS AND STRIKERS	143.96	35.020
ERECTORS, FITTERS AND TURNERS	132.34	35.100
METAL MACHINISTS	147.73	33.000
OTHER ENGINEERING LABOURERS	164.13	26.350
BOILERMAKERS	153.92	31.000
ELECT. APPLIANCE MAKERS AND FITTERS	136.58	40.370
ELECTRICIANS UNDEFINED	145.42	46.010
TOOLMAKERS	139.58	26.040
CUTLERS AND SCISSOR MAKERS	163.88	17.260
WIRE DRAWERS, WORKERS AND WEAVERS	156.06	30.410
TINPLATE GOODS MAKERS	144.06	30.610
BRASS AND BRONZE WORKERS	162.38	26.590
SHIP PLATERS AND RIVETTERS	152.23	18.010
SHIPWRIGHTS	139.06	42.500
SHIPYARD LABOURERS	169.58	25.720
RAILWAY COACH AND WAGON MAKERS	130.20	32.300
CYCLEMAKERS	143.22	30.630
MOTOR CAR CHASSIS MAKERS AND MECHANICS	131.31	41.360
COACH AND CARRIAGE MAKERS	158.19	46.270
WHEELWRIGHTS	119.28	34.230
IRONMONGERS AND HARDWARE DEALERS	122.16	42.420
GOLD AND SILVERSMITHS ETC.	111.38	38.460
WATCH AND CLOCKMAKERS	120.96	41.630
PIANO AND ORGAN MAKERS	159.38	54.760
DEALERS IN PRECIOUS METALS, JEWELLERY ETC.	108.16	41.000
BUILDERS	117.58	44.130
BUILDERS LABOURERS	159.18	29.420
CARPENTERS AND JOINERS	125.08	39.940
BRICKLAYERS	130.84	36.110
BRICKLAYERS LABOURERS	156.50	29.960
MASONS	130.49	31.250
MASONS LABOURERS	161.50	26.930
PLASTERERS	135.80	35.050

OCCUPATION	PEAK LEVEL IMR	FALL IN IMR FROM PEAK
PAINTERS AND DECORATORS	142.79	40.250
PLUMBERS	126.47	35.690
GASFITTERS	119.49	29.810
NAVVIES AND RAILWAY CONTRACT LABOURERS	148.85	21.830
PAVIOURS AND ROAD LABOURERS	138.55	36.480
CABINET MAKERS	144.26	41.420
FRENCH POLISHERS	142.21	35.030
UPHOLSTERERS	117.94	27.890
FURNITURE DEALERS	121.02	33.360
SAWYERS AND WOOD CUTTERS	133.56	26.400
COOPERS, HOOPMAKERS AND BANDERS	141.87	38.580
DEALERS AND MERCHANTS IN TIMBER ETC.	123.40	17.810
BRICK AND PLAIN TILE MAKERS	132.37	9.760
PLASTER AND CEMENT MAKERS	140.50	51.210
EARTHENWARE AND CHINA MAKERS	157.63	19.170
GLASS MAKERS	161.97	23.480
MANUFACTURING CHEMISTS	151.44	33.240
CHEMISTS AND DRUGGISTS	124.87	54.110
OIL MILLERS AND OIL CAKE MAKERS	169.13	29.720
GREASE, SOAP AND MANURE MAKERS	162.64	25.500
INDIARUBBER AND GUTTA PERCHA MAKERS	145.72	22.590
TANNERS AND CURRIERS	136.50	24.440
SADDLERS AND WHIP AND HARNESS MAKE	130.84	31.600
PRINTERS HAND COMPOSITORS	138.16	54.230
OTHERS IN PRINTING	136.98	42.980
TEXTILE WORKERS (COTTON):		
CARD AND BLOWING ROOM WORKERS	171.98	24.410
SPINNERS	157.91	22.160
WINDERS AND WARPERS	152.95	34.010
WEAVERS	171.65	33.380
TEXTILE WORKERS (WOOL):		
SPINNERS	128.87	14.680
WEAVERS	141.84	40.990
OTHERS	149.82	26.480
HOSIERY MAKERS	123.69	36.260
LACE MAKERS	122.21	15.750
TEXTILE WORKERS (UNDEFINED):		
BLEACHERS AND PRINTERS	154.87	27.770
DYERS	170.76	31.530
CALENDERERS AND FINISHERS ETC.	145.96	22.910
DRAPERS AND MERCERS	107.25	45.230
OTHER DEALERS IN TEXTILES	139.33	35.750
TAILORS	122.73	38.610
CLOTHIERS OUTFITTERS AND DEALERS	109.76	44.340

OCCUPATION	PEAK LEVEL IMR	FALL IN IMR FROM PEAK
BOOT AND SHOE MAKERS	132.28	22.960
BOOT AND SHOE DEALERS	109.97	45.720
WIGMAKERS AND HAIRDRESSERS	142.58	42.980
MILKSELLERS AND DAIRYMEN	122.23	38.950
CHEESEMONGERS, BUTTERMEN AND GROCERS	129.58	42.490
BUTCHERS	121.38	42.700
FISHMONGERS, POULTERERS AND GAME DEALERS	131.66	32.590
MILLERS AND CEREAL FOOD MAKERS	127.74	27.020
CORN SEED ETC. MERCHANTS AND DEALERS	100.19	22.290
BREAD AND BISCUIT MAKERS	147.23	46.880
BAKERS AND CONFECTIONERS	109.88	31.160
TEA COFFEE AND CHOC DEALERS	126.71	40.880
GREENGROCERS AND FRUITERERS	142.42	34.580
TOBACCONISTS	115.72	40.970
BREWERS	131.27	28.390
COFFEE AND EATING HOUSE KEEPERS	134.60	32.570
LODGING AND BOARDING HOUSE KEEPERS	150.48	36.040
INN AND HOTEL KEEPERS AND PUBLICANS	127.34	32.180
BARMEN	159.74	35.500
WAITERS (NOT DOMESTIC)	123.31	29.810
GAS WORKS SERVICE	147.97	33.940
WATERWORKS SERVICE	130.99	45.330
ELECTRICITY SUPPLY	137.69	42.010
SCAVENGERS AND DISPOSERS OF REFUSE	159.63	31.920
GENERAL SHOPKEEPERS	149.12	31.320
PAWNBROKERS	108.92	28.600
COSTERMONGERS, HAWKERS AND STREET SELLERS	162.24	19.870
GENERAL LABOURERS	147.38	23.640
ENGINE DRIVERS AND STOKERS (NOT RAIL)	138.21	29.330
RETIRED FROM BUSINESS	135.46	38.530
PENSIONERS	134.45	36.770
PRIVATE MEANS	92.21	43.970
OTHERS, INCLUDING STUDENTS	145.17	32.320
ITINERANT PREACHERS ETC.	150.67	57.880
SCIENTISTS	144.95	65.020

APPENDIX VII - OCCUPATIONS:

INFANT MORTALITY VARIABLES (2)

OCCUPATION	1902 LEVEL IMR	FALL IN IMR FROM 1902
PO TELEGRAPHISTS AND OTHER PO CLERKS	87.330	38.70
POSTMEN	99.980	29.37
POST OFFICE MESSENGERS	115.02	37.25
OTHER CIVIL OFFICERS CLERKS	85.230	50.90
POLICE	101.04	31.14
POOR LAW SERVICES	96.09	34.33
MUNI. PARISH ETC.OFFICERS	106.36	46.88
ARMY OFFICERS	69.340	38.43
SOLDIERS AND NCOS	106.71	22.43
NAVY OFFICERS	48.340	43.34
MEN OF THE NAVY AND MARINES	109.86	27.39
CLERGY OF ESTD CHURCH	63.620	43.45
MINISTERS, PRIESTS OTHER RELIGIONS	83.040	32.17
BARRISTERS AND SOLICITORS	57.890	35.39
LAW CLERKS	87.720	28.17
PHYSICIANS, SURGEONS	61.640	35.12
DENTISTS AND DENTISTS ASSTS.	87.500	30.64
SCHOOLMASTERS, TEACHERS ETC.	77.940	33.12
AUTHORS, EDITORS ETC.	85.700	35.81
CIVIL AND MINING ENGRS	73.640	49.29
PAINTERS, SCULPTORS AND ARTISTS	81.070	34.46
ARCHITECTS	65.190	28.06
MUSICIANS, SINGERS ETC.	114.54	36.55
ACTORS	144.41	31.53
PERFORMERS ETC.	123.52	22.86
DOMESTIC INDOOR SERVANTS	102.16	35.63
DOMESTIC COACHMEN AND GROOMS	87.000	17.24
DOMESTIC MOTOR CAR DRIVERS	90.670	32.65
DOMESTIC GARDENERS	83.810	25.94
GAMEKEEPERS	74.760	25.78
COLLEGE CLUB SERVICES	130.14	41.56
HOSPITAL INSTITUTE AND BENEVOLENT SOCIAL SERIVCE	104.84	27.51
CARETAKERS AND OFFICER KEEPERS	121.61	21.96
MERCHANTS, COMMODITY UNDEFINED	74.860	30.72
BROKERS, AGENTS, FACTORS	93.440	40.80
COMMERCIAL TRAVELLERS	94.010	36.62
ACCOUNTANTS	73.850	28.58
AUCTIONEERS, APPRAISERS ETC.	87.690	34.93
COMMERCIAL AND BUSINESS CLERKS	98.150	37.52
BANKERS AND BANK CLERKS	65.050	27.47
INSURANCE OFFICE CLERKS	99.020	37.30
INSURANCE AGENTS	121.09	34.82
RAILWAY OFFICIALS AND CLERKS	98.040	39.71
RAILWAY ENGINE DRIVERS STOKERS AND CLEANERS	117.21	29.09
RAILWAY GUARDS	117.42	28.17
RAILWAY SIGNALMEN	102.52	29.89

OCCUPATION	1902 LEVEL IMR	FALL IN IMR FROM 1902
RAILWAY POINTSMEN AND LEVEL CROSSING MEN	120.97	19.47
RAILWAY PLATELAYERS, GANGERS AND PACKERS	117.07	27.16
RAILWAY LABOURERS (NOT CONTRACT)	130.97	19.57
RAILWAY PORTERS	130.73	25.70
LIVERY STABLE KEEPERS, COACH AND CAB PROPRIETORS	112.50	34.62
COACHMEN (NOT DEOMESTIC) AND CABMEN	118.78	28.77
HORSEKEEPERS, GROOMS	120.12	22.70
MOTOR CAR AND VAN DRIVERS	125.25	29.76
CARMEN, CARRIERS ETC.	143.54	23.52
TRAMWAY SERVICE DRIVERS	131.19	47.47
TRAMWAY SERVICE CONDUCTORS	127.47	28.16
TRAMWAY SERVICE OTHERS	129.66	31.51
MERCHANT SERVICE:		
NAVIGATION	141.75	20.49
ENGINEERING DEPT	159.99	30.40
COOKS ETC.	111.29	23.59
BARGEMEN, LIGHTERMEN AND WATERMEN	144.90	16.50
DOCK AND WHARF LABOURERS	173.03	29.21
HARBOUR DOCK ETC. OFFICIALS	132.56	22.03
COALHEAVERS AND COAL PORTERS	145.84	23.33
MESSENGERS (NOT RAIL OR GOVT)	142.35	29.15
FARMERS AND GRAZIERS	79.63	26.21
FARMERS AND GRAZIERS:		
(SONS AND OTHER RELATIVES	87.89	27.25
FARM BAILIFFS AND FOREMEN	81.590	23.26
SHEPHERDS	78.470	27.64
FARM LABOURERS - CATTLE	86.370	16.89
FARM LABOURERS - HORSES	88.480	14.73
FARM LABOURERS - OTHERS	98.680	17.09
NURSERYMEN, SEEDSMEN AND FLORISTS	89.960	25.41
MARKET GARDENERS	101.27	19.75
OTHER GARDENERS (NOT DOMESTIC)	103.53	30.75
FISHERMEN	126.14	20.44
COAL AND SHALE MINERS:		
AT FACE	152.18	20.21
BELOW GROUND	149.66	20.58
ABOVE GROUND	149.61	18.15
MINE OWNERS, AGENTS AND MANAGERS	94.05	42.41
IRON MINERS AND QUARRIERS	123.24	17.44
STONE MINERS AND QUARRIERS	124.20	17.80
COAL AND COKE		

OCCUPATION	1902 LEVEL IMR	FALL IN IMR FROM 1902
MERCHANTS AND DEALERS	112.58	27.56
PIG IRON MAKERS	155.98	14.24
PUDDLING FURNACE WORKERS	166.23	24.41
STEEL MAKERS SMELTERS AND FOUNDERS	159.00	24.23
TIN PLATE MAKERS	125.33	9.97
OTHER IRONFOUNDERS	146.68	24.68
IRONFOUNDRY LABOURERS	163.19	10.53
BLACKSMITHS AND STRIKERS	128.11	26.98
ERECTORS, FITTERS AND TURNERS	125.24	31.43
METAL MACHINISTS	140.65	29.63
OTHER ENGINEERING LABOURERS	156.39	22.71
BOILERMAKERS	139.28	23.75
ELECT. APPLIANCE MAKERS AND FITTERS	125.54	35.13
ELECTRICIANS UNDEFINED	112.74	30.36
TOOLMAKERS	133.70	22.79
CUTLERS AND SCISSOR MAKERS	152.37	11.01
WIRE DRAWERS, WORKERS AND WEAVERS	147.37	26.31
TINPLATE GOODS MAKERS	131.79	24.15
BRASS AND BRONZE WORKERS	162.38	26.60
SHIP PLATERS AND RIVETTERS	148.20	15.79
SHIPWRIGHTS	118.62	32.59
SHIPYARD LABOURERS	159.16	20.87
RAILWAY COACH AND WAGON MAKERS	119.25	26.09
CYCLEMAKERS	135.65	26.76
MOTOR CAR CHASSIS MAKERS AND MECHANICS	122.14	36.97
COACH AND CARRIAGE MAKERS	111.49	23.77
WHEELWRIGHTS	119.28	34.24
IRONMONGERS AND HARDWARE DEALERS	110.31	36.24
GOLD AND SILVERSMITHS ETC.	111.38	38.46
WATCH AND CLOCKMAKERS	102.68	31.24
PIANO AND ORGAN MAKERS	109.86	34.37
DEALERS IN PRECIOUS METALS, JEWELLERY ETC.	80.81	21.04
BUILDERS	97.56	32.67
BUILDERS LABOURERS	151.24	25.72
CARPENTERS AND JOINERS	107.22	29.94
BRICKLAYERS	118.99	29.75
BRICKLAYERS LABOURERS	152.59	28.17
MASONS	120.74	25.70
MASONS LABOURERS	157.11	24.89
PLASTERERS	128.77	31.51
PAINTERS AND DECORATORS	126.13	32.36
PLUMBERS	114.17	28.76
GASFITTERS	118.05	28.95
NAVVIES AND RAILWAY CONTRACT LABOURERS	142.99	18.63

OCCUPATION	1902 LEVEL IMR	FALL IN IMR FROM 1902
PAVIOURS AND ROAD LABOURERS	127.37	30.91
CABINET MAKERS	121.65	30.54
FRENCH POLISHERS	142.21	35.03
UPHOLSTERERS	114.98	26.04
FURNITURE DEALERS	112.18	28.12
SAWYERS AND WOOD CUTTERS	127.81	23.09
COOPERS, HOOPMAKERS AND BANDERS	129.58	32.76
DEALERS AND MERCHANTS IN TIMBER ETC.	119.69	15.26
BRICK AND PLAIN TILE MAKERS	128.10	6.75
PLASTER AND CEMENT MAKERS	119.64	42.71
EARTHENWARE AND CHINA MAKERS	161.28	21.01
GLASS MAKERS	144.60	14.29
MANUFACTURING CHEMISTS	137.11	26.27
CHEMISTS AND DRUGGISTS	111.03	48.39
OIL MILLERS AND OIL CAKE MAKERS	169.13	29.72
GREASE, SOAP AND MANURE MAKERS	137.97	12.18
INDIARUBBER AND GUTTA PERCHA MAKERS	141.15	20.09
TANNERS AND CURRIERS	128.02	19.43
SADDLERS AND WHIP AND HARNESS MAKERS	123.55	27.57
PRINTERS HAND COMPOSITORS	114.04	44.55
OTHERS IN PRINTING	120.32	35.09
TEXTILE WORKERS (COTTON):		
CARD AND BLOWING ROOM WORKERS	149.94	13.31
SPINNERS	155.76	21.09
WINDERS AND WARPERS	135.12	25.30
WEAVERS	154.43	25.96
TEXTILE WORKERS (WOOL):		
SPINNERS	125.21	12.20
WEAVERS	109.81	23.79
OTHERS	142.42	22.67
HOSIERY MAKERS	115.10	31.50
LACE MAKERS	120.37	14.46
TEXTILE WORKERS (UNDEFINED):		
BLEACHERS AND PRINTERS	147.20	24.01
DYERS	147.92	20.96
CALENDERERS AND FINISHERS ETC.	131.50	14.43
DRAPERS AND MERCERS	99.93	41.22
OTHER DEALERS IN TEXTILES	110.51	18.99
TAILORS	109.99	31.50
CLOTHIERS, OUTFITTERS AND DEALERS	93.59	34.73
BOOT AND SHOE MAKERS	127.45	20.05
BOOT AND SHOE DEALERS	98.87	39.63
WIGMAKERS AND HAIRDRESSERS	122.09	33.42

OCCUPATION	1902 LEVEL IMR	FALL IN IMR FROM 1902
MILKSELLERS AND DAIRYMEN	113.04	33.99
CHEESEMONGERS, BUTTERMEN AND GROCERS	110.68	32.67
BUTCHERS	110.71	37.18
FISHMONGERS, POULTERERS AND GAME DEALERS	120.38	26.28
MILLERS AND CEREAL FOOD MAKERS	116.85	20.22
CORN, SEED ETC. MERCHANTS AND DEALERS	96.98	19.73
BREAD AND BISCUIT MAKERS	117.94	33.70
BAKERS AND CONFECTIONERS	109.46	30.90
TEA COFFEE AND CHOC DEALERS	110.84	32.42
GREENGROCERS AND FRUITERERS	128.07	27.25
TOBACCONISTS	95.03	28.12
BREWERS	121.79	22.82
COFFEE AND EATING HOUSE KEEPERS	134.60	32.58
LODGING AND BOARDING HOUSE KEEPERS	129.44	25.65
INN AND HOTEL KEEPERS AND PUBLICANS	126.51	31.74
BARMEN	150.09	31.35
WAITERS NOT DOM	116.17	25.50
GAS WORKS SERVICE	139.15	29.76
WATERWORKS SERVICE	119.91	40.29
ELECTRICITY SUPPLY	131.42	39.25
SCAVENGERS AND DISPOSERS OF REFUSE	151.34	28.19
GENERAL SHOPKEEPERS	135.60	24.48
PAWNBROKERS	103.82	25.10
COSTERMONGERS, HAWKERS AND STREET SELLERS	159.65	18.58
GENERAL LABOURERS	145.10	22.44
ENGINE DRIVERS AND AND STOKERS (NOT RAIL)	130.11	24.93
RETIRES FROM BUSINESS	111.56	25.37
PENSIONERS	122.46	30.59
PRIVATE MEANS	69.910	26.10
OTHERS, INCLUDING STUDENTS	126.74	22.48
ITINERANT PREACHERS ETC.	103.06	38.43
SCIENTISTS	81.580	37.86

APPENDIX VIII - OCCUPATIONS: FERTILITY DECLINE AND URBAN RESIDENCE VARIABLES

OCCUPATION	FERTILITY DECLINE (DURATION) INDEX	PROP. MALE WORKERS URBAN
PO TELEGRAPHISTS AND OTHER PO CLERKS	1.64	0.8643
POSTMEN	1.24	0.8643
POST OFFICE MESSENGERS	1.09	0.8643
OTHER CIVIL OFFICERS, CLERKS	1.17	0.8643
POLICE	1.23	0.8739
POOR LAW SERVICES	1.09	0.8739
MUNI. PARISH ETC. OFFICERS	1.40	0.8739
ARMY OFFICERS	0.99	0.7749
SOLDIERS AND NCOS	0.93	0.7749
NAVY OFFICERS	1.18	0.9227
MEN OF THE NAVY AND MARINES	0.67	0.9227
CLERGY OF ESTD CHURCH	0.62	0.6180
MINISTERS, PRIESTS - OTHER RELIGIONS	1.63	0.6180
BARRISTERS AND SOLICITORS	0.35	0.8257
LAW CLERKS	1.29	0.9201
PHYSICIANS, SURGEONS	1.02	0.8341
DENTISTS AND DENTISTS ASSTS	0.82	0.8937
SCHOOLMASTERS, TEACHERS ETC.	1.36	0.7866
AUTHORS, EDITORS ETC.	1.29	0.9019
CIVIL AND MINING ENGINEERS	0.59	0.8599
PAINTERS, SCULPTORS AND ARTISTS	0.94	0.9069
ARCHITECTS	0.86	0.9069
MUSICIANS, SINGERS ETC.	1.56	0.9069
ACTORS	1.18	0.9069
PERFORMERS ETC.	1.14	0.9069
DOMESTIC INDOOR SERVANTS	1.27	0.9227
DOMESTIC COACHMEN AND GROOMS	1.14	0.4112
DOMESTIC MOTOR CAR DRIVERS	0.86	0.4112
DOMESTIC GARDENERS	1.46	0.4112
GAMEKEEPERS	0.98	0.4112
COLLEGE CLUB SERVICES	1.39	0.9227
HOSPITAL, INSTITUTE AND BENEVOLENT SOCIAL SERVICE	1.46	0.7098
CARETAKERS AND OFFICER KEEPERS	1.58	0.8806
MERCHANTS, COMMODITY UNDEFINED	0.64	0.9019
BROKERS, AGENTS, FACTORS	1.32	0.9019
COMMERCIAL TRAVELLERS	1.31	0.9019
ACCOUNTANTS	1.47	0.9019
AUCTIONEERS, APPRAISERS ETC.	1.10	0.9019
COMMERCIAL AND BUSINESS CLERKS	1.27	0.9284
BANKERS AND BANK CLERKS	0.94	0.8941
INSURANCE OFFICE CLERKS	1.18	0.8941
INSURANCE AGENTS	1.05	0.8941
RAILWAY OFFICIALS AND CLERKS	1.41	0.8129
RAILWAY ENGINE DRIVERS, STOKERS AND CLEANERS	1.20	0.8129
RAILWAY GUARDS	1.17	0.8129

OCCUPATION	FERTILITY DECLINE (DURATION) INDEX	PROP. MALE WORKERS URBAN
RAILWAY SIGNALMEN	1.23	0.8129
RAILWAY POINTSMEN AND LEVEL CROSSING MEN	1.09	0.8129
RAILWAY PLATELAYERS, GANGERS AND PACKERS	1.08	0.8129
RAILWAY LABOURERS (NOT CONTRACT)	1.09	0.8129
RAILWAY PORTERS	1.18	0.8129
LIVERY STABLE KEEPERS, COACH AND CAB PROPRIETORS	1.24	0.9340
COACHMEN (NOT DOMESTIC) AND CABMEN	1.21	0.9024
HORSEKEEPERS, GROOMS	1.03	0.7424
MOTOR CAR AND VAN DRIVERS	0.68	0.9123
CARMEN, CARRIERS ETC.	0.92	0.8672
TRAMWAY SERVICE DRIVERS	0.84	0.9340
TRAMWAY SERVICE CONDUCTORS	0.98	0.9340
TRAMWAY SERVICE OTHERS	0.95	0.9340
MERCHANT SERVICE:		
NAVIGATION	1.07	0.9011
ENGINEERING DEPT	0.89	0.9011
COOKS ETC.	1.19	0.9011
BARGEMEN, LIGHTERMEN AND WATERMEN	0.93	0.9011
DOCK AND WHARF LABOURERS	0.77	0.9642
HARBOUR, DOCK ETC. OFFICIALS	1.14	0.9642
COALHEAVERS AND COAL PORTERS	0.93	0.9338
MESSENGERS (NOT RAIL OR GOVT)	1.09	0.9298
FARMERS AND GRAZIERS	1.17	0.1388
FARMERS AND GRAZIERS:		
(SONS AND OTHER RELATIVES)	0.83	0.1388
FARM BAILIFFS AND FOREMEN	1.06	0.1388
SHEPHERDS	1.02	0.1388
FARM LABOURERS - CATTLE	1.09	0.1388
FARM LABOURERS - HORSES	0.96	0.1388
FARM LABOURERS - OTHERS	1.00	0.1388
NURSERYMEN, SEEDSMEN AND FLORISTS	1.66	0.5860
MARKET GARDENERS	1.27	0.5860
OTHER GARDENERS (NOT DOMESTIC)	1.15	0.5860
FISHERMEN	0.94	0.7634
COAL AND SHALE MINERS:		
AT FACE	0.90	0.6738
BELOW GROUND	0.91	0.6738
ABOVE GROUND	1.11	0.6738
MINE OWNERS, AGENTS AND MANAGERS	1.41	0.6738
IRON MINERS AND QUARRIERS	0.88	0.6738
STONE MINERS AND QUARRIERS	1.16	0.6738

OCCUPATION	FERTILITY DECLINE (DURATION) INDEX	PROP. MALE WORKERS URBAN
COAL AND COKE MERCHANTS AND DEALERS	1.40	0.8013
PIG IRON MAKERS	0.90	0.8487
PUDDLING FURNACE WORKERS	0.93	0.8487
STEEL SMELTERS AND FOUNDERS	0.91	0.8487
TIN PLATE MAKERS	1.12	0.8470
OTHER IRONFOUNDERS	1.15	0.9180
IRONFOUNDRY LABOURERS	0.93	0.9180
BLACKSMITHS AND STRIKERS	1.04	0.7150
ERECTORS, FITTERS AND TURNERS	1.13	0.9260
METAL MACHINISTS	1.09	0.9370
OTHER ENGINEERING LABOURERS	0.82	0.9370
BOILERMAKERS	1.14	0.9370
ELECT. APPLIANCE MAKERS AND FITTERS	1.32	0.9190
ELECTRICIANS UNDEFINED	1.17	0.9190
TOOLMAKERS	1.15	0.9370
CUTLERS AND SCISSOR MAKERS	1.32	0.9370
WIRE DRAWERS, WORKERS AND WEAVERS	1.27	0.9370
TINPLATE GOODS MAKERS	1.24	0.9370
BRASS AND BRONZE WORKERS	1.06	0.9370
SHIP PLATERS AND RIVETTERS	0.86	0.9600
SHIPWRIGHTS	1.16	0.9600
SHIPYARD LABOURERS	0.79	0.9600
RAILWAY COACH AND WAGON MAKERS	1.27	0.8010
CYCLEMAKERS	1.11	0.9030
MOTOR CAR CHASSIS MAKERS AND MECHANICS	1.13	0.9030
COACH AND CARRIAGE MAKERS	1.16	0.8010
WHEELWRIGHTS	1.11	0.8010
IRONMONGERS AND HARDWARE DEALERS	1.37	0.9080
GOLD AND SILVERSMITHS ETC.	1.13	0.9490
WATCH AND CLOCKMAKERS	1.10	0.9490
PIANO AND ORGAN MAKERS	1.60	0.9490
DEALERS IN PRECIOUS METALS, JEWELLERY ETC.	0.87	0.9410
BUILDERS	1.17	0.7710
BUILDERS LABOURERS	0.84	0.8860
CARPENTERS AND JOINERS	1.25	0.7320
BRICKLAYERS	1.11	0.7770
BRICKLAYERS LABOURERS	0.93	0.7770
MASONS	1.19	0.7000
MASONS LABOURERS	0.93	0.7000
PLASTERERS	1.13	0.9170
PAINTERS AND DECORATORS	1.10	0.9590
PLUMBERS	1.18	0.8960
GASFITTERS	0.93	0.9170
NAVVIES AND RAILWAY CONTRACT LABOURERS	0.99	0.5990

OCCUPATION	FERTILITY DECLINE (DURATION) INDEX	PROP. MALE WORKERS URBAN
PAVIOURS AND ROAD LABOURERS	0.94	0.5990
CABINET MAKERS	1.13	0.9300
FRENCH POLISHERS	1.04	0.9300
UPHOLSTERERS	1.20	0.9300
FURNITURE DEALERS	1.18	0.9210
SAWYERS AND WOOD CUTTERS	1.16	0.9130
COOPERS, HOOPMAKERS AND BANDERS	1.29	0.9130
MERCHANTS AND DEALERS IN TIMBER ETC.	1.05	0.9130
BRICK AND PLAIN TILE MAKERS	1.09	0.7880
PLASTER AND CEMENT MAKERS	1.15	0.7880
EARTHENWARE AND CHINA MAKERS	1.04	0.7880
GLASS MAKERS	0.97	0.7880
MANUFACTURING CHEMISTS	1.19	0.8770
CHEMISTS AND DRUGGISTS	1.23	0.9260
OIL MILLERS AND OIL CAKE MAKERS	1.02	0.9370
GREASE, SOAP AND MANURE MAKERS	0.95	0.9370
INDIARUBBER AND GUTTA PERCHA MAKERS	0.95	0.9370
TANNERS AND CURRIERS	1.03	0.9140
SADDLERS AND WHIP AND HARNESS MAKERS	1.45	0.8030
PRINTERS, HAND COMPOSITORS	1.35	0.9500
OTHERS IN PRINTING	1.41	0.9500
TEXTILE WORKERS (COTTON):		
CARD AND BLOWING ROOM WORKERS	1.66	0.9320
SPINNERS	1.38	0.9320
WINDERS AND WARPERS	1.34	0.9320
WEAVERS	1.28	0.9320
TEXTILE WORKERS (WOOL):		
SPINNERS	1.45	0.9320
WEAVERS	1.34	0.9320
OTHERS	1.31	0.9320
HOSIERY MAKERS	1.71	0.9320
LACE MAKERS	1.90	0.9320
TEXTILE WORKERS (UNDEFINED):		
BLEACHERS AND PRINTERS	1.33	0.9370
DYERS	1.25	0.9370
CALENDERERS AND FINISHERS ETC.	1.21	0.9370
DRAPERS AND MERCERS	1.48	0.9250
OTHER DEALERS IN TEXTILES	1.43	0.9250
TAILORS	1.16	0.9070
CLOTHIERS, OUTFITTERS AND DEALERS	1.23	0.9290
BOOT AND SHOE MAKERS	1.18	0.8470
BOOT AND SHOE DEALERS	1.45	0.9290
WIGMAKERS AND HAIRDRESSERS	1.20	0.9310
MILKSELLERS AND DAIRYMEN	1.12	0.8980

OCCUPATION	FERTILITY DECLINE (DURATION) INDEX	PROP. MALE WORKERS URBAN
CHEESEMONGERS, BUTTERMEN AND GROCERS	1.03	0.8980
BUTCHERS	0.98	0.8110
FISHMONGERS, POULTERERS AND GAME DEALERS	1.21	0.8940
MILLERS AND CEREAL FOOD MAKERS	1.18	0.8260
CORN, SEED ETC. MERCHANTS AND DEALERS	1.25	0.8940
BREAD AND BISCUIT MAKERS	1.17	0.8280
BAKERS AND CONFECTIONERS	0.99	0.8210
TEA, COFFEE AND CHOC DEALERS	1.03	0.8140
GREENGROCERS AND FRUITERERS	1.11	0.8940
TOBACCONISTS	1.44	0.9550
BREWERS	1.06	0.8430
COFFEE AND EATING HOUSE KEEPERS	1.20	0.9540
LODGING AND BOARDING HOUSE KEEPERS	1.14	0.9540
INN AND HOTEL KEEPERS AND PUBLICANS	0.98	0.7240
BARMEN	0.76	0.9470
WAITERS (NOT DOMESTIC)	1.12	0.9650
GAS WORKS SERVICE	0.99	0.9210
WATERWORKS SERVICE	1.60	0.9210
ELECTRICITY SUPPLY	1.35	0.9210
SCAVENGERS AND DISPOSERS OF REFUSE	0.81	0.9340
GENERAL SHOPKEEPERS	1.28	0.8890
PAWNBROKERS	1.60	0.8890
COSTERMONGERS, HAWKERS AND STREET SELLERS	0.97	0.9030
GENERAL LABOURERS	1.00	0.7810
ENGINE DRIVERS AND STOKERS (NOT RAIL)	1.14	0.7860
RETIRED FROM BUSINESS	1.57	0.7200
PENSIONERS	0.99	0.7200
PRIVATE MEANS	1.14	0.7010
OTHERS, INCLUDING STUDENTS	1.57	0.7620
ITINERANT PREACHERS ETC.	1.65	0.6100
SCIENTISTS	1.34	0.9090

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