

MOTHER'S DEATH AND CHILDREN'S HEALTH.
Spain during the Demographic Transition

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Introduction

It is widely held that mothers are essential for the well-being of their children. They control the initial stages of a child's life and development almost completely, and only gradually begin to share this responsibility with their husbands, other family members or institutions as the child grows older. A mother's importance is such that the physical separation of the child from his mother's womb is really only the first step on the way to an independence that is never really achieved, at least in emotional terms.

From the standpoint of a child's health, the intervention of his mother appears to be fundamental, starting in the pre-natal period and continuing through the early stages of a child's development. An infant's birth weight is influenced by his mother's weight,

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health and the pre-natal care she receives. Initially, a newborn child depends completely on his mother for nourishment (via breastfeeding) and even after weaning mothers tend to control the way infant feeding practices are implemented. Mothers are instrumental in assuring adequate growth for their newborn infants, they can shield them from debilitating infections, and can nurse them back to full health and nutritional status as they recover. Mothers also nurture and protect, and they are central to the early stages of the socialization of their children.

This widely-held belief in the importance of mothers has often led scholars to see them as the relevant actors in the entire process of the mortality decline at young ages that is central to any process of demographic modernization, past or present. Mothers have always been the main custodians of their children's health, but before the demographic transition, they did not always put this authority to use wisely due to misconceptions, want of the proper education or, more basely, simple disinterest. Yet when they finally learned the proper methods of infant and child feeding and rearing, dramatic increases in the survival of children ensued, thus triggering the entire process of demographic transition. Conversely, when a mother is absent, for whatever the reason, we can expect the health and well-being of her children to suffer as well. Even though these appear to be reasonable propositions, it is interesting to note that there is relatively little empirical information on the subject.² This state of scientific knowledge, however, is less than desirable.³ It is the purpose of this paper to address the issue of the consequences for children of the absence of a mother.

In past societies, the absence of a mother was normally due to her death, either in childbirth or when her children were still strongly dependent on her. Part of this is due to what is called 'maternal mortality' and is directly related to pregnancy, puerperium and childbirth. Yet the authors of this paper believe that when assessing the importance of mothers for their children's health, the key variable is the 'mortality of mothers' rather than 'maternal mortality'. Mortality of mothers due to a wide variety of causes must have been just as important to the health of their children as mortality directly related to childbirth (maternal mortality), though the ages and number of the

² For the links between survival of delivery and survival of infants, see Loudon (1992: 483-85), Gray (1984), Woodbury (1926) and Yerushalmy, et.al. (1940). For the use of survey data to assess these issues, see, for example, McDermott, et. al. (1996), Desai and Alva (1998).

³ In the opinion of Irving Loudon (1992: 484) there is a lack of systematic studies of the links between maternal and infant mortality.

surviving children probably differed substantially. In more contemporary low-mortality contexts, the absence of a mother is more likely due to divorce, separation or to work than it is to her death. While this sort of absence may take its toll as well on children's well-being, it is normally not important for their survival. Thus there are two ways of tackling the issue of mothers, one based on their absence due to death and its implications for children's survival probabilities, and another based on their absence due to social reasons with its implications for well-being but not necessarily for survival. This paper will tackle the first set of issues where the indicators of both the mother's presence and the child's health are rather crude, but at least they are clearly defined. Furthermore, it represents the most common scenario for the importance of mothers historically and even today in many parts of the world.

As often occurs, the reason for the relative lack of studies on this issue is data driven. The subject cannot be addressed adequately without making use of a large enough data set containing individual longitudinal information in which a mother's health status can be linked to that of her children. The present paper is based on this sort of data taken from a research project currently under way in Spain. The authors generate a series of straightforward demographic indicators designed to show just how important the presence of a mother was for the survival probabilities of her children. The results are stunning, give ample evidence of just how important mothers were, and raise new issues for future research.

Data and Methods

The data base used for this paper is taken from the local archives of the town of Aranjuez, a municipality located some 45 km south from Madrid. It is a town with a large percentage of the active population dedicated to agriculture, though the services sector is not insignificant and, after the 1940s, factory production is also an important aspect of the local economy. Over the period covered by this research project (1870-1970), the population of the town goes from around 8,000 to just under 35,000 inhabitants. It is a period of profound demographic change with life expectancy (e_0) starting well below 30 but reaching near 75 by the 1970s, infant mortality rates ranging

from well above 200 per thousand in 1870 to near 28 per thousand a century later, and fertility falling by well over half over the period.

The data used in this paper are based on Civil Registration material. The research team received authorization to microfilm the vital records taking place in the town during the period under study. Once this material was computerized and checked for errors either in data input or in origin, the research team proceeded to create individual biographies made up of the key vital events of people's lives, making use of record linkage techniques not far removed from the traditional method of family reconstitution.⁴ While other sources of data will eventually be integrated into the data base (household information, heights of military recruits, etc.), the present paper is based entirely on the linked births and deaths of the residents of Aranjuez.

With these data, it was a relatively simple process to link the demographic outcomes of sibling groups to the health of their mothers. In order to trace the consequences of the absence of a mother, children were divided into two groups, those whose mothers die and those whose mothers survive. Each of these groups are defined in alternate ways so as to be able to afford a range of estimates and thus test for the robustness of our results. Surviving mothers are estimated as those who are present in some way in our data base (either at the birth of a child or at a child's death) until they are at least 41 or at least 45 years of age. This estimation strategy yields a fairly large subset of families, though we may be including some mothers who actually died when their children were still fairly young. For the most part, however, mothers dying after their mid 40s were likely present for the vast majority of the early lives of all of their children.

Identifying children whose mothers died presents more difficult challenges. Three types of estimate were used. The crudest of these is based on the life histories of children whose mothers died during their reproductive period. This method yields the largest sample of children, but includes a number of children who were born and died before their mothers died, and thus were not affected by the deaths of their mothers. In this way, mortality levels for those children will tend to be underestimated. The second and somewhat more restrictive approach includes only those children who were less than 24 months of age when their mother died. This sample is much smaller and

⁴ For further information on the way in which the data base is being constructed, see Reher, González-Quiñones and Sanz-Gimeno (2001).

somewhat closer to those young children really affected by a mother's death. While some of them may have been born and died before their mother's death, by and large this would not have been the case. It is true, however, that this approach yields less reliable estimates of the mortality of children who lose their mothers when they were somewhat older (above 2). Finally, a third estimation strategy was used that includes only those children under 12 months of age at the time of their mother's death. This much more restrictive estimation reduces sample size sharply and, at least in some ways, yields the most accurate results. Nevertheless, this last approach makes it practically impossible to estimate the effects of a mother's death on a child who has already survived the very early stages of life but where we might also expect to continue to find some sort of measurable effect. None of the approaches is foolproof, but together they yield a range of estimates which encompass the life experience of those children actually affected by the untimely death of their mothers.

This paper makes use of very straightforward life table techniques including the probability of death at different ages. Since births have been directly linked to deaths, generating these indicators is not difficult. They have been estimated for the following age intervals: mortality in the first month of life (neonatal), from 1 to 5 months, from 6 to 11, for children under 1 (infant mortality), 1, and 2-9 years of age. We have also included summary measures for the probability of death in the first two years of life (${}_2q_0$) and the first 10 years of life (${}_{10}q_0$). The $[q(x)]$ values always refer to the probability of death in any given age interval. The period of analysis has been restricted to 1870-1950, because at later dates mortality among mothers is extremely low. Period dates are based on birth dates. Subperiods have also been used (1870-1910 and 1911-1950), corresponding to clearly differing moments of the process of demographic modernization. Much of this paper will make use of comparative measures made up of the ratio between the $[q(x)]$ values of children whose mother has died and those whose mothers have survived. Since the estimate of survival of young children is exact, even to the day of their life, we are able to generate reasonable estimates with relatively small numbers of cases.⁵

⁵ One important caveat should be introduced here regarding our data. The definition of a live birth, embedded in nature of the Civil Register in Spain, stipulates that children who have not survived at least 24 hours are not considered either as live births or as infant deaths or stillbirths. This introduces a certain amount of underestimation of the likelihood of death, most noticeable in the very early stages of life.

Presentation of results

The results of this study are striking and deserve careful consideration. In very general terms, they provide ample proof that a mother's presence is essential for the health and survival probabilities of her children. A mother's death is linked to a far lower likelihood of survival for her children. The period of risk is greatest close to birth but remains high during the entire first year of life. It is also noticeable at higher ages, though to a considerably smaller degree.

These results can be seen in Table 1 and in Figure 1 of this paper. The ratios of death probabilities by the survival status of mothers give us a ready idea of just how important they were for their children's health. During the first month of life, young babies without mothers are between 1.5 and 5.5 times more likely to die than those whose mothers survive. Between the age of 1 and 5 months, the handicap for orphaned children is lower but still enormously important, ranging between 1.7 and 4.4 times higher for those children losing their mothers. During the second half of the first year of life, disadvantages of children without mothers are still important though somewhat less so than at younger ages (1.3-2.0). In sum, over the first year of life, mortality for children losing their mothers is between 1.5 and 3.1 times higher than for those who still had their mothers. For children aged 1, the loss of a mother means that mortality would still be between 1.2 and 1.3 times higher than for children with mothers. At higher ages, however, the results are no longer conclusive, at least when aggregating data for the entire period. Over the first two years of life, then, the loss of a mother means that mortality is as much as 2.0 times higher than when the mother is present, and over the first 10 years of life, excess mortality for orphans ranges could be as much as 1.6 times higher. While these ratios vary according to the estimation strategy used, all of them point to the fact that the presence of a mother was one of the primary determinants of child's likelihood of survival during the first two years of life.

If our data are organized into two general periods (1870-1910 and 1911-1950), one corresponding to high, pre-transitional levels of mortality, and the other to a period of rapidly declining mortality, extremely interesting changes over time emerge (Table 1 and Figures 2a, 2b and 3). During the first year of life in the earlier period, the

disadvantages of babies without mothers is clear, but at higher ages it is not. During the later period, the relative importance of mothers nearly doubles at all ages. Equally as interesting is the fact that a noticeable effect emerges for children of higher ages, mainly those 2 to 9 years of age, though for this age group low numbers limit the robustness of our results. Taken cumulatively, over the first two years of life, losing a mother increases the risk of death by 1.7 in the first period and by 3.0 in the second one. Over the first 10 years of life, excess mortality ranges is as high as 1.4 times higher during the first period, and as high as 2.5 times higher in the second one.

We have also been able to control for cause of death, though the limited number of cases has restricted much of our analysis to the entire period, except for certain summary indicators. Causes of death have been grouped according to the classification scheme originally set out by Thomas McKeown (1976). For this paper we have only included deaths due to infections caused by air-borne and by water- and food-borne micro-organisms. Not only do these two causes include a large part of the mortality of these age groups (approximately 50 percent), but they also tend to *be related more clearly to* the roles played by mothers. Table 2 shows the ratios between the likelihood of death by a given cause for children whose mothers have died as opposed to those whose mothers have survived.⁶ The results suggest that the loss of a mother brings on a substantial increase in the likelihood of death for both types of infection, though water- and food-borne infections show the effects of the loss of a mother far more clearly. This is most visible early in life (before 6 months of age), though differences persist throughout childhood. Over time, ratios increase substantially, especially for air-borne infections. By the twentieth century, for certain summary indicators, ratios for these infections are nearly as high as those for water- and food-borne infectious diseases.

Finally, when controlling for the sex of the child, important differentials have emerged (Figure 4). For the first month of life, boys are at a distinct disadvantage, with neonatal mortality ratios being twice as high for them as they are for young girls. After that period, however, the entire situation changes and girls end up showing markedly higher differential mortality than boys throughout most their early lives. Between the age of 1 and 5 months, the ratios of their mortality when controlling for the survival status of their mothers, is over one third higher than it is for boys. Even later in their

⁶ Due to limited numbers, the proportions of death by given causes has been based on the larger data set of mothers dying during the childbearing period.

first year of life, the differences in ratios continue to be substantial. After their first birthday, ratios by are quite similar for children aged 1 year, but again higher for girls at higher ages. In both these cases, restricted numbers have made disaggregating further impossible.

Discussion

These results should be interpreted within the context of the role mothers play for the health and well-being of their children. The first two years of children's lives are critical for their growth and for their health. It is a period marked by the gradual separation of children from their mothers and by high levels of overall vulnerability to infection. This early period is also one of transitions: one taking the child from the shelter of his mother's womb, followed by one of full coverage of breastfeeding, by another of supplementary infant feeding and finally by weaning. It is a period of great overall vulnerability and these transitions are especially critical moments during that period. It will only end when the child no longer depends on his mother for nutrition and is strong enough to withstand infection. When successful, it is a cycle of growth starting in the womb and ending with a youngster who is more likely to get in trouble climbing trees than to die of diarrhoea. As the extremely high levels of infant and early childhood mortality suggest, however, in many societies it has often not been a success story. It can also be argued that a key predictor of health later in life lies in just how successful this cycle of growth was newborn babies.

Throughout this period, a mother's intervention is vital for a child's health and survival. Even afterwards, mothers appear to be vital for children's health and well-being, though never in such a predominant way as they are during the initial stages of life. While mothers probably visualize their role in a global, holistic manner, it can be somewhat arbitrarily broken down into at least three different ways they intervene to assure the well-being of their babies. Some of these affect the prevalence of infectious disease, others have a bearing on the chances sick children have of surviving and others are only indirectly related to survival, and may have a more important effect on the overall physical and emotional well-being of the child. These different types of

interventions do not work alone, and important synergies arise. Moreover, they do not interact in the same way as a child grows. Understanding these different interventions will help us understand the results presented in this paper.

1) Mothers are essential in a very direct way for the *nutritional status* of a young children. Birth weight, the initial indicator of nutritional status, is dependent on the mother's health and nutrition before and especially during pregnancy, as well as on the genetic heritage of the infant.⁷ Breastfeeding, however, is the most important way mothers contribute directly to a child's nutritional status. Even though there are exceptions, it can be said that a baby of a healthy mother who is breastfed tends to be better nourished. A mother's role on this point is most important very early in life, and gradually diminishes as the child grows older and as other sources of infant feeding are utilized. Once weaning takes place, the direct and immediate effect ends, though, in general terms a cumulative effect continues to exist. A well-nourished baby at, say, 10 months of age is highly likely to be a well-nourished one at 20, even though breastfeeding has long since ended. In this way, the intervention of mothers tends to limit the deleterious effects of childhood diseases, but has very little to do with their prevalence.

2) The *control of infant and child feeding practices* is another of the essential roles of a mother. Hygiene, the choice of foods, and the way babies are fed are all ways in which mothers tend to act like a filter between their babies and different sources of nourishment. This role is of vital importance for the health of children when supplementary feeding begins, at the time of weaning and throughout much of early childhood. Its importance for survival (and possibly for overall health as well) gradually declines afterwards, but it does not really disappear until much later. In fact, it may never disappear entirely, though after the early stages of life it becomes a role that is shared by the father and by other family members. The control of infant and child feeding (outside of breastfeeding) is important for the prevalence of certain diseases, especially those of the digestive tract. There is an important synergy between the way children are fed and their nutritional status because repeated bouts of infectious diseases tend to halt or slow the process of growth (Lunn, 1991; Desai and Alva, 1998: 77). In this sense, controlling infant feeding properly also contributes, at least indirectly, to

⁷ It can be said that a baby's birth weight is one of the main predictors of survival during infancy.

reducing the gravity of infectious disease. The degree to which a mother is able to fulfil this role effectively depends on how well she is able to identify potential risks to a child's health derived from feeding practices.⁸ In this way, it is a function that is strongly subject to a mother's education (be it formal or informal) and/or to the prevailing customs in any given society.

3) At a more general level, mothers intervene in the daily life of their children as their *protectors*, their *care-givers*, their first and perhaps most important *educators*, and their *nurturers*. They choose their clothes, they make sure they are warmly dressed in cold weather, they are continually reminding them of who their friends should be and what they should do, and they initiate their entire educational process. This role tends to increase in importance after infancy and can be a shared one with fathers, though it is unlikely that fathers ever intervene as actively as mothers in the lives of their young children. Mothers are also nurturers and the main source of comfort for their young children. They are the ones who nurse them back to health when ill, and they are the ones children come to for comfort and support during difficult times. The likelihood of a sick child's recovery is quite probably strongly influenced by the active presence of his mother at his side. This role of mothers is unquestionably important for a child's mental and emotional well-being, for a healthy life and eating habits, and ultimately for their social well-being later in life.

The importance of a mother for her child is overwhelming and very direct close to birth (via breastfeeding). Later, as supplementary feeding begins, her direct influence gradually diminishes and becomes increasingly indirect, though it is quite likely that effects for health of breastfeeding persist throughout much of childhood, and perhaps later in life as well. Estimating the effects of both direct and indirect motherly interventions for an outcome variable (survival) that only indicates the complete lack of health, is an inadequate and reductionist way of assessing the importance of mothers for their children. Nevertheless, despite its limitations, the results presented in this paper illustrate in a measurable way an important part of their role.

Over the first year of life, our results have not only shown the extremely high levels of excess mortality for children without mothers, but also a fairly steep decline in

⁸ See, for example, Caldwell (1979) and many others.

the importance of this excess mortality, especially after 6 months of age.⁹ Neonatal mortality is especially affected by the absence of a mother, and was often as much as 3-5 times higher for children without mothers. A mother's death during the first month of a child's life means that the child was practically never breastfed, and when she died before 6 months of age, breastfeeding was short in duration and probably more or less directly truncated by her death. Clearly, the most important way mothers intervene in the health and well-being of their newborn children was through breastfeeding.¹⁰ When the mother dies before the child has had any chance to be breastfed or if she was too ill to breastfeed her newborn infant, the baby's health was in serious jeopardy. When a mother's death occurs before supplementary feeding had commenced, the truncation of breastfeeding means that the child not only is denied access to this vital source of nourishment, but also that his entire feeding regimen is changed abruptly. Even for very young children, the chances of survival are higher for those who have had access to at least some breastfeeding than for those who had no access at all. In this way, a mother's milk appears to have a cumulative effect on a child's health.

For children above six months of age, excess mortality continues to be very high, though not so much as at younger ages. For these children, there are two possible scenarios. For those whose mothers died precisely at that age (6-11 months), supplementary feeding has probably already begun and, equally as important, a child has been able to store up several months of relatively stable access to his mother's milk, as long as she was not sick over the period. On the other hand, for those children whose mothers died when they were younger, the fact that they were still alive at six months of age means that they were able to survive the initial shock of their mothers' death and the sudden change in their feeding practices. Much the same can be said for babies of 12-23 months of age, where ratios continue to be quite high, though at somewhat lower levels than for earlier ages. At these ages, the risks inherent in losing a mother continue to be

⁹ Earlier studies on this issue, based on different sources of data, have all shown that the risk of death for infants losing their mothers was far higher than for those whose mothers survived. The most comparable analysis and results come from the study by Robert M. Woodbury (1926:43) carried out in 1920s in which infant mortality for children whose mothers died within the first year of a child's life was 4 times greater than for those babies with surviving mothers. Our own results indicate that the excess mortality is 3 times higher. For other similar studies, see also, Loudon (1992: 483-485) and Yerushalmy, et.al. (1940: 1020).

¹⁰ For more on the importance of breastfeeding in historical populations, see Fildes (1986), Knodel and Kintner (1977) and Kintner (1985). Contemporary survey data for Lesotho suggest that a short duration of breast feeding is the leading cause of infant mortality and morbidity (Worku and Makatjane, 1996).

related to having had prior access to a mother's milk, though in a less direct way than children of younger ages.

It is after the first couple of months of life when a mother's indirect role in the entire process of infant feeding and care becomes essential for the health of her children. This role is relatively unimportant for neonates and of more limited importance for children under 6 months of age who, for the most part, continue to be breastfed. Afterwards this role of mothers is vital. When she dies, the control of infant feeding and care falls to the father, perhaps an older sister or to some other family member. None of these persons are able to carry out this function nearly so efficiently and affectionately as a mother. Even though our data are not explicit on this point, we feel that children who have already been weaned probably were far more likely to survive than those still breastfeeding when their mothers died. This is not only because they were able to avail themselves completely of their mother's milk at younger ages, but also because the mother was present to guide them through a particularly sensitive transition in infant life. Apart from the neonatal period, a child's life has two key transitions when risks for his health are severe: when supplementary feeding starts (often as young as 2 or 3 months) and, more important, when weaning takes place (often between 6 and 15 months of age in Spain). Children being weaned are particularly sensitive to the digestive tract diseases so clearly linked to the way in which the child is fed. When weaning is caused abruptly by the death of a mother, she can no longer be a factor governing the way this transition takes place and the child's chances of survival are in jeopardy.

The changing importance of the different roles a mother plays for the health of her children during the first two years of life receives further support from the results presented in Table 3. Here we have been able to group children by their precise age at the death of their mother and then estimate the exact number of days they survive until their own deaths, as long as these occurred before 5 years of age. Even though these are indeed small numbers, the results are very interesting. For those children dying during their early childhood, the younger they are when their mothers die, the less time they live and the more likely it is for them to die within a month of their mother's death. In other words, for the very young, a mother's death tends to have a sudden effect on their health, while for children of higher ages, the effect is somewhat less immediate. Access to the mother's milk is essential in the first few months of life, and, though important,

somewhat less essential later on. The cumulative effect of a mother's milk on a child's health is profound. Severing access to that milk at a very young age is likely to be fatal. After the first six months of life, however, despite high percentages of deaths within a month of the mother's death, our results suggest that survival of children was likely to be considerably longer, due probably to their accumulated nutritional status by that age. These results also point to the fact that a mother's role in the entire process of infant feeding assumes increasing importance as the child's age increases, though her direct contribution to the child's nutrition via breastfeeding tends to decrease.¹¹

Over the first two years of life, a mother is vital to her child's health both as his or her main (or only) source of a nutrition (breastfeeding) and as the one in charge of the entire process of infant feeding and care. Our results suggest that as a child grows the balance between these two roles changes. Her direct role becomes a remembered effect, so to speak, one that can be seen in the cumulative growth and nutritional status of the baby. With age, child feeding and child care begin to take precedence as the central contribution of a mother to a baby's health, though both of roles are always present.

A number of these points have received support from our analysis of deaths by cause, where it has been shown that in Aranjuez ratios of death rates for children with and without mothers are far higher for infections due to water- and food-borne micro-organisms than they are for air-borne infections.¹² All three of the traditional roles of mothers come into play for infectious diseases caused by water- and food-borne micro-organisms: a well-nourished (breastfed) baby is more likely to survive a bout of disease, careful governance of infant and child feeding limits the incidence of infections, and a caring mother can help a sick child to recovery. One of her roles limits the prevalence of these infections, and two others tend to increase the likelihood of survival for sick babies. On the other hand, there is little mothers can do to limit the incidence of infections due to air-borne micro-organisms, though they are in a position to contribute

¹¹ Had there been enough cases to enable us to isolate those children whose mothers died when they were more 15 months of age, and thus had almost certainly already been weaned before their mother's death, the results would probably have indicated that the percentage dying within a month of a mother's death was very low and their average time of survival was greater.

¹² For a discussion of these issues in the light of the ideas of Thomas McKeown, see Schofield and Reher (1991: 7-11). See also McKeown (1976). For a general and often critical evaluation of McKeown's ideas, see, for example, Szreter (1988: 7-17), Kunitz (1987).

to increasing a sick child's probability of survival. This helps explain why a mother's absence tends to be more important for water- and food-borne infections.

It is also interesting to observe that excess mortality affects food- and water-borne infections throughout the first 10 years of life, as opposed to excess mortality due to air-borne micro-organisms which is generally confined to the first two years of life. This underscores once again the fact that the most important role mothers play for the health of their children is related in one way or another to the entire process of child care and child feeding. This is where a their intervention is most decisive. For infectious diseases caused by air-borne micro-organisms, the intervention of mothers is only significant for survival during the first two years of life, becoming an indirect supportive one thereafter. At least this was the case before the onset of the demographic transition.

Once mortality began to fall and as the process of demographic modernization got under way, however, mothers became increasingly important for their children's health in a greater variety of ways. Ratios of excess mortality in the absence of a mother increase for all ages and relatively older children begin to show the negative effects of a mothers death. During the first period, when mortality remained quite high and before the demographic transition had gathered steam, a mother was important for her child's survival during the first year of life and, to a lesser degree, for children 12-23 months of age. During the second period when mortality was declining dramatically, in early life ratios are over twice as high as they were for the first pre-transitional period. There is also substantial evidence that children 2-9 years of age began to be more adversely affected by the death of their mothers.

Maternal education has often been considered central to the entire process of childhood mortality reduction during the demographic transition.¹³ It is commonly held that during this period mothers came to believe that their children were likely to survive and this led to increasing investments in the care and health of their children. Mothers began to control the entire process of infant feeding more carefully and pay closer attention to the advice given out by public health authorities. Furthermore, as they were better nourished themselves, they tended to have healthier babies. In an indirect way,

¹³ For an overview of the role of maternal education in the demographic transition in Spain, see Reher (2001).

the results from Aranjuez give very strong support to the case for mothers as the central figures for the improvement of infant and child health.

It is also apparent that over the course of the demographic transition the survival of older children (>2) began to depend on the presence of their mothers, something that was not the case when mortality was high. It is likely that the role of mother as caregivers, comforters and nurturers must have always been important, despite the fact that our results suggest that there was no directly measurable effect during the pre-transition period. Once mortality began to decline, however, the importance of this role also increased substantially. Evidence of this change can be found in the increase over time in excess mortality due to air-borne infections, especially for older children, which becomes nearly as important as it is for food- and water-borne infections, especially during the first two years of life. In this way, during the demographic transition, the role mothers played for the health of their children deepened and widened over what it had been in pre-transitional times. At this stage, losing a mother had a far greater relative effect on a child's health than it did during the earlier period.

The demographic transition led to an enhancement of the role mothers played for the well-being of their children. This change was related to attitudes and to knowledge, and thus can be safely attributed to the education of mothers. While this education may have often been informal, it had strong implications for survival. By the 1920s, 30s or 40s, losing a mother was far more damaging to the child than losing her 50 years earlier. Considering that it was also mothers who first implemented fertility control, often in response to their own successful health strategies for their children, it is safe to say that they can be considered the key protagonists of the entire process of demographic modernization sweeping Europe during the first half of the twentieth century.¹⁴

The results presented here regarding sex differences show that young boys were far more clearly affected by their mother's death during the first month of life, and girls were more affected throughout the rest of their childhood. These results should be understood within both biological and social contexts. The comparative disadvantage of boys during the first month of life is related to the fact that they generally tend to be

¹⁴For the links between mortality and fertility in the course of the demographic transition, see Reher (1999).

weaker, less viable, than newborn girls.¹⁵ It is a biological weakness that informs men's health throughout much of their lives, but is strongest at the very beginning of life and also towards adulthood and old age. Our results suggest that denial of access to breastfeeding because of the death of a mother took a far higher toll on newborn boys than it did on newborn girls, and offers ample support for this biological weakness. Afterwards, however, boys are at a clear comparative advantage over girls throughout the rest of their first year of life. These results suggest that in a male-oriented culture such as Spain's, an orphaned boy tended to receive far more attention from the rest of his family than an orphaned girl. Fathers, siblings and other family members probably intervened more assertively in the case of young males than they did for young females. By implication, a girl's best bet to survive was to have her mother with her. Boys were also affected by their mothers death, but after the first month of life, they were comparatively better off than their sisters. While our results are not conclusive, they suggest that there was a differential treatment of children by sex, at the very least when the mother died.

Some preliminary conclusions

This paper has been based on micro data taken from the town of Aranjuez in Spain over the course of the demographic transition. In so doing, we have been able to link the survival status of mothers to the health of their children. Despite the local nature of this study and the often limited size of our sample, many of the results have far-reaching implications for our understanding of the past, for our understanding of the role mothers played in the entire process of demographic modernization and for the contemporary developed and developing world as well. These preliminary conclusions can be summed up briefly in the following points:

1) Mothers were essential for the health of their children. Their role was a complex and layered one. It included both direct and indirect interventions, starting with

¹⁵ An indirect example of this can be found in the sex ratios of death rates in Aranjuez, which are substantially higher for neonatal mortality (1.26) than the are during the first year of life (1.13).

breastfeeding but covering a wide range of activities. Most of these had measurable effects on the demographic outcomes of their children. An orphaned child was subject to strikingly higher probabilities of death than one who had his mother at his side. Effects were highest and most direct nearest birth, but remained visible over the first two years of a child's life, or even later.

2) The demographic transition led to a substantial enhancement of the importance of mother's for the health of their children. Orphaned children were far worse off (in relative terms) than before, and for the first time the importance of mothers for the well-being of their older children appears to become measurable. This enhancement affected all of a mother's functions in the life of her child, but were most important for the way she controlled the process of infant feeding and the way she intervened to protect, comfort and care for both her children whether or not they were ill. In other words, the way mothers intervened tended to change and broaden considerably. It is likely that education was a key factor bringing about this change, though it was aided by general increases in the nutritional status of the population. In many ways, the demographic transition was an important instance for the empowerment of women.

3) An indirect effect of declining adult mortality during the demographic transition was the fact that it reduced mortality among mothers, and thus indirectly contributed to improving the survival probabilities of their children.¹⁶ At a larger, societal level, reductions in the mortality of women of reproductive age, by enhancing survival during childhood, indirectly contributed to creating the context whereby conscious fertility control began to be implemented.

4) In times of demographic crisis, when high levels of mortality preferentially affected adults of reproductive age, there was a delayed and indirect effect leading to increases in death rates for young children whose mothers had not survived. The historical decline of crisis mortality had a long-range beneficial effect on the survival of children.

5) Many of these links should be visible in developing countries over the past 30 or 40 years. Mothers have probably always been central to the health of their children, and the persistent declines in mortality over these past decades can safely be attributed

¹⁶ In Spain, for example, the percentage of women aged 20-24 surviving to age 50-54 went from 73.5% in 1900-1 to 82.5% in 1930-1 (Dopico and Reher, 1998: 113, 153).

to a large extent to them and to female education. The impending AIDS crisis in Africa is likely to have an indirect and negative side effect for the health of children whose mothers are afflicted by this disease.

6) In most of the developed world, with the possible exception of Eastern Europe, it is no longer possible to estimate the effects of the absence of a mother in terms the survival probabilities of her children. Nevertheless, we feel that mothers continue to be as important for the health and well-being of their children as they were in the past, but the effect is no longer measurable in the way we have done in this paper. Estimating this effect, however, constitutes an important challenge to social scientists and health specialists everywhere. If, however, the results of this research end up showing that the absence of a mother, for whatever reason, has negative effects on the well-being of her children, the implications for modern society will be as uncomfortable as they are unwanted.

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Table 1:

Probabilities of death [q(x)] during early life by mother's survival status, 1870-1950

Period/Age	Estimated q(x) by Survival Status of Mothers					Ratio 1 (3)/(2)	Ratio 2 (4)/(2)	Ratio 3 (5)/(2)
	Mother survives at least to age 44	Mother survives at least to age 41	Mother dies during childbearing period	Mother dies when child is under age 2	Mother dies when child is under age 1			
	(1)	(2)	(3)	(4)	(5)			
Entire period	n=10924	n=12777	n=2586	n=494	n=262			
0 months	0.0295	0.0279	0.0441	0.0931	0.1527	1.58	3.33	5.46
1-5 months	0.0645	0.0593	0.0983	0.1897	0.2613	1.66	3.20	4.41
6-11 months	0.0634	0.0585	0.0745	0.1157	0.0915	1.27	1.98	1.56
0 years	0.1497	0.1390	0.2022	0.3502	0.4313	1.45	2.52	3.10
1 year	0.0826	0.0751	0.0863	0.0997	...	1.15	1.33	...
2-9 years	0.1145	0.1032	0.1130	0.0865	...	1.09	0.84	...
0-1 years	0.2199	0.2036	0.2711	0.4150	...	1.33	2.04	...
0-9 years	0.3092	0.2858	0.3534	0.4656	...	1.24	1.63	...
1870-1910	n=7387	n=8005	n=1740	n=351				
0 months	0.0340	0.0344	0.0500	0.0997	...	1.46	2.90	...
1-5 months	0.0743	0.0743	0.1089	0.2057	...	1.47	2.77	...
6-11 months	0.0751	0.0757	0.0876	0.1315	...	1.16	1.74	...
0 years	0.1729	0.1738	0.2276	0.3789	...	1.31	2.18	...
1 year	0.1029	0.1025	0.1086	0.1101	...	1.06	1.07	...
2-9 years	0.1502	0.1486	0.1536	0.1082	...	1.03	0.73	...
0-1 years	0.2580	0.2585	0.3115	0.4473	...	1.21	1.73	...
0-9 years	0.3694	0.3686	0.4172	0.5071	...	1.13	1.38	...
1911-1950	n=3537	n=4772	n=746	n=143				
0 months	0.0201	0.0172	0.0335	0.0769	...	1.95	4.48	...
1-5 months	0.0444	0.0345	0.0874	0.1515	...	2.53	4.39	...
6-11 months	0.0402	0.0311	0.0532	0.0804	...	1.71	2.58	...
0 years	0.1012	0.0807	0.1649	0.2797	...	2.04	3.47	...
1 year	0.0434	0.0337	0.0514	0.0777	...	1.52	2.30	...
2-9 years	0.0503	0.0396	0.0474	0.0421	...	1.20	1.06	...
0-1 years	0.1402	0.1117	0.2078	0.3357	...	1.86	3.01	...
0-9 years	0.1835	0.1469	0.2453	0.3636	...	1.67	2.48	...

Notes: (1) Date of birth defines periods. (2) "n" refers to the number of births to women of each category.

Table 2:
Probabilities of death [q(x)] by cause during early life by mother's survival status, 1870-1950

Age/periods	Mother survives at least to age 41		Mother dies during childbearing period		Ratios	
	Water & Food-borne	Air-borne	Water & Food-borne	Air-borne	Water & Food-borne	Air-borne
	(1)	(2)	(3)	(4)	(3)/(1)	(4)/(2)
Entire period	n=716	n=1495	n=210	n=335		
0 months	0.0031	0.0069	0.0059	0.0094	1.93	1.37
1-5 months	0.0143	0.0206	0.0283	0.0303	1.98	1.47
6-11 months	0.0138	0.0219	0.0200	0.0241	1.45	1.10
0	0.0296	0.0470	0.0503	0.0592	1.70	1.26
1	0.0188	0.0330	0.0228	0.0354	1.21	1.07
2-9	0.0129	0.0523	0.0181	0.0586	1.41	1.12
0-1	0.0458	0.0754	0.0684	0.0875	1.50	1.16
0-9	0.0560	0.1170	0.0817	0.1303	1.46	1.11
1870-1910						
0-1	0.0541	0.1024	0.0782	0.1092	1.44	1.07
0-9	0.0685	0.1603	0.0954	0.1672	1.39	1.04
1911-1950						
0-1	0.0319	0.0300	0.0523	0.0497	1.64	1.66
0-9	0.0352	0.0444	0.0574	0.0613	1.63	1.38

Note: Specific causes have been grouped according to McKeown's classification system.

Table 3:
Length of life after mother's death (Children dying under age 5)

Exact age of child at mother's death	Number	Average length of life (in months)	Percentage of deaths within 30 days of mother's death
0 months	53	3.38	33.96
1-5 months	33	5.22	42.42
6-23 months	39	12.38	20.51

Figure 1: Probability of death $q(x)$ during early life by survival status of mother, 1870-1950

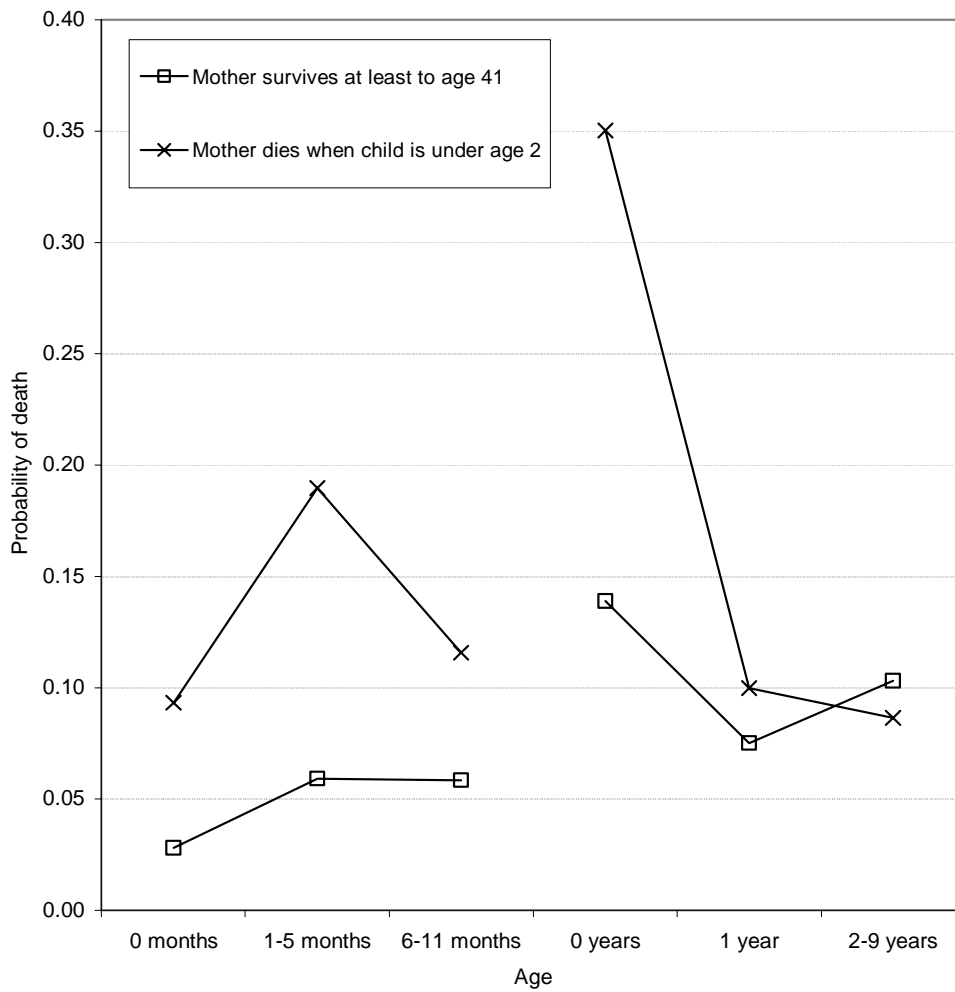


Figure 2a: Probability of death [q(x)] during early life by survival status of mother, 1870-1910

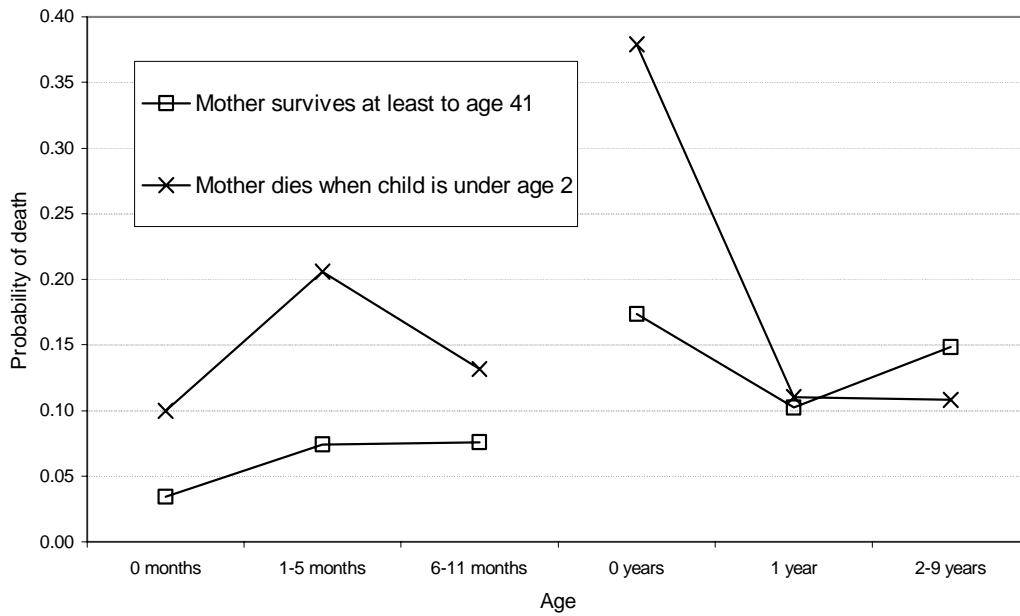


Figure 2b: Probability of death [q(x)] during early life by survival status of mother, 1911-1950

