Journal of Interdisciplinary History, LI:4 (Spring, 2021), 509–531.

Francisco J. Marco-Gracia

Adapting Family Size and Composition: Childhood Mortality and Fertility in Rural Spain, 1750–1949

Scholars have offered diverse opinions about whether large families are justified in attempting to control their fertility. Indeed, heated discussions about voluntary fertility-control strategies depending on family size appear to have occurred across centuries and locations. In the fourteenth century, for example, Paludanus stated that couples used coitus interruptus to avoid having more children than a family could maintain. Similarly, in the eighteenth century, Féline stated, "Husbands become very practical upon seeing their wives' complaints about the cost of children." Later that century, Malthus expressed a similar sentiment: "Indeed, it seems difficult to suppose that a labourer's wife who has six children, and who is sometimes in absolute want of bread, should be able always to give them the food and attention necessary to support life."[1]

This article analyzes the extent to which human agency was instrumental and effective in fertility and birth-control decisions during the period from 1750 to 1949 in ten rural communities of northeastern Spain. The initial hypothesis is that families that experienced relatively high childhood survival rates controlled their fertility during both the pre-transitional period and the demographic transition. The analysis is based on longitudinal microdata,

Francisco J. Marco-Gracia is a postdoctoral researcher in Economic History at University of Zaragoza. He is the author of "Revisiting the Effect of Tme of Birth on Neonatal, Infant, and Child Mortality in Rural Spain, 1830–1929," *American Journal of Human Biology,* XXXII (2020), available at https://doi.org/10.1002/ajhb.23307; "Fertility Control due to Short-Term Economic Stress in Rural Aragón (Spain), 1801–1909," *Revista de Historia Económica—Journal of Iberian and Latin American Economic History* (2019), 1–27, available at https://doi.org/10.1017/S0212610919000144; "The Genesis of the Second Demographic Transition in Rural Aragon (1970–2012)," *Revista Española de Investigaciones Sociológicas* (*REIS*), 161 (2018), 63–86.

 https://doi.org/10.1162/jinh_a_01626

1 Peter Paludanus, *Sentences* (1309–1310), 4.31.3. See also Angus McLaren, *A History of the Contraception: From Antiquity to the Present* (New York, 1990), 145. Pére Féline, *Cathécisme des gens mariés* (Rouen, 1880; orig. pub. 1782), 7; Thomas R. Malthus, *An Essay on the Principle of Population* (Mineola, 2007; orig. pub. 1798), 29.

which allows for a deep understanding of the reproductive changes that occurred during the last three centuries.

According to much recent scholarship, human decision making about fertility cannot be understood in isolation from the relationship between mortality and fertility—a connection that has received particular attention with regard to the demographic transition. The classical theory of demographic transition states that the fall in infant mortality led to the voluntary reduction of fertility, in response to an increase in average family size. Therefore, the cornerstones of the classical theory of demographic transition are, first, that fertility is subject to readjustment, depending on child mortality and, second, that a decrease in child mortality is a necessary impetus for fertility control. This proposal has come under strong criticism in recent decades, especially in the context of the Princeton European Fertility Project, which identified different models of demographic transition. Its researchers did not consider the drop in fertility as necessarily a response to a fall in mortality; indeed, in some places, the fall in fertility preceded the fall in mortality. Other authors, however, have confirmed the validity of the original theory of demographic transition, reaffirming the connection between a decrease in child mortality and a reduction in fertility.[2]

This article uses the different perspectives and methodologies proposed during the previous decade by Reher, Sandström, Sanz-Gimeno, and other scholars, that reveal that changes in mortality affected family decisions to control fertility during the demographic transition and earlier. Families having relatively many surviving children reduced their total marital fertility. Therefore, as the classical theory of demographic transition postulates, a connection existed between childhood mortality and parental fertility. The gender

2 For the neoclassical theory of the demographic transition, see Frank W. Notestein, "Population: The Long View," in Theodore W. Schultz (ed.), *Food for the World* (Chicago, 1945), 36–57; Kingsley Davis, "The Theory of Change and Response in Modern Demographic History," *Population Index*, XXIX (1963), 345–366; for the Princeton European Fertility Project, John Knodel, *The Decline of Fertility in Germany*, 1871–1939 (Princeton, 1974); Massimo Livi-Bacci, *A History of Italian Fertility during the Last Two Centuries* (Princeton, 1977); Edward A. Wrigley, Ros S. Davies, James E. Oeppen, and Roger S. Schofield, *English Population History from Family Reconstitution 1580–1837* (New York, 1997); for the position opposed to the Princeton European Fertiliy Project, Jean-Claude Chesnais, "La transition démographique: étapes, formes, implications économiques: Etude de series temporelles (1720–1984) relatives a 67 pays," *Population* (French Edition), XLI (1986), 1059–1070; Dudley Kirk, "Demographic Transition Theory," *Population Studies*, L (1996), 361–387.

composition of families is a further indicator of human agency. Young men and women had distinct roles in their families. Preference for a male child could be the determining factor in couples' willingness to have an additional child. The fertility-control strategies of couples were also crucial to the composition of their families.[3]

This article's main contribution is that it expands the period previously analyzed (in referenced articles) by 120 years. It incorporates new evidence, covering a longer term, including the pre-transitional period. The results resolve some of the uncertainties raised in the reference articles. In addition, the combination of several methodologies enables new support for the perspective that childhood mortality was related to fertility control. According to the results, the experienced mortality could have affected birth intervals (spacing) even in the pre-transitional period. Finally, the examination of gender preferences in a country where sex ratios between birth and five years were exceptionally high offers new clues about sex preferences in the long term. This article focuses on a rural setting (small agrarian villages), where most of the individuals under study had living standards close to the basic survival levels.[4]

3 For reference articles, see David Reher and Alberto Sanz-Gimeno, "Rethinking Historical Reproductive Change: Insights from Longitudinal Data for a Spanish Town," *Population and Development Review*, XXXIII (2007), 63–75; Frans Van Poppel, Reher, Sanz-Gimeno, María Sánchez-Domínguez, and Erik Beekink, "Mortality Decline and Reproductive Change during the Dutch Demographic Transition," *Demographic Research*, XXVII (2012), 299–338; Reher and Glenn Sandström, "Dimensions of Rational Decisions-Making during the Demographic Transition, Aranjuez (Spain) Revisited," *Historical Life Course Studies,* II (2015), 20–36; Reher, Sandström, Sanz-Gimeno, and Van Poppel, "Agency in Fertility Decisions in Western Europe during the Demographic Transition: A Comparative Perspective," *Demography*, LIV (2017), 3–22; for the different social and economic roles of men and women and their preferences, Karsten Hank, "Parental Gender Preferences and Reproductive Behaviour: A Review of the Recent Literature," *Journal of Biosocial Science*, XXXIX (2007), 759–767; Sandström and Lotta Vikström, "Sex Preference for Children in German Villages during the Fertility Transition," *Population Studies*, LXIX (2015), 57–71; for fertility-control strategies (stopping and spacing), George Alter, *Family and the Female Life Course: The Women of Verviers, Belgium, 1849–1880* (Madison, 1988); Tommy Bengtsson and Martin Dribe, "Deliberate Control in a Natural Fertility Population: Southern Sweden, 1766–1864," *Demography*, XLIII (2006), 727–746.

4 For sex ratios in nineteenth-century Europe, see Francisco J. Beltrán-Tapia and Domingo Gallego-Martinez, "Where Are the Missing Girls? Gender Discrimination in 19th-Century Spain," *Explorations in Economic History*, LXVI (2017), 117–126; for historical Spanish wages and standards of living, Cristina Borderías Mondéjar and Luisa Muñoz Abeledo, "¿Quién lleva el pan a casa en la España de 1924? Trabajo y economías familiares de jornaleros y pescadores en Cataluña y Galicia," *Revista de historia industrial*, LXXIV (2018), 77–106; Luis Germán Zubero, "Coste de la vida y poder adquisitivo de los trabajadores en Zaragoza durante el primer tercio del siglo XX," in Carlos Forcadell Alvárez (ed.), *Razones de historiador: Magisterio y presencia de Juan José Carreras* (Zaragoza, 2009), 373–390.

BACKGROUND This article contributes new evidence from rural Spain about the evolution of the historical fertility transition and human agency. The analysis centers on the passage from a regime that Henry called "natural fertility" to one of "controlled fertility" from a mortality perspective. The evolution of modern society is intimately connected to the changes in fertility that occurred during earlier centuries. Coale and Watkins described this process as a transition from "nonparity-specific limitation of marital fertility to the parity-specific practice of contraception and abortion."[5]

Researchers have learned a great deal through aggregated data and microdata since the earliest proposal of the demographic transition theory in the first half of the twentieth century. However, they have not yet settled the question of whether any kind of generalized fertility control existed in the pre-transitional period or how mortality influenced fertility at the family level. This article investigates the important role of childhood mortality through the comparison of two periods—the first, from 1750 to 1899, to find evidence of human agency in the pre-transitional period, and the second, from 1900 to 1949, to look closely at the fertility transition itself.

The demographic transition in Spain developed in several stages. The first stage saw a decrease in childhood mortality, with no effect on fertility, leading to an increase in mean family size. Thus, a mortality change caused an increase in family size. During the second stage, fertility decreased, thereby compensating for low childhood mortality. During the third stage, fertility decreased even more than did mortality, resulting in a decline of mean family size.

The Connection between Childhood Mortality and Fertility Decrease The literature reveals three types of connection between childhood mortality and a decrease in fertility. The first, the *individual-level biological effect*, is related to maternal lactation. A longer lactation period initially leads to a longer birth interval, and lactation can be prolonged indefinitely while a child is alive. The survival of children tends to prolong the breastfeeding period and thus to increase birth intervals, even without any explicit intention to control fertility.

5 Louis Henry, "Some Data on Natural Fertility," *Eugenics Quarterly,* VIII (1961), 81–91; Ansley J. Coale and Susan Cotts Watkins, *The Decline of Fertility in Europe* (Princeton, 1986), 10.

The second connection, the *individual-level behavioral effect*, is related to ideal family size. If parents had an ideal family size (of living children) in mind, they would tend to "replace" children who died until they achieved their ideal family size. Studying this mechanism is challenging, especially for the pre-transitional period, because researchers are unable to distinguish whether the conception of a new child arose from a desire to "replace" a lost one or whether, after the death of a child, lactation no longer controlled fertility. In addition, given that some children died, researchers cannot determine whether having a new child arose from a rational decision to "replace" or extend the family or whether, with more time available, conceptions occurred more naturally and spontaneously.[6]

This final point is related to the decision to acquire a large family as a kind of insurance in old age. If childhood mortality was high, parents might have wished to have many children so that mortality would not rob them of all their offspring, and some of them would survive to care for them and their property in old age. When mortality decreased, this need diminished. During the demographic transition, the need for parents to produce many children lessened because couples could reach a "sufficient" family size before completing their reproductive cycle.

Did an ideal family size exist before the demographic transition? The desire to limit family size is entailed in the desire to control fertility, and it has a relationship—at least to some degree—with the notion of an ideal family size. This is not to say that desired

6 Alberto Palloni and Hantamala Rafalimanana, "The Effects of Infant Mortality and Fertility Revisited: New Evidence from Latin America," *Demography*, XXXVI (1999), 41–58; Anne R. Pebley, Hernan Delgado, and Elena Brinemann, "Fertility Desires and Childhood Mortality Experience among Guatemalan Women," *Studies in Family Planning*, X (1979), 129–136; Knodel, "Starting, Stopping, and Spacing during the Early Stages of Fertility Transition: The Experience of German Village Populations in the 18th And 19th Centuries," *Demography*, XXIV (1987), 143–162; Douglas L. Anderton and Lee L. Bean, "Spacing and Fertility Limitation: A Behavorial Analysis of a Nineteenth Century Frontier Population," *ibid.*, XXII (1985), 169–183; John R. Gillis, Louise A. Tilly, and David Levine, *The European Experience of Declining Fertility, 1850–1970: The Quiet Revolution* (New York, 1992); Samuel H. Preston, "Introduction," in *idem* (ed.), *The Effects of Infant and Childhood Mortality on Fertility* (New York, 1978), 1–18; Kazuo Yamaguchi and Linda R. Ferguson, "The Stopping and Spacing of Childbirths and Their Birth-History Predictors: Rational-Choice Theory and Event-History Analysis," *American Sociological Review*, LX (1995), 272–298; Geraldine P. Mineau, Bean, and Anderton, "Migration and Fertility: Behavioral Change on the American Frontier," *Journal of Family History*, XIV (1989), 43–61; Daniel J. Hruschka, Rebecca Sear, Joseph Hackman, and Alexandria Drake, "Worldwide Fertility Declines Do Not Rely on Stopping at Ideal Parities," *Population Studies*, LXXIII (2019), 1–17.

family size is a closed or fixed concept at the time of marriage; it could rather be a decision that develops over time, conditioned by the survival of children. Van de Walle argued that the concept of ideal family size is the result of a "mutation in the history of mentalities and cultures" that allows for family size to become an object of conscious choice; he considered this concept to have "appeared not long before the fertility transition." Seccombe made a similar point. Van de Walle justified this theory in two ways. First, contemporary African societies in situations of "natural fertility" often avoid giving an exact number when asked about their desired family size. Van de Walle considered this attitude to be comparable to that which prevailed in pre-industrialized Western societies. Second, the European literature for earlier centuries reveals no references to a specific ideal family size, expressed as a number, until the end of the eighteenth century, when the demographic transition began in France. Although Van de Walle accepted the probable existence of a maximum desired number of living children, all possibly still living in the family home, this limit does not exactly equate with an ideal family size.[7]

STUDY AREA AND DATA The microdata in this research pertain to a rural area of around 500 km^2, comprising ten parishes—Alfamén, Aylés, Botorrita, Jaulín, Longares, Mezalocha, Mozota, Muel, Tosos, and Villanueva de Huerva. The distance between this region and its capital city of Zaragoza is between 19 and 40 km. The total population of the parishes was 3,949 in 1750, rising to 5,520 in 1801 and to 7,765 in 1910, before decreasing to 7,207 in 1960. The Alfamén & Middle Huerva Database (AMHDB), which was developed according to the Family Reconstitution Method proposed by Fleury and Henry, contains 95,817 individuals and offers high-quality insight into a rural context. The AMHDB, which was formed from the collected parish registers of baptisms, marriages, and deaths between the late fifteenth century and mid-twentieth century—includes

7 For a discussion about ideal family size, see Coale, "The Demographic Transition Reconsidered," *Proceedings of the International Population Conference* (Liège, 1973), I, 53–73; Reher and Sanz-Gimeno, "Rethinking Historical Reproductive Change: Insights from Longitudinal Data for a Spanish Town," *Population and Development Review*, XXXIII (2007), 63–75; Wally Seccombe, "Starting to Stop: Working-class Fertility Decline in Britain," *Past & Present*, 126 (1990), 151–188; Etienne Van de Walle, "Fertility Transition, Conscious Choice, and Numeracy," *Demography*, XXIX (1992), 489, 501.

all individuals born in the study area or who migrated there. However, it lacks information concerning outgoing migrants from the time of their departure, except for some marginal notes in the baptism registers about weddings and/or deaths.[8]

The increase in migratory movements from rural to urban areas throughout the nineteenth century and particularly during the twentieth century could have affected the composition of the sample if the families that migrated had different characteristics from those that remained in the study area. But analyses of the available variables, such as age at first marriage and socioeconomic origin, have not revealed important differences. Many of those who emigrated from the study area, both men and women, tended to be literate, thereby leaving a relatively large proportion of illiterate people behind. This pattern could be linked to the delay in the beginning of the fertility transition and the dissemination of ideas on fertility control. These differences in literacy levels occur throughout the period for which literacy data are available, namely, the mid-nineteenth century onward. Thus, selection biases would have been relatively constant over time, until full literacy was achieved among people born in the 1930s.

Occupational Categories During the study period, the ten parishes, which lie in Ebro Valley, close to the Algairén Mountains, were known for the production of cereal, wine, and sheep. To analyze the occupations of the heads of household, this article consulted four sources: annual population lists from 1747 to 1830, in which occupational information appears every fifteen years (on average); population censuses for 1857 and 1860; electoral censuses for 1890, 1894, 1900, 1910, 1920, 1930, 1934, 1945, 1951, and 1955; and data extracted from parish registers.

We classified the social structure into five occupational groups: (1) day laborers and small owners who were unable to make a living from these properties alone and so needed other forms of employment; (2) farmers with enough land for subsistence; (3) sheep and goat shepherds (either owners or non-owners), which also includes some landowners; (4) artisans (potters, bakers, blacksmiths, tailors, glaziers, etc.), which also includes some landowners; (5) "others,"

8 For the method of family reconstitution, see Michel Fleury and Henry, *Des registres paroissiaux à l'histoire de la population: Manuel de dépouillement et d'exploitation d l'état civil ancient* (Paris, 1956).

meaning all remaining occupations not previously categorized (public servants, military personnel, doctors, teachers, etc.) and those of unknown occupation.

This study considers only marriages in which both spouses reached the age of forty-nine; who had a known date of marriage; and all of whose children had known dates of birth, as well as evidence of still being alive at age twenty (and, if not, a known date of death). These restrictions substantially reduced the sample and caused slight bias. The database contains 16,979 families, among whom 10,452 couples were married between 1750 and 1949. Among that subgroup, 5,074 families, both parents had reached the age of forty-nine (and information exists about them). For only 1,229 families, data about what happened to all of their children exist. The restrictions left us with 11.8 percent of the families recorded for the period (1750–1949).

To examine the representativeness of the selected sample, we compared basic demographic variables. The average age at first marriage from 1750 to 1824 in the entire population was 21.8 years for women and 25.7 years for men; in our sample, it was 21.7 for women and 25.3 for men. Similarly, from 1825 to 1899, the age at marriage for the entire population was 22.8 years for women and 26.4 years for men, whereas in our sample, the respective figures were 22.9 years and 26.2 years. Finally, in the entire population from 1900 to 1949, this age was 23.3 years for women and 27.0 years for men; in our sample, it was 23.3 and 27.1 years, respectively.

Analysis of the differences in marital fertility showed that the average marital-fertility rate among families in which both spouses reached the age of forty-nine was 6.84 children between 1750 and 1824. The equivalent figure was 6.52 children in our selected sample. Similarly, the fertility rate was 6.89 between 1825 and 1899, compared to 6.88 in our sample and 4.82 between 1900 and 1949, compared to 4.56 in our sample. These results show highly similar values for age at first marriage, and a slight bias in our sample in favor of families with fewer children.

Life expectancy has increased during the last two centuries. Individuals in the twentieth century had a greater likelihood of reaching age forty-nine than did individuals in the previous century. However, we did not find that families in which both spouses reached age forty-nine had different demographic characteristics from those families in which both spouses did not, probably because

Table 1 Number of Complete Familial Reproductive Histories, per Decade, That Met the Selection Criteria, 1750–1949

FIRST-BIRTH COHORT	NUMBER	FIRST-BIRTH COHORT	NUMBER
1750–1759	18	1850–1859	62
1760–1769	25	1860–1869	60
1770–1779	27	1870–1879	58
1780–1789	25	1880–1889	72
1790–1799	27	1890–1899	77
1800–1809	43	1900–1909	99
1810–1819	63	1910–1819	65
1820–1829	45	1920–1929	147
1830–1839	46	1930–1939	110
1840–1849	55	1940–1949	105

NOTE The selection criteria are that both spouses reached age 49, that their date of marriage is known, that they had children, that the dates of birth for all children are available, and that information about whether those children were still alive at age 20 is available and, if not, the date of death is.
SOURCE The Alfamén & Middle Huerva Database.

death was not predictable in most cases. Table 1 depicts the number of marriages that met the selection criteria, organized by the year of birth of their first child. The data in the table are aggregated by decade.

METHODOLOGY To understand why fertility decreased, it is necessary to examine the timeframe and pace of change. For this reason, we include two types of analyses. First, we used descriptive statistics to study the evolution of important demographic variables over time. The populations of interest, however, were heterogeneous, and the variables were related to diverse individuals in, for example, different socioeconomic groups. Hence, the interpretation of the means should be viewed with caution, with awareness of the heterogeneity of the sample and the centuries. Second, we used a single-event (single-failure) model regression to analyze in depth the relationship between fertility and childhood mortality, controlling for different factors to be explained below.

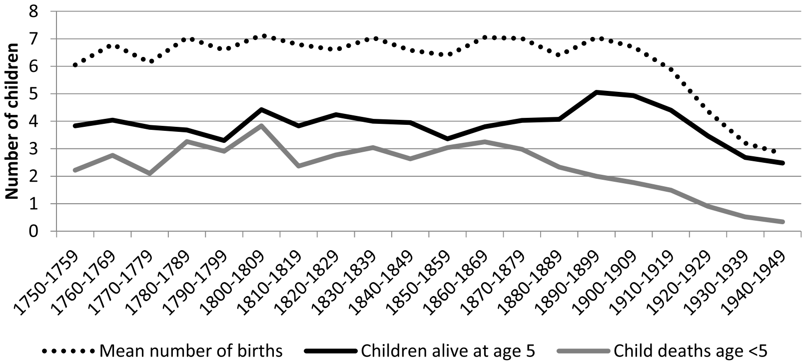
Our reference research, based on event-history analysis, found clear evidence that the survival of children affected the likelihood of having an additional child. We applied a Cox proportional-hazards model to estimate the statistical significance and effect of the scale of childhood mortality and the sex composition of the surviving children, using a single-event (single-failure) model regression. Individuals were included in the analysis from the time when they had their second child until they were fifty years old in order to analyze the likelihood of their having an additional child (the event of interest). The notation of the single failure is $h(t, x(t), \beta) = h_o(t) \exp[x'(t)\beta]$. As developed by the reference articles, h_o (the baseline hazard) denotes the reference risk function, which characterizes the changes produced over time and is indexed to time since the last birth (t), in years. The function $\exp[x'(t)\beta]$ expresses the effect of the explanatory variables. As discussed below, a regression was performed for each parity between 2 and 6.[9]

All the regressions controlled for socioeconomic family status. We were especially interested in differences between the two main socioeconomic groups, farmers and day laborers. Hence, we used "farmers" as a reference category. The models also included a continuous variable that measured the temporal distance (in years) between the birth of the first and second children. The intention was to include the influence of large intervals on low fertility in the model—a useful control variable for capturing unobserved differences in fecundity. In the regressions, the pre-transitional period was divided into two sub-periods—1750–1859, a period of high birth and mortality ratio, and 1860–1899, which occurred between the decline in childhood mortality and the decline in fertility. Our aim was to capture the evolution of the relationship between mortality and fertility in the analyzed stages of the demographic transition.

The variable "lactation indicator" was also included to capture the effect of the mother having ceased lactation because of the last breastfeeding child's death. This indicator combines information about the time of birth of the previous child with an index of the child's vital status (alive or deceased). Lactation indicator was modeled in three subgroups: conceiving another child during the twelve months after the death of the previous child, possibly just a biological response, since the mother would return to normal ovulation; conceiving thirteen to eighteen months afterward, possibly a behavioral effect of parents no longer in mourning and wanting to "replace" the deceased child; and conceiving after a period of eighteen months, or while the previous child was still alive. In a context of natural fertility, the cessation of breastfeeding would be expected to increase the likelihood of conceiving a new child.

9 For the reference articles, see note 3.

Fig. 1 Indicators of Reproduction, 1750–1949 (Organized by Year of Marriage)



NOTE N = 1,229 marriages.
SOURCE The Alfamén & Middle Huerva Database.

Mother's age at the time of conception serves as a control variable; it affects fertility for both physiological and behavioral reasons.[10]

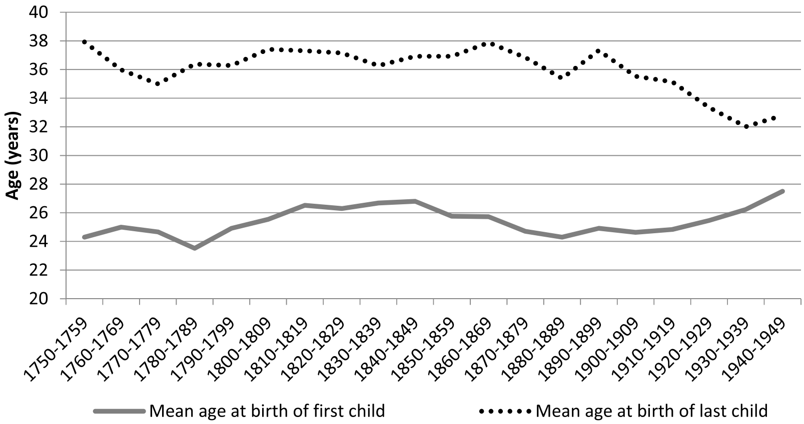
RELEVANT CONTEXTUAL FACTORS Figure 1 offers perspectives on the reproductive process. The first aspect is the number of children born; this rate was consistent with other high marital-fertility areas in Spain. We analyzed marital fertility only in stable families. The mean number of children remained stable during the nineteenth century and fell rapidly in the twentieth century.

The second aspect is the number of children who died before age five. In the mid-nineteenth century, the number of children who died before their fifth birthday began to decrease steadily.

The third aspect is the number of children who survived until age five. From 1880–1889 to 1890–1899, family size increased slightly because of declining childhood mortality and exceeded the mean of four children during the previous period. From the beginning of the twentieth century, fertility began to decrease, slowly at first and then

10 For other articles that used the same methodology based on the "lactation indicator," see Alter, *Family and the Female Life Course*; Aliaksandr Amialchuk and Elitsa Dimitrova, "Detecting the Evolution of Deliberate Fertility Control before the Demographic Transition in Germany," *Demographic Research*, XXVII (2012), 507–542; Reher, Sandström, Sanz-Gimeno, and Van Poppel, "Agency in Fertility Decisions," 3–22.

Fig. 2 Duration of Reproduction, 1800–1949 (Organized by Year of Marriage)



NOTE N = 1,229 marriages.
SOURCE The Alfamén & Middle Huerva Database.

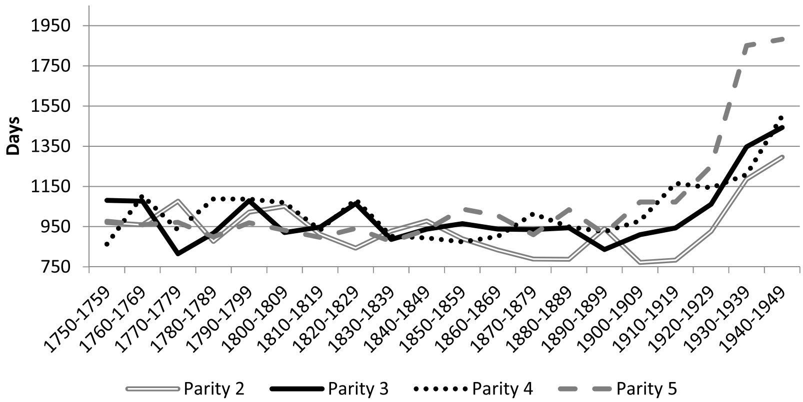
more quickly. At that point, the mean family size became smaller.[11]

Distinct stages can be identified. First, until the mid-nineteenth century, high fertility and high childhood mortality remained static. Second, starting in the 1860s, childhood mortality began to decrease slightly, while family size increased as a consequence of mortality decline. Third, beginning in 1900, fertility decreased, possibly in response to the increase in family size. Fourth, beginning in 1920, family size decreased. Figure 2 illustrates the variation in mean age at the birth of the first and last child; the beginning of the transition is clearly in evidence.

Figure 3 depicts the mean birth interval for the sample, that is, changes in the spacing of children. This variable is convoluted because of a heterogeneity of values, some families (at least sometimes) having short birth intervals and others having long intervals. Observation of the evolution of birth intervals over time, however, reveals the effect of the beginning of the fertility transition and the

11 For problems related to the analysis of means, see Gustav Feichtinger, "The Statistical Measurement of the Family Life Cycle," in John Boogaarts, Thomas K. Burch, and Kenneth W. Wachter (eds.), *Family Demography: Methods and Their Application* (New York, 1987), 81–101; Miguel Requena, "Sobre el calendario reproductive de las muejres españolas," *Revista Española de Investigaciones Sociológicas*, LXXIX (1997), 43–79.

Fig. 3 Birth Interval in Days, 1750–1949 (Organized by Year of Marriage)



NOTE N = 1,229 marriages.
SOURCE The Alfamén & Middle Huerva Database.

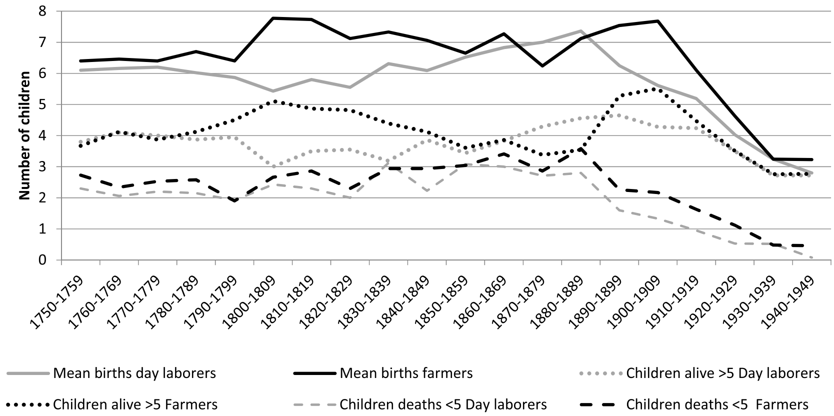
use of spacing. We can observe a gap between the beginning of the fertility transition (first decade of the twentieth century in the studied area) and the moment when average birth intervals increased strongly (1920s).

As in the reference literature for the town of Aranjuez, no important changes for parities 2 to 5 occurred until the 1920s, apparently indicating no significant changes in birth intervals among low parities until that decade. Birth intervals 4 and 5 increased to a slightly greater extent than parities 2 to 3. The most significant changes involved the highest parities (over 5), though they could have resulted from either the voluntary use of spacing or failures in stopping strategies. The data could indicate that both stopping and spacing were in use during the demographic transition as fertility-control strategies. The spacing of intervals between low parities became more common after 1920.[12]

These figures permit the identification of two distinct periods during the demographic transition. In the first, before the 1920s,

12 For the evolution of spacing and stopping in the study area, see Marco-Gracia, "How Was the Fertility Transition Carried Out? Analysis of Fertility Control Strategies and Their Evolution in Rural Aragon, Spain (1880–1955)," *Historia Agraria*, LXXVI (2018), 189–220; for the case of Aranjuez, note 3.

Fig. 4 Indicators of Reproduction, 1800–1949 (Organized by Year of Marriage), by Agrarian Occupation of Husband



NOTE $N = 748$ marriages.
SOURCE The Alfamén & Middle Huerva Database.

mothers were younger when they had their last child relative to the pre-transitional period but older when they had their first child, with an increased birth interval thereafter. The slight increase in the birth interval grew more extreme for the high parities. The second stage began in 1920, when the stopping strategy was accompanied by a spacing strategy for all parities (except parity 1). This practice increased the birth interval more substantially.

Fathers' occupations signal differing family patterns. Figure 4 depicts a comparison of mean births, deaths, and surviving children, disaggregated into two main occupational groups, day laborers and farmers. Fertility and childhood mortality were slightly greater among farmers than day laborers throughout most periods.

The reasons why farmers' families had higher childhood mortality in our study area than they did elsewhere in Europe are unclear. Possibilities include income levels similar to that of day laborers, the predominance of low-productivity rain-fed crops in the area, and the need for women to work to meet the minimum conditions for survival. Mothers from land-owning families returned to work relatively soon. Women who worked as day laborers stayed with their children longer than did farming women because of the greater obstacles that they faced in a return to the labor market

Table 2 Descriptive Statistics for Variables of Interest

	1750–1899			1900–1949		
VARIABLE	N	MEAN	SD	N	MEAN	SD
Marital fertility	703	6.71	0.110	526	4.56	0.115
Children deaths <5 y.	703	2.72	0.759	526	0.95	0.057
Age at first marriage (women)	703	22.51	0.158	526	23.34	0.143
Age at last child (mother)	703	36.51	0.236	526	33.59	0.268

SOURCE The Alfamén & Middle Huerva Database.

during the postpartum period. In any case, explicating this pattern requires further investigation.[13]

Table 2 presents a summary of the main descriptive statistics, showing the mean and standard deviation for each period. The statistics relate to marital fertility, number of children who died before age five, age of women at first marriage, and age at last child.

Parity-Progression Ratios To study the likelihood of having an additional child, we applied parity-progression ratios. Table 3 estimates the likelihood of having an additional child as a function of the number of surviving children for each parity. In this three-dimensional table, the rows refer to the number of surviving children from previous births; the columns denote different parities; and the main content of the table shows the likelihood of having a new child. Thus, what is being examined is whether a couple did or did not have a new child, as a contingent function of the number of children born and the number of children who survived. It is possible to analyze changes in the propensity for a new child without considering child survival by reading the cells horizontally. The results indicate that during the pre-transitional period, the likelihood of having a new child did not depend unequivocally on the number of surviving children.

Table 4 is similar to Table 3 but shows a different period (1900–1949). This time, parity was studied only to parity 5 because both the number of births and childhood mortality decreased during the demographic transition. For all cases, the more children who survived, the smaller was the likelihood of the family having another child. This effect was evident even for the lowest parities. Hence, it seems possible that fertility-control strategies might have

13 For historical Spanish wages and standards of living, see note 5.

Table 3 The Likelihood of an Additional Birth by Parity and Number of Surviving Children, 1750–1899

1750–1899	PARITY						
SURVIVING	1 TO 2	2 TO 3	3 TO 4	4 TO 5	5 TO 6	6 TO 7	7 TO 8
0	0.929 (163)	0.925 (104)					
1	0.962 (558)	0.932 (261)	0.857 (103)	0.825 (54)			
2		0.940 (346)	0.908 (246)	0.869 (128)	0.849 (71)		
3			0.872 (222)	0.901 (195)	0.872 (122)	0.793 (80)	0.700 (38)
4				0.918 (141)	0.842 (136)	0.786 (97)	0.708 (59)
5					0.830 (104)	0.809 (96)	0.697 (76)
6						0.797 (60)	0.691 (55)

NOTE The number of cases is shown in parentheses. Twins were not considered.
SOURCE The Alfamén & Middle Huerva Database.

Table 4 The Likelihood of an Additional Birth by Parity and Number of Surviving Children, 1900–1949

1900–1949	PARITY			
SURVIVING	1 TO 2	2 TO 3	3 TO 4	4 TO 5
0	0.929 (56)	0.933 (15)		
1	0.804 (423)	0.802 (106)	0.960 (25)	
2		0.754 (269)	0.723 (101)	0.595 (24)
3			0.680 (167)	0.720 (72)
4				0.674 (113)

NOTE The number of cases is shown in parentheses. Twins were not considered.
SOURCE The Alfamén & Middle Huerva Database.

been developed during the entire reproductive cycle. Families adjusted their fertility to changes in childhood survival, and stopping was a common strategy during the demographic transition in the study area.

Birth Intervals The tables for birth interval were developed in a similar manner to those for parity-progress ratios, except that the mean birth intervals served as the reference periods. Table 5 shows estimates for the mean duration of birth interval, controlling for the number of surviving children of each woman up to parity 8. The results included in Table 5 show increasing birth intervals associated with an increase in the number of surviving children. Therefore, birth intervals changed to a limited degree according to childhood survival, possibly a consequence of some parents slightly controlling their fertility. Parents could have made their decisions to address the problems associated with having many young surviving children; strain on the family budget could have increased greatly with the presence of several dependent children in the household. Overall, the results suggest a population that was not in a state of purely "natural" fertility. The use of spacing was not unknown to these villagers in the pre-transitional period; the number of registered births decreased during years of economic shock (due to price crises). Both results could indicate a desire to control fertility in stress situations among populations that were close to the minimum living standards for survival.[14]

Table 6 demonstrates that during the demographic transition (1900–1949), the birth interval again changed as a contingent

14 For natural fertility, see note 5; for fertility control due to short-term economic stress in this area, Marco-Gracia, "Fertility Control due to Short-Term Economic Stress in Rural Aragón, Spain, 1801-1909," *Revista de Historia Económica—Journal of Iberian and Latin American Economic History* (2019), available at https://doi.org/10.1017/S0212610919000144.

Table 5 Mean Birth Interval as a Function of Parity and Number of Surviving Children, 1750–1899

1750–1899	PARITY						
SURVIVING	1 TO 2	2 TO 3	3 TO 4	4 TO 5	5 TO 6	6 TO 7	7 TO 8
0	817 (163)	890 (104)	944 (21)				
1	932 (558)	943 (261)	966 (103)	892 (54)			
2		981 (346)	974 (246)	934 (128)	871 (71)	828 (33)	
3			978 (222)	996 (195)	948 (122)	941 (80)	910 (38)
4				919 (141)	954 (136)	958 (97)	907 (59)
5					1,002 (104)	980 (96)	919 (76)
6						1,081 (60)	926 (55)
7							929 (35)

NOTE The number of cases is shown in parentheses. Twins were not considered.
SOURCE The Alfamén & Middle Huerva Database.

Table 6 Mean Birth Interval as a Function of Parity and the Number of Surviving Children, 1900–1949

1900–1949	PARITY			
SURVIVING	1 TO 2	2 TO 3	3 TO 4	4 TO 5
0	699 (56)	836 (15)		
1	1,030 (423)	919 (106)	920 (25)	
2		1,197 (269)	1,116 (101)	1,097 (24)
3			1,206 (167)	1,129 (72)
4				1,313 (113)

NOTE The number of cases is shown in parentheses. Twins were not considered.
SOURCE The Alfamén & Middle Huerva Database.

function of the number of children and childhood survival. Tables 4 and 5 show a common behavior with different intensity—increasing intervals as the number of surviving children rose. Based on those tables, we can deduce that spacing was a common fertility-control strategy during both the pre-transitional period (albeit slightly) and the demographic transition. By contrast, stopping was clearly associated with the demographic transition.

RESULTS Table 7 provides the results from a Cox single-failure proportional-hazards model for parities 2 to 6. Because the Schoenfeld residuals analysis of the results obtained from the model found no sign of nonproportional effects, the model appears to be robust.[15]

The results confirm a relationship between the likelihood of having an additional child and the survival rate from previous births; the last child is particularly important. Parents whose children had a high survival rate had a relatively low likelihood of any new birth. All analyzed parities show strong effects on increase in the hazard of additional births among the couples with low survival rates (approximately 25 to 60 percent extra). The results might indicate the existence of a "replacement" behavior (individual-level behavioral effect). A combination of the variables "period" and "total number of child deaths" has proven to be a good indicator of the relationship between fertility and mortality over time. Our results confirm that, during the pre-transitional period, the mortality of previous

15 For the Schoenfeld residual analysis, see Patricia M. Grambsch and Terry M. Therneau, "Proportional Hazards Tests and Diagnostics Based on Weighted Residuals," *Biometrika*, LXXXI, 515–526; for "missing girls" in Spanish censuses during the nineteenth century, note 3.

Table 7 Cox Proportional-Hazards Regression: Hazard Ratios of Reaching Parities 2–6 (Single Failure): Marriage cohorts, 1750–1949

	CATEGORY	%	PARITY 2	%	PARITY 3	%	PARITY 4	%	PARITY 5	%	PARITY 6
Birth interval child 1–2 in years	–		–		0.76***		0.79***		0.70***		0.68***
Period × total number of child deaths											
A = 1750–1859											
	A × Anyone	28.8	1	20.8	1	17.2	1	12.4	1	11.7	1
	A × 1 child	5.8	1.69**	13.4	1.54**	13.9	0.93*	14.1	1.03	12.1	0.85
	A × 2 children	–	–	1.3	2.20**	5.3	1.01	8.3	1.06**	10.	1.03*
	A × 3 or more	–	–	–	–	0.7	1.07**	3.8	1.19*	6	1.15**
B = 1860–1899											
	B × Anyone	21.3	1.26	15.8	0.98	11.5	0.86	9.4	0.87*	8.6	0.84
	B × 1 child	8.8	1.81***	12.7	1.21*	14.0	1.04	12.6	1.03*	10.8	1.10
	B × 2 children	–	–	2.6	1.73**	5.5	1.10**	7.7	1.08	8.3	1.13*
C = 1900–1949											
	C × 3 or more	–	–	–	–	1.4	1.16**	4.4	1.11**	8.0	1.21*
	C × Anyone	31.1	1.10	23.2	0.99	17.7	0.79	12.2	0.67	7.2	0.75
	C × 1 child	4.2	1.60**	8.9	1.12*	9.5	1.11	10.0	1.09*	8.3	1.08
	C × 2 children	–	–	1.3	1.26*	2.6	1.17	4.3	1.14*	6.2	1.09*
	C × 3 or more	–	–	–	–	0.7	1.19**	0.8	1.17*	1.5	1.16**

Socioeconomic status of the father	Day-laborer	28.7	1.11	27.2	1.01	26.0	0.73**	26.2	0.75*	27.9	0.69
	Farmer	32.4	1	33.2	1	33.2	1	33.7	1	32.7	1
	Non-migrant shepherd	3.2	0.75	3.2	1.49	3.2	0.79	3.1	0.79*	2.3	0.70
	Artisan	3.3	1.27	2.6	0.84	3.1	0.89*	2.9	0.87	3.2	0.96
	Other/no data	32.4	0.90	33.8	1.07	34.5	0.85	34.1	1.07	33.9	0.95
Sex composition of surviving children	Mixed or none	–	–	31.2	1	53.8	1	67.8	1	77.1	1
	Only boys	–	–	32.7	0.98	23.7	0.97	17.0	0.79	13.9	1.03
	Only girls	–	–	36.1	1.26*	22.5	1.28**	15.2	1.17**	9.0	1.12*
Age of the mother	< 25	33.3	0.90	18.5	1.02**	12.3	1.17***	7.9	1.57***	5.6	1.56*
	25–29	40.2	1	44.0	1	36.2	1	25.7	1	19.4	1
	30–34	15.8	0.62***	23.3	0.97***	33.1	0.90***	39.9	0.79***	38.0	0.73***
	35–39	6.6	0.71*	9.6	0.45***	14.0	0.58***	19.6	0.44***	29.4	0.43**
	> 40	4.1	0.68	4.6	0.22**	4.4	0.24***	6.9	0.24***	7.6	0.25***
Lactation indicator (months after child death)	1–12 months	4.5	5.47***	3.4	6.53***	3.6	2.48***	4.2	4.22***	3.9	3.61***
	13–18 months	5.5	4.41***	5.1	3.84***	4.6	3.96***	7.2	5.30***	4.6	2.40***
	>18 or child alive	90.0	1	91.5	1	91.8	1	88.6	1	91.5	1
	No of episodes	966		907		794		656		540	
	Chi2	120.7		154.4		108.5		91.2		73.7	
	Prob. > Chi2		0.0000		0.0000		0.0000		0.0000		0.0000

*$p < 0.1$.
**$p < 0.05$.
***$p < 0.01$.

NOTE Coefficients in exp(β)-form.

SOURCE The Alfamén & Middle Huerva Database.

children was related to the likelihood of having an additional child. This finding could indicate that the intention to have children to suit a couple's wishes was related to fertility, even during the pre-transitional period, possibly influenced by a desired ideal family size. The intensity of such behavior increased during the transition.

Similarly, the "lactation indicator" confirms that the mortality status of the previous child determined the timing of the next conception. These strong results confirm that the lactation period affected the timing of the birth of an additional child. The death of the previous child substantially increased the hazard of additional births. This mechanism could serve to postpone the pregnancy (individual-level biological effect).

The reaction to child mortality and sex preferences can vary according to different social strata. However, differences in socio-economic status do not appear to have played a decisive role in fertility. The small samples for the categories "shepherds" and "artisans" could have affected the results. As we expected, the variable "age of mother" strongly affected the likelihood of having an additional child. Young mothers had a strong likelihood.

The results demonstrate a clear preference for male offspring. The male bias results in the study area of rural Spain are stronger (+10 percent) than in urban Spain and other European countries. This preference could be the function, however, of a higher mortality among girls than boys during the first years of life in the study area. Nonetheless, the results of this analysis could help to explain the high sex ratios found in the Spanish parish registers in this period.

Our conclusions are consistent with those obtained for the town of Aranjuez, where the survival of previous children correlated with a reduced likelihood of having an additional child, and the survival or death of the last child greatly influenced the likelihood of the birth of an additional child. A Schoenfeld residuals analysis performed on the results found the residuals to be insignificant, thus demonstrating that a more parsimonious model that assumes a constant effect over time is preferable.[16]

16 For the important role of parents in early childhood, see Reher and Fernando González-Quiñones, "Do Parents Really Matter? Child Health and Development in Spain during the Demographic Transition," *Population Studies*, LVII (2003), 63–75; for the Schoenfeld residual analysis, note 14.

This article, which applies the methodology of recent studies to examine the relationship between childhood mortality and fertility control as an indicator of human agency, calls into question the idea of "natural" fertility in the pre-transitional period. It suggests that families could have applied a spacing strategy that responded to their experience of childhood mortality. The relatively long birth intervals (extra weeks or months) during the pre-transitional period could have reflected either the use of basic contraceptive techniques or a relatively low coital frequency, whether by design or by contingencies associated with attending to several children. Nonetheless, our findings speak significantly to the relationship between mortality and fertility before the demographic transition. The use of spacing during this period is consistent with the use of spacing during "complicated" years—for example, during an economic shock. Furthermore, we demonstrate that in the transitional period, childhood survival affected families' fertility rates and thus conditioned their reproductive strategies. The death of the previous child was especially important for the birth of an additional child. Throughout the entire period studied, families that experienced high childhood mortality had a strong likelihood of having an additional child.[17]

Both spacing and stopping were popular fertility-control strategies during the fertility transition (from 1900 onward). Spacing of children differed according to parity and period. Until the 1920s, the main increases in spacing occurred from parity 4, especially from parities 6 to 8—possibly as a consequence of spacing in families that had reached a sufficient size or of a failure using stopping. Stopping occurred during the entire demographic transition.

The preference for at least one surviving male child is consistent with the literature analyzing high sex ratios in Spain. The preference for boys might have eventually declined in Spain, as it did in other European countries, but precise conclusions will have to await new studies of other areas.[18]

17 See Bengtsson and Dribe, "Deliberate Control, 727–746.

18 For the case of the Netherlands and Sweden, see Reher, Sandström, Sanz-Gimeno, and Van Poppel, "Agency in Fertility Decisions," 3–22.