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Kin and birth order effects on male child mortality: three East Asian populations, 1716–1945☆,☆☆

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Abstract

Human child survival depends on adult investment, typically from parents. However, in spite of recent research advances on kin influence and birth order effects on human infant and child mortality, studies that directly examine the interaction of kin context and birth order on sibling differences in child mortality are still rare. Our study supplements this literature with new findings from large-scale individual-level panel data for three East Asian historical populations from northeast China (1789–1909), northeast Japan (1716–1870), and north Taiwan (1906–1945), where preference for sons and first-borns is common. We examine and compare male child mortality risks by presence/absence of co-resident parents, grandparents, and other kin, as well as their interaction effects with birth order. We apply discrete-time event-history analysis on over 172,000 observations of 69,125 boys aged 1–9 years old. We find that in all three populations, while the presence of parents is important for child survival, it is more beneficial to first/early-borns than to later-borns. Effects of other co-resident kin are however null or inconsistent between populations. Our findings underscore the importance of birth order in understanding how differential parental investment may produce child survival differentials between siblings.

☆Author's contribution: Hao Dong designed the study, was responsible for the analysis, including the production of the harmonized data as well as all statistical calculations, wrote the first draft of this manuscript, and collaborated closely in the manuscript revisions; Matteo Manfredini assisted in much of the evolutionary biological framework; Satomi Kurosu manages the Japanese data, helped prepare the analytical file, and commented on the draft manuscript; Wenshan Yang manages the Taiwanese data, helped prepare the analytical file, and reviewed the draft manuscript; James Z. Lee conceived and coordinated this study, led the effort to create the Chinese data, participated in the study design, and revised the manuscript. All authors gave final approval for publication.

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Competing interests

We have no competing interests.

Supplementary Materials

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Keywords

Kin effects; Birth order; Parental investment; Sibling difference; Child mortality; East Asia

That parents, especially mothers, are important for infant and child survival is a truism for humans and indeed almost all mammals (Clutton-Brock, 1991; Sear & Coall, 2011; Sear & Mace, 2008). According to classical kin selection theory (Hamilton, 1964a, 1964b), other things being equal, such universal maternal effect should be similar between siblings.

Differential parental investment, however, is evident in many species. According to Trivers (1972), any parent investment in an offspring increases his/her chances of survival and reproductive success at the expense of the parent's ability to invest in other offspring. From an evolutionary point of view, natural selection would have favored specific parental behavioral strategies aimed at increasing fitness by investing more in those children with greater reproductive value (Geary & Flinn, 2001). In other words, differential parental investment may be a product of natural selection, which favors those better able to take advantage of the differential chances of survival and reproductive success of offspring (Clarke & Low, 2001; Clutton-Brock, 1991; Daly & Wilson, 1995; Trivers, 1972, 1974).

Parental favoritism would then be based on an evolutionary mechanism making parents able to judge the reproductive value of each of their offspring and invest in proportion to their expected fitness. Put it differently, "selection will favor the evolution of mechanisms in parents that favor offspring who are likely to provide a higher reproductive return on the investment" (Buss, 2015, 198). Many are the variables and the factors that could play a role in the parental evaluation of the reproductive value, such as offspring sex and age, child health status and individual characteristics of offspring phenotypic quality (with particular attention to congenital disability), parental age, and, obviously, available resources (Clutton-Brock, 1991; Daly & Wilson, 1995; Hertwig, Davis, & Sulloway, 2002; Trivers, 1974; Trivers & Willard, 1973).

Multiple studies of human populations document that the mechanisms of such differential parental investment can be quite complex, resulting in child survival differentials that vary greatly between regions, periods, and sub-populations (Hrdy, 1987). Differential parental investment according to offspring sex, exemplified by the Trivers–Willard hypothesis (Trivers & Willard, 1973), is probably the best known example (Boesch, 1997; Bradbury & Blakey, 1998; Cameron & Linklater, 2000; Clutton-Brock & Albon, 1982; Isaac, Krockenberger, & Johnson, 2005; Ligon & Hill, 2010; Svensson & Nilsson, 1996). While such phenomena are atypical for contemporary human European (Kolk & Schnettler, 2016) and North American (Freese & Powell, 1999; Gaulin & Robbins, 1991) populations, there are now a number of well documented cases of explicit sex-selective infanticide, neglect, abuse, and abortion, as well as overwhelming aggregate evidence of highly skewed infant and child sex ratios, for many developing and historical human populations, especially from Africa and Asia (Cronk, 2007; Drixler, 2013; Fujita et al., 2012; Guggenheim, Davis, & Figueredo, 2007; Hrdy, 1987; Lee & Wang, 2001). Much of this literature focuses on sex ratio differences at birth or among infants and children, and suggests that, in contrast to the expectation of relatively equal sex ratio (Fisher, 1930), sex, parity, and sex composition and even sequence of surviving children can bias parental investment (Choe, Hao, & Wang, 1995; Daly & Wilson, 1984; Lee, Wang, & Campbell, 1994; Park & Cho, 1995; Tsuya & Kurosu, 2010; Zeng et al., 1993). Direct comparisons with individual-level longitudinal data on neonatal and perinatal mortality differences further reveal that, such differentials are not only subject to characteristics of offspring, but also shaped by parental and household circumstances (Bengtsson, Campbell, & Lee, 2004; Tsuya, Wang, Alter, & Lee, 2010). And such parental preferences, whether in East and South Asia or elsewhere, are embedded in local cultural and social context (Drixler, 2013; Hrdy, 1999; Lee & Wang, 2001; Muhuri & Preston, 1991).

Along with sex, age is the other individual characteristic often evaluated by parents in order to determine offspring contribution to parental fitness. The offspring reproductive value, in fact, increases with age at least until puberty, which makes older offspring much more valued than younger ones by parents. Offspring age is then by definition strictly associated with birth order, which is another way to look at the temporal sequence of offspring. A growing literature emphasizes the potential role of birth order in shaping sibling differentials in survival and reproductive success in humans and non-human primates (Barclay & Kolk, 2015; Draper & Hames, 2000; Faurie, Russell, & Lummaa, 2009; Low, 1990; Low & Clarke, 1992; Mace, 1996a, 1996b; Modin, 2002; Stanton, Lonsdorf, Pusey, Goodall, & Murray, 2009) Compared with later-borns, first-borns survive longer and develop further with less uncertain early defects, reach reproductive maturity earlier, and benefit more from the generational overlap with parents and other older kin for support and care (Daly & Wilson, 1995; Hrdy & Judge, 1993; Jeon, 2008; Stanton et al., 2009; Trivers, 1974). In addition, in societies practicing primogeniture or partible inheritance, to recognize the heir with concomitant early biased parental investment helps to avoid domestic social tension as well as to prepare children for their adult roles (Hrdy & Judge, 1993).

Unequal parental investment however may increase and trigger competitive and rivalry behaviors among offspring as well as parent-offspring conflicts (Daly & Wilson, 1990; Mock & Parker, 1997; Sulloway, 1997). Although parents could be pressed to reduce such conflictual family dynamics by operating an equal distribution of resources among offspring, Hertwig et al. (2002) have demonstrated that an unequal cumulative distribution of parental investment among siblings may occur even in spite of equal parental allocation at each time point.

The intensity of such conflicts among siblings, competing for limited family resources, both material and affective, has been usually claimed to depend on sibship size and offspring composition, especially by gender. According to the resource dilution hypothesis, the larger the sibship size, "the more the resources are divided and hence, the lower the quality of the output" (Blake, 1981, 421). Compared to siblings from smaller families, many studies have in fact proved that offspring from large families have lower educational attainment (Conley & Glauber, 2006; Hauser & Sewell, 1986; Hill & O'Neill, 1994), lower height (Oberg, 2015) and less chances to achieve higher social status (Davis, 1997). Consequently, large family sizes might induce stronger competition among siblings for finite family resources. In such situation, firstborns tend to be favored over laterborns (Black, Devereux, & Salvanes, 2005), largely due to their period of undiluted parental investment (Salmon, 2003). On the other hand, lastborns and middleborns would preferentially conflict one another, with the latter destined to suffer the most for the fewest resources.

It has been suggested, especially in the field of evolutionary psychology, that offspring would therefore compete with one another “in an effort to secure physical, emotional, and intellectual resources from parents” (Sulloway, 1997, 21), setting up strategies and behaviors, when interacting with parents, so specific and peculiar as to prompt a process of niche differentiation within the family (Rhode et al., 2003; Sulloway, 1997, 2001). Eventually, the occupation of such family niches would make them possible to maximize their differences, in other words, “to make themselves unique in their parents’ eyes” (Saad, Gill, & Nataraajan, 2005).

Some authors, especially Sulloway (1997), stress specifically the role of birth order as one of the key determinants of such a niche differentiation and different sibling strategies. The idea is that birth order would be specifically associated with many important individual characteristics such as age, strength, power, and role within the family (Sulloway, 1997). In this respect, siblings would acquire different personality traits according to birth order. In particular, firstborns would be the most conservative, in the attempt to preserve their privileged status and birth prerogatives, laterborns would be more nonconforming and altruistic, whilst middleborns would be the least close to their parents as a consequence of the fact that they were the only offspring who never experienced a period of exclusive parental investment (Rhode et al., 2003; Salmon & Daly, 1998). However, some factors could bias and modulate such a model of family dynamics, namely socio-economic status, sibship size, and birth interval (Emst & Angst, 1983; Sulloway, 1997).

Thus, birth order is a key factor in both parent- and sibling-driven family dynamics. Both parental investment theory and Sulloway’s theory of family niches, in fact, support the idea that offspring’s position in the time sequence of siblings would be strongly associated with resource availability, parental care, inheritance practices, and prospective reproduction. However, a question naturally follows but remains empirically unexamined: Do effects of parents, and possibly other co-resident kin, vary by birth order in shaping child survival differentials? Our premise is that, if the investment of parents, and possibly of other co-resident kin, is biased by birth order, then the influence of presence of such kin on child survival should differ by birth order. While a growing number of studies identify effects of the presence of parents and occasionally other female coresident kin on human child survival, few directly examine their possible interaction with birth order (Sear & Coall, 2011; Sear & Mace, 2008). Similarly, while there are studies of birth order differentials in early-age accidents, health and mortality (Bakketeig & Hoffman, 1979; Bijur, Golding, & Kurzon, 1988; Hobcraft, McDonald, & Rutstein, 1985; Horwitz, Morgenstern, & Berkman, 1985; Nixon & Pearn, 1978), they overlook the possibility that these effects may differ according to the presence or absence of parents and other kin. As we shall see in this article, such expected differential importance of kin presence is especially the case in East Asian societies where birth order favoritism is apparent (Feng, 1937; Hayami, 1983; Lee & Campbell, 1997; Skinner, 1992).

This paper contributes to the literature by examining whether and how birth order and the presence or absence of parents and other kin in the household interact to shape child mortality in East Asia. We do so not for one population but for three 18th–20th century East Asian populations with 172,038 annual or triennial linked observations of 69,125 boys aged 1–9. We find consistent evidence that while all three East Asian societies had strong son preference (Das Gupta et al., 2003), biased parental investment favored early over later born male siblings.

1. Data

Our study takes advantage of three datasets from historical household registers: the China Multi-Generational Panel Dataset—Liaoning (CMGPD-LN), the Colonial Taiwan Household Registration Database—Beipu, Chupei, and Ermei (CTHRD-BCE), and the Japanese *Ninbetsu-Aratame-Cho* Population Register Database—Shimomoriya and Niita (NAC-SN), described and compared in detail in Dong, Campbell, Kurosu, Yang, and Lee (2015) with geographic locations shown in Appendix Map a1. These datasets are transcribed from historical population registers from Qing China, Tokugawa Japan, and Colonial Taiwan, in total covering 2.1 million observations of 310,000 individuals. Such population registration systems were products of East Asian systems of civilian administration, taxation and military organization, and are documented in detail elsewhere (Hayami, 1979; Katz & Chiu, 2006; Lee, Campbell, & Chen, 2010). Specifically, the CMGPD-LN data are transcribed from Eight Banner household registers, compiled every three years by the Qing imperial household agency to record individual demographic and socio-economic events for a population of 260,000 individuals residing in the Liaoning province, northeast China between 1749 and 1909. The NAC-SN data are transcribed from annual Japanese population registers that record demographic and socio-economic information for 6000 individuals in two villages, Shimomoriya and Niita, in contemporary Fukushima prefecture in northeast Japan between 1716 and 1870. The CTHRD-BCE data are transcribed from a set of household registers from three townships, Beipu, Chubei, and Emei, in north Taiwan, compiled by the Japanese colonial administration covering a total population of 45,000 individuals between 1906 and 1945. These Taiwan colonial registers, unlike Chinese and Japanese household registers, are continuous in the sense that they were updated as individual vital events and other changes occurred. To make our data and estimation comparable, we transform the CTHRD-BCE data into the NAC-SN person-year format.

All three datasets are panels that record individuals, including their vital events, longitudinally. The original data transcribed from household registers were cross-sectional, and resembled repeated censuses of the same community. To produce these panel datasets that follow individuals prospectively over time, we linked cross-sectional observations of the same individual across different registers. Our data record vital events that occurred in the intervals between registers. These intervals are one year long in the NAC-SN and CTHRD-BCE and three years long in the CMGPD-LN.

Our data are especially valuable for studies of kin effects because they not only include detailed information on kinship but also record all household members and most if not all residents in the community. All three sets of population registers record detailed relationship to the household head for each household member, which enables us to reconstruct the relationship between individuals in the household. The relatively complete parent–child linkage in all three datasets provides additional information to identify grandparents, uncles and aunts, brothers, and other kin within and even beyond the household. Moreover, because these household registers were designed to cover the whole community and updated regularly, our data provide time-varying information on presence and absence of specific kin in almost all households.

We restrict our data to observations of live male children approximately 1–9 years old (see Appendix Note a1 for specific age coding definitions) who are also observed in the next register. We exclude the first year of life because of poor recording in these registers of infants who died early, in particular of females who died by infanticide. Since our Chinese registers – the majority of our East Asian data – record boys much better than girls (Dong et al., 2015; Lee et al., 2010), we have no choice but to focus on male children. In any case, given the patriarchal and highly hierarchical nature of these East Asian societies, there are stronger reasons to expect birth order differences in treatment by parents and other kin for boys than for girls (Das Gupta et al., 2003; Feng, 1937; Hayami, 1983; Lee & Campbell, 1997; Skinner, 1992). Moreover, while we restrict our study to male children aged 1–9 because we assume kin effects are most pronounced when children are young and dependent on adult care and supervision, according to our own examinations as well as previous studies (Bengtsson et al., 2004), such effects may also hold for even older male children.

Our study samples include 172,038 observations of 69,125 boys age 1–9, including 4758 death records that have an immediate preceding observation 1 or 3 years earlier: 86,924 triennial observations of 56,065 boys including 3837 deaths from the CMGPD-LN, 75,796 annual observations of 11,615 boys including 635 deaths from the CTHRD-BCE, and 9318 annual observations of 1445 boys including 286 deaths from the NAC-SN (see Appendix Table a1 for descriptive statistics).

2. Methods

Like other mortality studies based on these East Asian historical population registration data (Bengtsson et al., 2004; Campbell & Lee, 1996, 2009; Dong & Lee, 2014; Tsuya & Kurosu, 2002), we apply discrete-time event-history analysis via logistic regressions (Allison, 1984). This approach is more appropriate than continuous-time techniques such as proportional hazard models for our data that only specify that an event occurred during a fixed time interval, but do not specify the date of the event. Because there may exist unknown correlations in mortality risks for children who live together, we adjust for clustered standard errors at the household level. The within-family comparison approach is an alternative way to take account of unobserved heterogeneity between families often by controlling for the fixed effect at family level, which has become popular in recent analysis of birth order differentials in mortality (e.g. Barclay & Kolk, 2015). However, because the absence of either or both parents is uncommon – no more than 20 percent (see Appendix Table a1) – estimations of a within-family comparison approach in our study are based on only a limited number of families in which multiple children experience the absence of parents. The extent to which these families are different from others is unclear, and pose a potential bias for our relatively small Japanese analytical sample. As a result, while our robustness check produces very similar findings with the within-family comparison approach (see Table a5), we prefer to report the results from the discrete-time event history analysis with clustered standard error correction as our main findings.

Our outcome variable is a dummy variable indicating whether an individual died during either the next year in the NAC-SN and CTHRD-BCE data or during the next three years in the CMGPD-LN.

For parental presence, we construct a categorical variable that differentiates between both parents, only mother, only father, and none present in the household. Two dummy variables indicate the presence of paternal grandmothers and grandfathers. We focus on paternal kin because East Asian populations are predominantly partrilocal and patrilineal. As extended families are relatively common in East Asian populations (Bengtsson et al., 2004), including these measures for co-resident kin other than parents and grandparents provides us an opportunity to examine their possible effects in the household as well as possible birth order differentials in such effects. We therefore include three count variables to measure number of co-resident paternal aunts, uncles and their wives. Especially, we distinguish the two types of aunts – father's sisters and uncles' wives – to examine whether genetic relatedness conditions the effects of aunts. We include birth order among male siblings as a continuous variable. To avoid the outlier effect of extremely high birth orders, we code 6th and later births as 6.

We also include a selection of controls for possible confounding factors in our analysis of child mortality. Following previous studies (Bengtsson et al., 2004; Campbell & Lee, 2009; Dong & Lee, 2014), our estimation includes two dummy variables to control for differential mortality consequences for children born to young (before age 20) and old (after age 36) mothers, and another dummy variable to control for whether preceding birth interval of the indexed individual is less or equal to 2 years. Other control variables are number of co-resident brothers aged 0–9 as a measure of sibling competition, household size, 10-year period fixed effects, and regional fixed effects to account for spatial mortality differences.

Our analysis follows two steps. We first estimate the overall effects of specific kin presence on boy's probability of dying in next 1 or 3 years. We then examine whether there are interaction effects between birth order and the presence or absence of parents and such other female relatives as paternal grandmothers, father's sisters, and uncle's wives.

3. Results

3.1. Effects of kin presence in the household

As in most other populations (Sear & Coall, 2011; Sear & Mace, 2008), parents are so important to the survival of children in our study populations that child mortality could increase substantially when they are absent. In the CMGPD-LN, as reported in Table 1 (see Appendix Table a2 for complete estimated results), the odds of dying in the next 3 years for those children whose parents are both absent are 40.4% more than those living with both parents. In the NAC-SN, in terms of the odds of dying in next year, the estimated increase in mortality risks due to the absence of both parents is 76.6%. In the CTHRD-BCE, although not statistically significant (p = 0.167), the direction and magnitude of such effect appear to be similar with the other two populations. In addition, absence of mother in the CMGPD-LN and of father in CTHRD-BCE is also associated with increased child morality risks. And since parental survival and parental presence for young children are very similar, our alternative measure – parental survival status – confirm such observed patterns (Appendix Table a3).

By contrast, in line with the existing understanding on our or similar East Asian historical populations (Bengtsson et al., 2004; Jamison, Cornell, Jamison, & Nakazato, 2002), living with other kin has no consistent, if any, effects on male child mortality. Not only there is no evidence that living with grandmother reduces child mortality, as reported elsewhere (Bengtsson et al., 2004), living with grandfather actually increases child mortality risks in the CMGPD-LN. Also in the CMGPD-LN, co-resident father's sisters, the genetically related aunts, have a positive effect on child mortality risks, while in the CTHRD-BCE co-resident uncles' wives, the non-genetically related aunts, have a negative effect. And, in both the CMGPD-LN and CTHRD-BCE, co-resident uncles have a negative impact on child survival. These effects of co-resident kin other than parents may reflect the domestic interaction and resource competition within Chinese extended families. In the NAC-SN, where household size is smaller and co-residence is less common than the other two Chinese populations, we find null effects of either aunts or uncles.

In all three populations, birth order by itself makes little difference in male child mortality.

3.2. Interaction effects of kin presence and birth order

Living with parents, especially the mother, improves the survival of early-born children more than later-borns in all three populations. Based on our estimations that have the same model specifications as those reported in Table 1 but further introduce interaction terms between parental presence and child's birth order (see Appendix Table a4 for complete results), with those living with both parents as the reference group, Fig. 1 reports the average marginal effects of the absence of father, mother, or both parents along with the increase of birth order. While absent fathers make little difference, there are birth order differentials in the effects of absent mothers or both parents on probability of dying in next 1 or 3 years: the resulting negative impact on child survival clearly decreases when birth order increases. Early-borns, especially first-borns, experience increased mortality risks when mother is absent in the CMGPD-LN and CTHRD-BCE and when both parents are absent in all three populations. However, mortality increase due to the absence of mother or both parents decreases for later-borns. For some children of high birth order (5 or above), it may even become beneficial, probably a result of having elder siblings as alternative care givers (Sear & Mace, 2008). In other words, while, as suggested in Table 1, parental presence has similar yet inconsistent effects on child mortality and birth order itself has no effect, the interaction of the two modulates child mortality consistently in all our study populations to reduce the mortality of early born versus later born children so long as both parents, or only mothers, are present.

Estimations including parental survival status as the alternative measure, as shown in Fig. 2, also confirm these findings. This also suggests that for young children in these study populations, parental presence or absence is largely due to the survival status of their parents.

Across all three populations, there is no evidence of consistent differences by birth order in the effects of grandmother, father's sisters, or uncles' wives. Grandmothers in the NAC-SN are the only kind of female relatives of which the effect of presence varies by children's birth order. Although not reported with details here, such grandmother effect is in the same direction as the observed parental differential effects (Fig. 1). The finding of no birth order interaction effects of female relatives in general is however not surprising given that in earlier analysis we also found no overall effects for the presence of those female relatives on child mortality.

Several checks confirm that our estimated results are not sensitive to alternative model specifications or additional possibly confounding factors, and suggest that the influence of such birth order differentials in parental investment is likely to occur early (Appendix Tables a5–a10). Models controlling for the fixed effects of father – the within-family comparison approach – confirm our main findings (Table a5). So do models replacing the 10-year period fixed effects with yearly/5-year period fixed effects or linear year effect (Table a6). In addition to our controls for the number of co-resident brothers of similar ages and household size in the main analysis, we further assure that our findings are not just a product of the selection effect that high birth order children could be different from others because they only come from large households. Neither relaxing the linear assumption nor altering the scale of the birth order measure (Table a7) nor further taking account of female siblings (Table a8) confound our findings. Where household socio-economic information is available, as in the CMGPD-LN and NAC-SN, we find that the observed patterns are also independent of socio-economic status (Table a9). Last but not the least, a comparison between the time-invariant birth order measure in our main analysis and a time-variant measure of seniority among living brothers suggests that parental differential investment occurs at early ages. First-borns' birth order and seniority are the same as long as they are alive. But later-borns can achieve greater seniority than their born birth order upon the death of older brothers. In other words, the difference between our birth order measure and seniority measure concentrates to later-borns, especially at their later childhood. We find that the observed differentials in parental effects are less apparent by seniority than by birth order. It implies the important consequences of preferential treatment to children in early childhood in the sense that biased parental investment later shifted to those senior yet later-born children may not benefit them as much as first-borns (Table a10).

4. Discussion

Based on comparable estimations of three individual-level panel datasets from northeast China, northeast Japan and north Taiwan between 1716 and 1945, our analysis confirms the overall importance of co-resident kin in influencing child survival in historical East Asia. In all three populations parents have consistent and substantial effects in reducing male child mortality. Effects of co-resident paternal grandparents, uncles and aunts, however, are negligible or specific to one population or another but not common across all three populations.

More importantly, the importance of parents to male child survival differs by birth order, suggesting a likely bias in parental investment. In the absence of parents, mortality increases substantially among first-borns but less so among later-borns. Thanks to newly constructed “big” historical population panel data, we find that this pattern of birth order differentials in response to parental presence is not only robust to several possibly confounding factors and mechanisms, but also prevalent and consistent in all three East Asian populations for as long as two centuries.

Unfortunately, since we focus exclusively on male children due to their better complete recording especially in the CMGPD-LN, we cannot study in this paper the degree to which such biased parental investment is also reflected in sex-selective mortality and in infant mortality. Due to the incomplete recording of births and infant mortality as well as infanticide, we are unable to confirm if birth order differentials in parental investment on infants are similar or even stronger compared with what we find among young children. Moreover, our observational data do not allow us to distinguish whether such biased parental investment is an unintended consequence or a “conscious” choice of parents.

That being said, both evolutionary/biological and cultural/social mechanisms may co-exist in shaping what we have observed in this study. Many studies, especially from historical demography and economic history (e.g. Bengtsson et al., 2004), often highlight the “active” agency of the parents. However, preferential treatment by birth order is also likely reinforced by “passive” mechanisms like long-lasting cultural norms and social institutions, as well as ecological context (Hrdy & Judge, 1993). In our case, the observed sibling differentials also well fit the inheritance practices of primogeniture in historical Japan as well as the partible-inheritance primogeniture-ancestor worship practices in historical China. Early-borns, especially first-borns, are favored by lineage rules and receive either the whole or sometimes a larger share of inheritance since they alone host the ancestor worship ceremony and head the extended family (Feng, 1937; Hayami, 1983; Shiga, 1978). In that regard, our findings from populations in the past also have important implications for our understanding of the saliency of such social preferences in East Asia today (Das Gupta et al., 2003; Skinner, 1992).

With changing mores and declining fertility, parental preferences and investment in children have changed significantly in the last century. Emerging techniques in contraception, gender detection, and induced abortion have also shifted the timing for parental preferential investment from post-natal to pre-natal (Lycett & Dunbar, 1999). Nevertheless, we can still observe increasingly skewed sex ratios at birth in China (Coale & Banister, 1994; Hesketh, Li, & Zhu, 2005; Zeng et al., 1993), Japan (Imaizumi & Murata, 1981), and Taiwan (Freedman, Chang, & Sun, 1994), particularly by parity (Coale & Banister, 1994; Freedman et al., 1994; Hesketh et al., 2005; Zeng et al., 1993). Understanding past parental agency and behavior therefore not only reinforces our appreciation of how the presence or absence of parents and grandparents can continue to influence child survivorship, but also informs and illuminates our understanding of why contemporary family planning and family care policies and behavior vary greatly across the world. The possible connection between this history of detailed parental control and the sustained success of China's and Taiwan's family planning policies over the last half-century as well as the even earlier Japanese fertility decline remains speculative but noteworthy. In that regard, present-day human preferential investment in children may seem to differ from the past, but is really far more similar than apparent.

Data accessibility

The CMGPD-LN is available for download via the ICPSR website (http://www.icpsr.umich.edu/icpsrweb/ICPSR/series/265). The CTHRD is available via application and approval by the Program for Historical Demography, Academia Sinica (http://www.demography.sinica.edu.tw/EN/en_achievement_b.htm). The NAC-SN is available via application and approval by the Population and Family History Project at Reitaku University (http://www.fl.reitaku-u.ac.jp/pfhp/index-e.html).

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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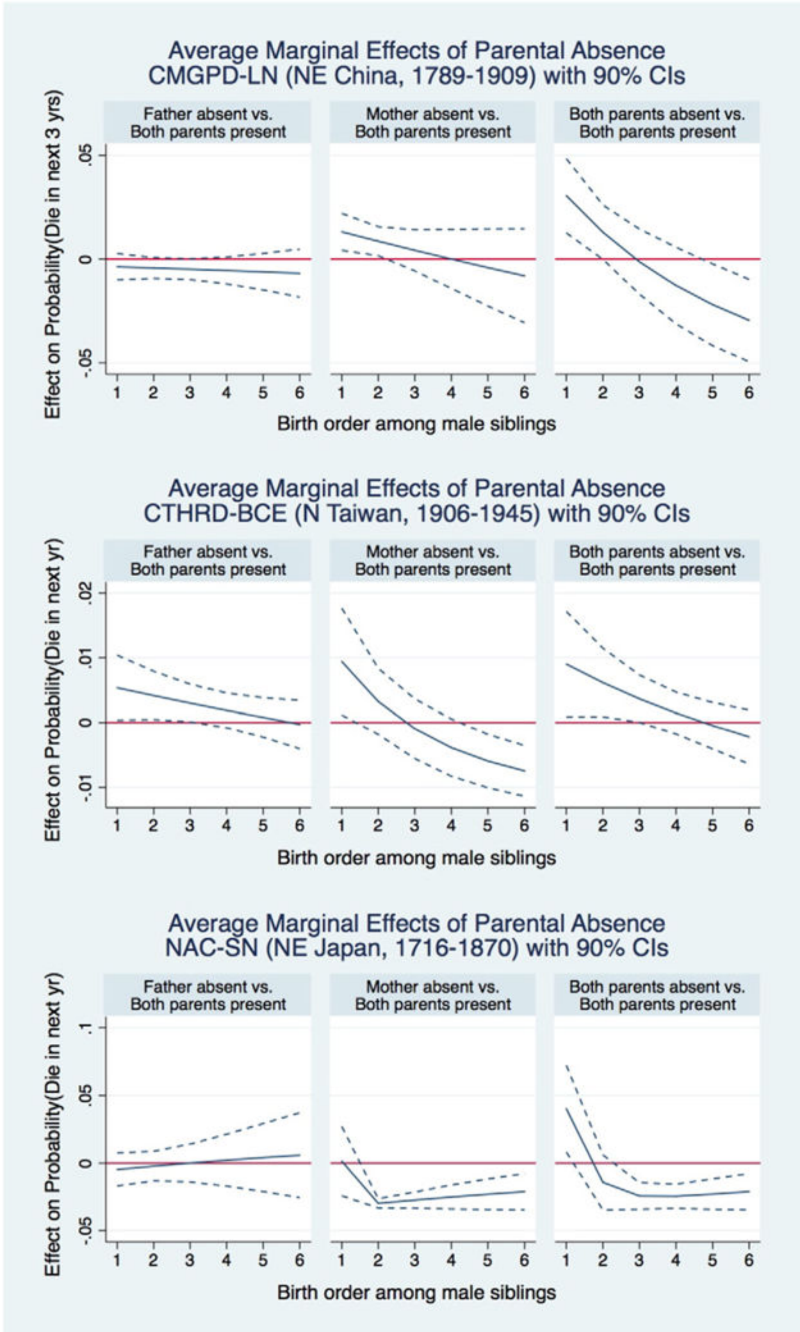

Fig. 1.

Average marginal effects of parental absence vs. presence by birth order.

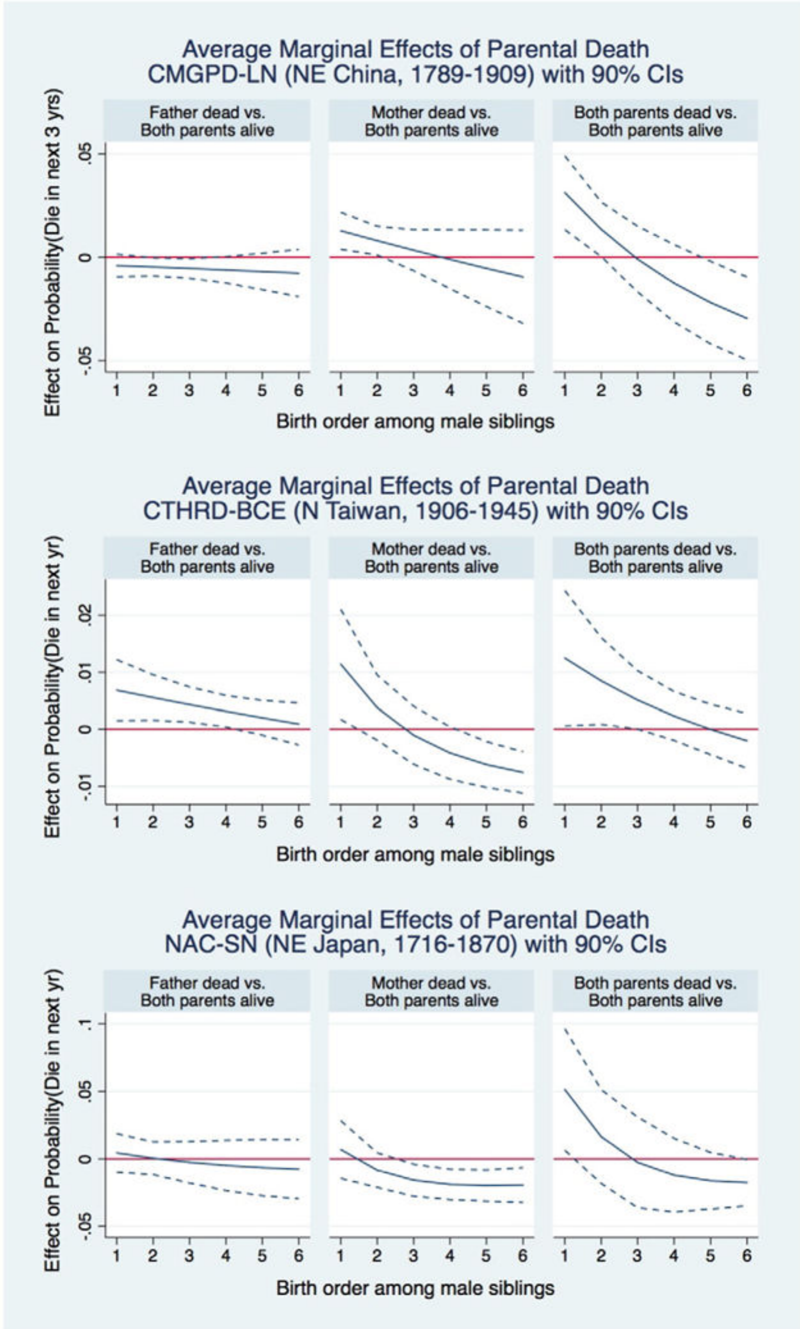

Fig. 2.

Average marginal effects of parental survival status by birth order.

Table 1

Estimated effects of kin presence/absence and birth order on male child mortality risks.

	CMGPD-LN (Northeast China)		CTHRD-BCE (North Taiwan)		NAC-SN (Northeast Japan)	
	Odds Ratio	**P-value**	**Odds Ratio**	**P-value**	**Odds Ratio**	**P-value**
Parental Presence (Ref.: Both present)						
Father absent	0.898	0.161	1.340	0.077	0.908	0.697
Mother absent	1.229	0.018	1.267	0.385	0.596	0.295
Both absent	1.404	0.020	1.313	0.167	1.766	0.054
Grandmother presence	0.957	0.256	1.000	1.000	1.030	0.826
Grandfather presence	1.081	0.049	0.890	0.324	1.075	0.615
No. of co-resident father's sisters	1.110	0.043	1.453	0.167	1.126	0.609
No. of co-resident uncles' wives	1.021	0.248	0.861	0.071	0.813	0.496
No. of co-resident uncles	1.045	0.005	1.099	0.078	1.017	0.926
No. of co-resident brothers aged 0–9	0.905	0.004	1.056	0.323	1.249	0.157
Birth order among male siblings	1.018	0.341	0.991	0.793	0.884	0.162
Other controls	Yes		Yes		Yes	
Pseudo R^2	0.077		0.049		0.075	
Log Pseudo Likelihood	−14,522.909		−3488.527		−1181.953	
Deaths	3837		635		286	
Individuals	56,065		11,615		1445	
Observations	86,924		75,796		9318	

Notes: Other controls include maternal age at birth, proceeding birth interval, age and age squared, household size, 10-year period fixed effects, regional fixed effects, and the intercept. Standard errors are adjusted for clusters of household. See electronic supplementary table a2 for the complete estimated results.