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RESEARCH ARTICLE

Two paths to smaller families: Socioeconomic and urban–rural disparities in delayed first birth in China and implications for an ageing society

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ABSTRACT China's fertility transition produced two distinct demographic pathways to smaller families: one driven by delayed childbearing, and the other by direct limits on family size. Using data from the 2011–2018 China Health and Retirement Longitudinal Study, we examine cohorts whose reproductive years unfolded under successive fertility policy regimes, from pre-policy to one-child policy periods. Kitagawa decomposition shows that delayed first births account for 22% of urban–rural differences but only 10% of educational differences in completed fertility, indicating that urban and rural populations reached similarly small families through different mechanisms. These timing patterns have enduring consequences: when today's older adults reach age 80, the children of urban and highly educated parents are 2–3 years younger than those of rural and less educated parents, with delayed first birth explaining over half of the educational gap in eldercare timing. The findings reveal a previously overlooked dimension of inequality: namely, that as China ages, differences in first birth timing have created disparities in who has children available to provide care, and when.

KEYWORDS Delayed fertility • Socioeconomic gradient • Urban–rural divide • China • Population ageing

Introduction

China has experienced one of the most rapid fertility transitions worldwide, although the pace of the transition has varied widely across socioeconomic groups and geographic regions. Beginning in the 1970s, due to a combination of socioeconomic changes and successive family planning campaigns – first the *"later, longer, fewer"* (*wan, xi, shao*) policy and later the one-child policy – the total fertility rate (TFR) in China fell from about 5.8 children per woman in 1970 to below replacement level by the mid-1990s, and decreased further to roughly 1.3 by 2020 (Feeney and Yuan, 1994; Gu et al., 2007). This sharp fertility decline compressed into decades a demographic shift that took centuries in most developed countries (Basten and Jiang, 2015; Cai, 2012). Importantly, this transition unfolded unevenly across China's social and geographic landscape: urban population adopted

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smaller families earlier and through different policy mechanisms than rural population (Li et al., 2024; Zheng, 2024). These differences are now reflected in distinct birth cohorts who reached reproductive ages before, during and after major family policy shifts, each shaped by a unique combination of policy constraints and socioeconomic opportunities. As these cohorts enter old age with record-low family sizes, understanding their demographic pathways is critical for assessing how fertility timing has structured intergenerational age gaps and the availability of eldercare.

International research has consistently documented socioeconomic gradients in fertility timing, with higher education typically being associated with greater postponement of childbearing (Beaujouan et al., 2023; Neels and De Wachter, 2010; Rendall et al., 2005; Van Bavel, 2010). In Western European contexts, the magnitude of these timing differences can be substantial: Berrington, Stone and Beaujouan (2015) found that in the UK, differences in fertility timing between educational groups accounted for approximately 57% of the observed gap in family size between the highest and lowest educational groups for women born between 1960–69. This pattern reflects how socioeconomic fertility differentials are typically maintained through delayed childbearing in contexts characterised by voluntary fertility decline, where higher educated women tend to postpone their first birth to pursue education and career opportunities.

In China, education is consistently associated with later childbearing and smaller families (Niu and Qi, 2020; Zhang and Zhao, 2023; Zhao and Zhang, 2018), yet few studies have quantified how much delayed fertility contributes to these differences across socioeconomic groups. Under the one-child policy, which imposed strict limits on family size regardless of social status, the timing of childbearing, especially of the first birth, may have been one of the few remaining channels through which socioeconomic variation in fertility could emerge. This policy environment makes it essential to determine whether differences in completed fertility reflect quantum effects, meaning variation in the total number of children, or tempo effects, meaning variation in the timing of births. While tempo effects include several dimensions such as age at first birth, birth spacing and age at last birth, our analysis focuses on first birth timing as one important component of fertility tempo. If educational disparities in China are partly explained by later entry into parenthood, as has been observed in many Western contexts, it would indicate that socioeconomic differentiation in fertility behaviour persisted despite policy constraints. Conversely, if first birth timing explains little of these educational disparities, it would suggest that fertility differentials during China's partially non-voluntary transition operated through mechanisms other than tempo, unlike the voluntary postponement patterns typical of Western Europe.

Beyond educational disparities, China's pronounced urban–rural divide constitutes another key but understudied dimension of fertility stratification. In contrast to the relatively fluid urban–rural continuum observed in Western societies, China's household registration (*hukou*) system established a rigid institutional boundary between urban and rural populations, producing distinct fertility policies (Feeney and Feng, 1993; Feeney and Yuan, 1994), mortality patterns (Zeng et al., 2001, 2002; Zhao et al., 2014) and migration constraints (Chan and Zhang, 1999; Wu and Treiman, 2004) in urban and rural areas. These institutional divisions shaped contrasting opportunity structures and fertility behaviours. Urban women faced expanding educational and career prospects that raised the opportunity costs

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of early childbearing, while rising housing costs and competitive labour markets made postponement economically rational for them (Fang et al., 2013). In rural areas, by contrast, agricultural livelihoods imposed fewer career penalties on early motherhood, and extended family networks often supported larger families that reduced individual economic strain.

As Greenhalgh (2008) notes, China's fertility policies were explicitly differentiated by rural and urban residence: urban residents were typically restricted to having one child, whereas many rural families were permitted to have 1.5 or two children. This policy distinction, combined with contrasting socioeconomic incentives, produced divergent pathways to smaller families. Fertility decline in urban areas was driven largely by postponement strategies shaped by higher opportunity costs, while fertility decline in rural areas mainly occurred through earlier stopping behaviour in response to direct policy constraints. Empirical evidence suggests that these mechanisms operated in parallel. Li and Liang (1993) show that urban fertility fell from 3.7 to 1.8 during the 1970s as a result of fewer births and notably longer birth intervals, whereas rural fertility declined from 5.6 to 2.0 during the 1980s-1990s primarily because couples stopped childbearing earlier, with little change in spacing. While these patterns suggest that fertility timing played a different role in the fertility transition in urban and rural areas, existing research has not systematically quantified these contributions. Accordingly, our first research question is as follows: To what extent have differences in first birth timing contributed to educational and urban–rural disparities in family size across birth cohorts who experienced the fertility transition?

While numerous studies have documented China's fertility decline and its policy and socioeconomic determinants (Guo et al., 2019; Lavely and Freedman, 1990; Niu and Qi, 2020; Piotrowski and Tong, 2016; Wang and Mason, 2008), most have focused on family size alone, while overlooking how fertility timing shapes the intergenerational structure of families. Differences in when people have children, and not just in how many children they have, can have lasting consequences for the age relationship between parents and offspring, and, in turn, for the availability of family care in later life. In China's rapidly ageing society, this timing dimension is of growing importance. Parents who delay childbearing reach advanced ages when their children are younger and potentially more capable of providing support, whereas early childbearing compresses generations and increases the likelihood that children are facing their own health or caregiving demands at the same time as their parents start to need care (Margolis and Myrskylä, 2011; Zeng and Vaupel, 2003). Together, these factors create potential mismatches between care needs and care availability that may vary considerably across socioeconomic groups depending on their typical patterns of fertility timing. Our second research question is therefore: How have educational and urban–rural patterns in first birth timing contributed to differences in intergenerational age structures across birth cohorts, and what are the implications of these differences for eldercare availability?

Our study addresses these two questions using data from the China Health and Retirement Longitudinal Study (CHARLS, 2011–2018). We analyse birth cohorts who reached reproductive ages before (cohorts born before 1940), during (cohorts born in 1940–1950 and 1950–1960) and after (cohorts born after 1960) major family planning reforms were implemented to examine how educational and urban–rural differences in delayed fertility shaped family sizes and intergenerational age structures. Using the number

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of living children as a measure of completed fertility, we apply Kitagawa decomposition to quantify how much of the socioeconomic and geographic gaps in family size and eldercare timing can be attributed to differences in first birth timing.

We focus on first birth timing because it marks the entry into parenthood and determines the age gap between parents and children, influencing when care needs and caregiving capacities align in later life. Age at first birth is also one of the most widely studied indicators of fertility tempo (Beaujouan et al., 2023; Berrington et al., 2015; Neels and De Wachter, 2010), and is a key mechanism through which education shapes fertility in voluntary contexts. Examining this measure in China allows us to assess whether similar processes operated under a policy-constrained regime. While other tempo dimensions such as birth spacing or age at last birth also matter, limited variation in higher order births among later cohorts restricts meaningful analysis.

Method

Data

We use data from the Chinese Health and Retirement Longitudinal Study (CHARLS) 2011–2018, a nationally representative survey of adults aged 45 and older in China (Zhao et al., 2014). CHARLS provides detailed retrospective information on fertility history, educational attainment and urban–rural residence for respondents born across several decades. This study focuses on participants with at least one living child, who comprised 96.4% of the original sample. After excluding 924 respondents without living children from the initial 25,586 participants, our final sample consisted of 24,662 individuals. On average, these respondents were 56.74 years of age and had 2.5 living children.

Although CHARLS is a longitudinal survey, we pool data from all available waves (2011, 2013, 2015 and 2018) to maximise coverage and minimise missing information. Fertility histories, which include information on age at first birth and number of living children, were collected retrospectively and are time-invariant once reported. Therefore, pooling observations does not duplicate individuals' fertility histories, but it does allow us to include respondents who entered in later waves or whose demographic information (e.g. education or urban–rural residence) was updated in subsequent interviews.

The sample covers multiple birth cohorts who experienced different socioeconomic and policy contexts during their reproductive years: pre-1940 (N = 2678), 1940–1950 (N = 4864), 1950–1960 (N = 7286) and post-1960 (N = 8291). The pre-1940 cohort reached reproductive ages during the 1950s-1960s, largely before the introduction of systematic fertility policy interventions, and thus experienced relatively unrestricted fertility under traditional demographic regimes. The 1940–1950 cohort experienced their peak reproductive years (1960s–1980s) during the initial implementation of the "later, longer, fewer" campaigns of the 1970s that promoted delayed marriage, longer birth intervals and smaller families. The 1950–1960 cohort lived through their reproductive years (1970s–1990s) during the implementation and early years of China's one-child policy beginning in 1979. The post-1960 cohort experienced their reproductive years (1980s–2000s) during the policy

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window characterised by established enforcement mechanisms and differentiated urban–rural implementation. This cohort variation allows us to examine how fertility timing patterns varied across different policy contexts, and to assess whether different socioeconomic groups exhibited similar or divergent demographic patterns as policy environments evolved throughout China's fertility transition.

Measuring first birth timing

Researchers have employed various approaches to measuring first birth timing and delayed childbearing, each of which has distinct advantages and limitations in different research contexts. The most prevalent approach involves making simple temporal comparisons of mean ages at first birth across cohorts or time periods (Beaujouan et al., 2023; Beck et al., 2024; Kohler et al., 2002), which effectively captures broad trends of fertility postponement, but does not distinguish timing variations within birth cohorts. Meanwhile, many studies treat age at first birth as a continuous variable without establishing explicit definitions of "delayed" fertility (Giuntella et al., 2022; Goisis and Sigle-Rushton, 2014; Tropf and Mandemakers, 2017), limiting their ability to categorise individuals or examine timing effects systematically. Some researchers have used fixed thresholds, such as distinguishing between younger and older mothers using the 27th birthday as a cutoff (Frejka and Sardon, 2006), though this approach may not account for changing fertility norms. In contexts where fertility patterns shift across cohorts, relative measures that adjust for cohort-specific norms may provide more meaningful distinctions between early and delayed childbearing, allowing researchers to identify individuals who postpone fertility relative to their contemporaries, rather than relying on a single pre-determined age cut point.

We adopt a relative approach that accommodates changing fertility norms across China's rapid demographic transition. We operationalise delayed first birth in two complementary ways: *standard delayed first birth* (first birth exceeding the cohort-specific mean age) and *very delayed first birth* (first birth exceeding the cohort-specific mean plus one standard deviation). This measurement approach acknowledges the significant cohort changes in fertility norms throughout China's transition, with a "delayed" birth in the 1940s differing substantially from one in the 1980s, while using cohort-specific thresholds accounts for period-specific social and economic conditions influencing typical childbearing patterns.

Other measures

Family size is measured using the self-reported number of living children for each respondent, which captures completed fertility for our sample of adults aged 45 and older. Educational attainment is categorised into three levels: low education (no formal education to elementary school), middle education (middle school only) and higher education (high school, vocational school and college or above).

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Urban–rural residence is coded as a binary indicator based on respondents' current place of residence and administrative *hukou* status as recorded in the survey. This measure reflects respondents' residential and registration status at the time of the interview, rather than during their childbearing years. Although this approach is standard in studies using CHARLS, it may not fully capture the historical residence of individuals who migrated after completing fertility. However, because most cohorts in our analysis (born before 1960) completed childbearing prior to the large-scale urban–rural migration that accelerated in the 1990s (Chan and Zhang, 1999; Wu and Treiman, 2004), potential misclassification bias is likely minimal.

Eldercare metrics

To directly connect our analysis of delayed first birth patterns to the implications for eldercare, we have developed metrics that potentially capture different dimensions of intergenerational support structures. These metrics translate fertility timing differences into practical measures of eldercare availability and implications of potential strain on family support systems.

Our primary measure, Child's Age When Parent Reaches 80, is calculated as:

$$\text{Child's Age When Parent Reaches } 80 = 80 - \text{Mother/Father's Age at First Birth} \quad (1)$$

This metric represents the age of the eldest child when the mother reaches age 80, an important threshold when intensive care needs often emerge. Lower values indicate that the children will be younger and potentially more capable of providing intensive care when their parents reach advanced ages.

Building on this measure, we have developed three additional metrics to capture different aspects of intergenerational support dynamics: *Potential Caregiving Years* (measuring pre-retirement years available for caregiving), *Care Overlap Index* (measuring potentially problematic competing demands) and *Care Timing Quality Index* (assessing optimal timing for caregiving capacity). Detailed formulas for these supplementary metrics are included in Appendix A. We compare these metrics across educational levels (low, middle and high) and urban–rural residence to assess how socioeconomic status shapes not just family size, but also the timing of eldercare needs relative to the adult children's life course stages.

We employ Kitagawa decomposition to quantify how much of the family size differences between socioeconomic groups (educational levels or urban–rural status) are attributable to differences in first birth timing versus differences in family size within fertility timing groups. For each cohort, the decomposition partitions the family size difference between two groups (e.g. higher vs lower education) into two components. The composition effect captures the portion attributable to differences in the distribution of first birth timing differences between groups, indicating how much of the family size gap would change if both groups had the same timing-specific family sizes but differed in the timing of first births. The rate effect captures the portion attributable to differences in completed family sizes within fertility timing groups, indicating how much of the gap would remain if both groups had the same first birth timing distribution but differed in family size conditional on timing.

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This approach allows us to isolate the contribution of first birth timing differences to overall socioeconomic disparities in family size.

Formally, for educational differences, the decomposition is:

$$\text{Difference} = \sum_i [(r_{1i} - r_{2i})(c_{1i} + c_{2i})/2] + \sum_i (c_{1i} - c_{2i})(r_{1i} + r_{2i})/2] \quad (2)$$

where r represents rates (family sizes), c represents compositions (proportions of delayed/non-delayed fertility) and i represents categories (delayed vs non-delayed fertility). The first two terms represent the rate effect, and the latter represents the composition effect. The same approach is applied to decompose urban–rural differences.

We perform this decomposition separately for each birth cohort to examine how the contribution of first birth timing differences to socioeconomic differences in family size has evolved across different periods. Additionally, we compare results using both standard and very delayed fertility measures to distinguish between moderate and extreme fertility postponement. All analyses are conducted using Stata 16SE. Survey weights are used.

Results

Educational and urban–rural gradients in first birth timing and family size

Socioeconomic gradients in first birth timing existed throughout China's fertility transition, though they emerged differently for educational than for urban–rural stratification. Table 1 shows a persistent and strong educational gradient in first birth timing. Among the pre-1940s cohort, those with higher education were substantially more likely to delay their first birth, with a gap of 39.3 percentage points between the lowest and highest education groups (40.7% vs 80%). This gap widened to 46.7 percentage points for the 1940–1950 cohort (39% vs 85.7%) before stabilising at around 50.6 percentage points for more recent cohorts. This gradient persisted throughout China's fertility transition, with higher education being consistently and strongly associated with delayed childbearing across all cohorts.

The contrast is particularly evident for very delayed first births (first births more than one standard deviation above the mean age). Among the post-1960 cohort, 39.2% of adults with the highest educational level, compared to just 10.3% of those with the lowest educational level, experienced a very delayed first birth – a gap that has increased by approximately 60% since the pre-1940 cohort.

Unlike the educational gradient, which was strong even in the earliest cohort, urban–rural differences in first birth timing emerged gradually over cohorts. Table 1 reveals that among the pre-1940s cohort, there were minimal urban–rural differences in the share with a delayed first birth (46.9% vs 43.5%, a gap of only 3.4 percentage points). However, this gap widened to 15.0 percentage points for the 1950–1960s cohort (60.7% vs 45.7%) and remained substantial, at 14.3 percentage points, for the post-1960s cohort (58.7% vs 44.4%). This growing urban–rural divide reflects the increasingly differential experience of the demographic transition in China's urban versus rural areas, which is a product of

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Table 1. First birth timing and socioeconomic patterns by birth cohort in China

	Cohort				
	Pre-1940	**1940–1950**	**1950–1960**	**Post-1960**	**Total**
Characteristics					
Fertility timing					
Mean age at first birth (SD)	25.74 (6.27)	24.68 (4.70)	24.91 (3.86)	23.86 (3.35)	24.59 (4.28)
% with delayed first birth	45.00%	45.70%	52.40%	50.80%	49.20%
% with very delayed first birth	14.70%	13.90%	14.90%	14.80%	14.60%
By educational level					
% with delayed first birth					
No formal education	40.70%	39.00%	35.70%	35.80%	37.2%
Elementary or less	47.1%†	43.4%†	52.0%†	47.1%†	47.4%
Middle school	46.00%	52.20%	61.40%	50.80%	54.3%
High/vocational school	60.4%†	67.9%†	65.7%†	65.5%†	65.6%
College or above	80.0%†	85.7%†	89.4%†	86.4%†	86.2%
% with very delayed first birth					
No formal education	14.20%	13.90%	9.20%	10.30%	11.3%
Elementary or less	14.4%†	12.3%†	15.5%†	14.1%†	14.1%
Middle school	17.60%	15.40%	17.70%	11.50%	14.4%
High/vocational school	12.3%†	16.6%†	18.0%†	20.8%†	18.4%
College or above	32.0%†	31.6%†	39.0%†	39.2%†	36.9%
By urban–rural residence					
% with delayed first birth					
Urban	46.90%	53.30%	60.70%	58.70%	56.5%
Rural	43.50%	40.30%	45.70%	44.40%	43.6%
Urban–rural gap	3.4	13	15	14.3	12.9%
% with very delayed first birth					
Urban	16.50%	15.50%	17.90%	19.20%	17.8%
Rural	13.20%	12.70%	12.60%	11.20%	12.1%
Urban–rural gap	3.3	2.8	5.3	8	5.7%
Sample size	2678	4864	7286	8291	23119

Note. Standard deviations are shown in parentheses for the mean age at first birth. Delayed first birth is defined as first birth occurring after the cohort-specific mean age at first birth. Very delayed first birth is defined as first birth occurring more than one standard deviation after the cohort-specific mean age. † indicates categories that combine multiple education groups for simplicity.

uneven policy implementation, expanding urban educational and employment opportunities and rapidly changing urban norms regarding family formation.

Despite differences in fertility timing patterns, all population segments experienced substantial fertility declines and convergence towards smaller family sizes across cohorts.

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Table 2. Family size across birth cohorts and socioeconomic groups in China

	Cohort				
	Pre-1940	**1940–1950**	**1950–1960**	**Post-1960**	**Total**
Panel A: Overall family size					
Mean number of children (SD)	4.12 (2.31)	3.45 (1.87)	2.89 (1.52)	2.18 (1.24)	2.85 (1.68)
Panel B: Family size by educational level					
No formal education	4.35 (2.41)	3.78 (1.98)	3.21 (1.67)	2.68 (1.45)	3.42 (2.01)
Elementary or less	4.08 (2.28)	3.42 (1.85)	2.87 (1.51)	2.16 (1.22)	2.81 (1.66)
Middle school	3.87 (2.15)	3.19 (1.72)	2.75 (1.43)	2.08 (1.19)	2.58 (1.52)
High/vocational school	3.54 (1.98)	2.85 (1.54)	2.51 (1.32)	1.95 (1.08)	2.35 (1.38)
College or above	3.12 (1.76)	2.47 (1.31)	2.18 (1.15)	1.68 (0.94)	2.02 (1.21)
Educational gap (high-low)	−1.23***	−1.31***	−1.03***	−1.00***	−1.40***
Panel C: Family size by urban–rural residence					
Urban	3.78 (2.08)	3.12 (1.65)	2.58 (1.31)	2.01 (1.12)	2.54 (1.48)
Rural	4.38 (2.43)	3.67 (1.96)	3.10 (1.63)	2.42 (1.35)	3.14 (1.82)
Urban–rural gap	−0.60***	−0.55***	−0.52***	−0.41***	−0.60***
N	2678	4864	7286	8291	23119

Note. Standard deviations shown in parentheses. Educational gap represents the difference in the mean family size between the college educated and no formal education groups. Urban–rural gap represents the difference in the mean family size between urban and rural residents. Negative values indicate that the first group (urban/higher educated) has smaller family sizes than the comparison group (rural/lower educated). ***$p < 0.001$ for *t*-tests comparing the mean family size between educational groups (high vs low education) or between urban and rural residents within each cohort.

Table 2 documents this universal decline, with the mean family size decreasing from 4.12 children among the pre-1940 cohort to 2.18 children among the post-1960 cohort (Panel A). This decline occurred across all socioeconomic groups. Panel B shows that even among the highest fertility group (those with no formal education), the average family size declined from 4.35 to 2.68 children, while among the lowest fertility group (college educated), it declined from 3.12 to 1.68 children. Similarly, Panel C shows that both urban and rural populations experienced substantial reductions in family size, with the average family size of urban families decreasing from 3.78 to 2.01 children and that of rural families declining from 4.38 to 2.42 children across cohorts. This convergence towards smaller family sizes occurred despite persistent socioeconomic differences in absolute levels. The educational gap between the highest and lowest educated groups remained relatively stable (ranging from −1.00 to −1.31 children), while the urban–rural gap narrowed from −0.60 to −0.41 children.

Decomposition of socioeconomic differences in family size

This convergence towards similar family sizes despite divergent timing patterns raises a critical question: How much of the remaining socioeconomic differences in family size

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Table 3. Decomposition of difference in family size gap by cohort

Cohort	Total difference	Composition effect	Rate effect	% due to composition	% due to rate
Panel A: Urban–rural differences in family size					
Standard delayed first birth					
Pre–1940	−0.601	−0.04	−0.561	6.60%	93.40%
1940–1950	−0.545	−0.122	−0.423	22.30%	77.70%
1950–1960	−0.512	−0.087	−0.426	16.90%	83.10%
Post–1960	−0.409	−0.053	−0.356	13.00%	87.00%
Very delayed first birth					
Pre–1940	−0.601	−0.044	−0.557	7.30%	92.70%
1940–1950	−0.545	−0.027	−0.518	4.90%	95.10%
1950–1960	−0.512	−0.027	−0.486	5.20%	94.80%
Post–1960	−0.409	−0.031	−0.379	7.50%	92.50%
Panel B: Educational differences in family size (high vs low)					
Standard delayed first birth					
Pre–1940	−0.981	−0.034	−0.947	3.40%	96.60%
1940–1950	−0.738	−0.071	−0.667	9.60%	90.40%
1950–1960	−0.564	−0.033	−0.53	5.90%	94.10%
Post–1960	−0.498	−0.041	−0.458	8.20%	91.80%
Very delayed first birth					
Pre–1940	−0.981	−0.034	−0.947	3.40%	96.60%
1940–1950	−0.738	−0.071	−0.667	9.60%	90.40%
1950–1960	−0.564	−0.033	−0.53	5.90%	94.10%
Post–1960	−0.498	−0.041	−0.458	8.20%	91.80%

Note: This table presents the Kitagawa decomposition of socioeconomic differences in family size across birth cohorts. Negative values for "total difference" indicate that the urban/higher educated groups have smaller family sizes than the rural/lower educated groups. The composition effect represents the portion of the total gap attributable to differences in delayed first birth prevalence, while the rate effect captures differences in family size within fertility timing groups. Standard delayed first birth is defined as first birth occurring after the cohort-specific mean age. Very delayed first birth is defined as first birth occurring more than one standard deviation after the cohort-specific mean age.

can be attributed to differences in first birth timing? We address this question through decomposition analysis. Table 3 shows how much of the family size differences between socioeconomic groups and regions can be attributed to differences in first birth timing.

Despite this strong educational gradient in first birth timing, differences in age at first birth explain only 3.4% to 9.6% of the education-based family size gap across cohorts using our standard measure, with very similar results (3.4% to 9.6%) being generated when using the more restrictive measure of very delayed first births (Panel B, Table 3). The consistency across the two timing measures suggests that differences in first birth timing explain only a small portion (less than 10%) of educational differences in completed fertility.

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The remaining portion (more than 90%) of the educational gap operates through mechanisms other than first birth timing, which could include differences in birth spacing or stopping behaviour, or differential responses to policy constraints. However, our analysis cannot distinguish among these possibilities. The decomposition shows that the vast majority of educational differences in family size stem from the "rate effect", meaning that highly educated individuals have fewer children than less educated individuals regardless of whether they delay entry to parenthood. Among those who delay the first birth, individuals with higher education still have substantially fewer children than lower educated individuals; similarly, among those who do not delay the first birth, highly educated individuals have smaller family sizes than their less educated counterparts.

Importantly, these educational differences have persisted despite China's fertility policies, which suggests that even within policy constraints, different educational groups display distinct fertility behaviours. While China's fertility policies created upper limits on family size, enforcement varied by time period, geography and social group, and compliance was not uniform across educational levels (Gu et al., 2007; Niu and Qi, 2020; Zhang and Zhao, 2023; Zhao and Zhang, 2018). China's policies may have limited how much timing differences could translate into family size differences, but they did not eliminate educational variation entirely. This contrasts with contexts characterised by voluntary fertility decline, where delayed childbearing typically reduces completed fertility through biological or social constraints. The results indicate that educational differences in family size cannot be primarily attributed to differences in first birth timing. While we cannot directly observe the underlying mechanisms, this pattern suggests that factors beyond the timing of entry into parenthood explain the majority of educational fertility differentials.

Delayed first births contribute substantially to explaining urban–rural family size differences throughout China's fertility transition, although the magnitude of the contribution varies depending on the timing measure used. Using our standard measure of delayed first birth, differences in first birth timing explain 6.6% of the urban–rural family size gap for the pre-1940 cohort, 22.3% of this gap for the 1940–1950 cohort during an intense period of policy implementation and 13.0% of this gap for the post-1960 cohort (Panel A, Table 3). However, when using the more restrictive measure of very delayed first births, the contributions are generally smaller (ranging from 4.9% to 7.5% across cohorts), suggesting that moderate postponement plays a more important role than extreme postponement in urban–rural fertility differences. This finding quantifies how the urban fertility decline has incorporated meaningful first birth postponement as one mechanism for achieving smaller families in urban areas, whereas this pattern is largely absent in rural areas.

Implications for an ageing society and intergenerational support systems

Table 4 presents the results of our decomposition analysis for the post-1960 cohort, showing how much of the socioeconomic differences in caregiving metrics can be attributed to differences in first birth timing.

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Table 4. Intergenerational age structures and eldercare metrics by socioeconomic and regional differences (post-1960 cohort)

Eldercare metric	Total difference	Component due to delayed first birth	Component due to other factors	% due to delayed first birth
Panel A: Urban–rural differences				
Child's Age When Parent Reaches 80 (years)	−0.99***	−0.42	−0.57	42.30%
Potential Caregiving Years	+0.99***	0.44	0.55	44.80%
Care Overlap Index	−1.20***	−0.46	−0.74	38.20%
Care Timing Quality Index	+0.81***	0.33	0.48	40.50%
Panel B: Educational differences (high vs low)				
Child's Age When Parent Reaches 80 (years)	−2.54***	−1.44	−1.1	56.70%
Potential Caregiving Years	+2.54***	1.48	1.06	58.30%
Care Overlap Index	−2.45***	−1.28	−1.17	52.10%
Care Timing Quality Index	+2.21***	1.19	1.02	53.90%

Note: This table presents the Kitagawa decomposition of socioeconomic differences in eldercare metrics for the post-1960 cohort. Negative values for total difference in "Child's Age When Parent Reaches 80" and "Care Overlap Index" indicate that the urban/higher educated groups have more favourable values (younger children when parents reach advanced age, and fewer years of problematic care overlap). Positive values for "Potential Caregiving Years" and "Care Timing Quality Index" indicate that the urban/higher educated groups have more favourable values (more pre-retirement caregiving years and better overall timing quality). The percentages in the rightmost column show how much of each total difference is attributable specifically to the different prevalence of delayed fertility between groups. *** $p < 0.001$

For the urban–rural divide, Table 4 shows that differences in first birth timing account for a substantial share of disparities in intergenerational age structures. Specifically, 42.3% of the urban–rural gap in a child's age when the parent reaches age 80 is attributable to the higher prevalence of delayed first birth among urban residents. In other words, nearly half of the urban advantage in having younger children during the parents' advanced ages stems from later entry into parenthood. We note, however, that this analysis focuses on the age of the first (eldest) child, whereas rural families with multiple children may experience different eldercare dynamics through having more potential caregivers, though this distinction operates through family size rather than through timing mechanisms. For the post-1960 cohort, whose average number of living children has already declined to around 2.2, such quantity differences are smaller, making timing a more salient dimension of inequality. Similarly, differences in first birth timing explain 44.8% of the urban–rural difference in potential caregiving years and 38.2% of the difference in the Care Overlap Index.

For educational differences, first birth timing explains over half of the disparities in eldercare timing. The total educational difference in the child's age when the parent reaches age 80 is 2.54 years, with differences in first birth timing explaining 56.7% of this gap (1.44 years), meaning that the children of highly educated parents are nearly 1.5 years

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younger when their parents reach advanced ages solely due to delayed childbearing patterns. In terms of potential caregiving years, the total educational advantage is 2.54 years, with first birth timing explaining 58.3% of this difference (1.48 years), meaning that children of educated parents have nearly 1.5 additional years of pre-retirement caregiving capacity. Similarly, first birth timing accounts for 52.1% of the educational difference in the Care Overlap Index, explaining 1.28 years of the total 2.45-year difference in intensive care timing.

Overall, the evidence presented in Table 4 suggests that first birth timing is likely a major mechanism through which socioeconomic status shapes eldercare contexts. While we previously found that first birth timing explains a relatively modest portion of socioeconomic differences in family size (less than 10% for education and up to 22% for urban–rural status), it accounts for 40–60% of the socioeconomic differences in eldercare metrics. This contrast highlights how fertility timing has become a pathway through which socioeconomic factors influence intergenerational support structures in later life.

Robustness checks

To assess the robustness of our findings, we conducted additional analyses using different definitions of first birth timing. First, we compared our standard definition (births exceeding the cohort-specific mean age) with a more stringent "very delayed first birth" measure (births exceeding the mean plus one standard deviation), as shown in Table 2. While the magnitude of timing's contribution varied – notably for urban–rural differences, where it decreased from 13.0% to 7.5% for the post-1960 cohort – the fundamental pattern remained consistent. First birth timing explained a modest but meaningful portion of family size differences, with direct fertility quantum effects (the rate effect) consistently dominating.

We extended our sensitivity analysis by implementing alternative thresholds including the 75th and 90th percentiles of the cohort-specific age distributions (results not shown). These percentile-based approaches confirmed our main findings while showing slightly smaller composition effects, with first birth timing explaining only 4–7% of urban–rural family size differences when using the 90th percentile threshold (compared to 7–12% when using the mean-based definition). Importantly, across all measurement approaches, the rate effect remained the dominant mechanism, accounting for 88–96% of socioeconomic differences in family size.

For our eldercare metrics, we tested whether the observed socioeconomic patterns were sensitive to the definition of delayed first birth. When using the median as the threshold, the contribution of first birth timing to eldercare disparities remained substantial, explaining 40–54% of educational differences and 32–38% of urban–rural differences in the timing of children's caregiving availability. The 75th percentile threshold yielded similar results (38–52% for educational differences and 35–40% for urban–rural differences). Even with fixed age cutoffs (age 27 for the post-1960 cohort), which are less sensitive to cohort-specific fertility patterns, first birth timing still explained 36–48% of educational differences and 30–35% of urban–rural differences in eldercare metrics.

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Discussion

Our analysis yields three main findings. First, we document strong and persistent socioeconomic gradients in first-birth timing: higher educated and urban residents consistently delayed their first birth more than their lower educated and rural counterparts across all cohorts (Table 1). Second, despite these strong gradients in timing, first birth timing explains only a modest portion of the socioeconomic differences in family size: i.e. less than 10% for educational differences but up to 22% for urban–rural differences (Table 3). This divergent pattern suggests that first birth timing played different roles across different dimensions of social stratification during China's fertility transition. Third, these timing differences created lasting intergenerational age structures with implications for eldercare, with first birth timing explaining 40–60% of socioeconomic differences in the timing of children's caregiving availability (Table 4). These findings lead to two broader conclusions about China's demographic transition and its implications for population ageing.

First, our results suggest that China experienced a "two-track" fertility transition in which different population segments reached similarly small families through distinct demographic pathways. First birth timing accounted for up to 22% of urban–rural differences in family size but less than 10% of educational differences in family size among historical cohorts. Meaningful first birth postponement played an important role in the fertility decline among urban populations, while among rural populations, the fertility decline occurred primarily due to direct constraints on family size with limited timing shifts. Although the family sizes of these two groups converged, differences in their fertility timing patterns remained, and in some cases widened. This observation aligns with Lesthaeghe (2010)'s concept of the second demographic transition, which states that fertility behaviours diversify rather than converge during later stages of demographic change.

The relatively small role of timing in explaining educational fertility differences found for China contrasts with the patterns reported for contexts with voluntary fertility transitions. In the United Kingdom, for instance, delayed childbearing accounts for roughly 57% of educational differences in completed fertility (Berrington et al., 2015). In China, however, fertility policies may have compressed natural socioeconomic variation in timing effects by imposing universal constraints on family size regardless of women's preferences. Alternatively, educational gradients may have operated through other tempo dimensions, such as birth spacing or stopping behaviour, which are not captured here. Either way, the comparison highlights how policy environments can reshape the mechanisms through which education and socioeconomic status influence fertility outcomes (Frejka et al., 2010).

In other East Asian contexts without explicit fertility policies, educational differences in postponement have been shown to be significant drivers of educational differences in fertility. In South Korea and Japan, delayed marriage and childbearing substantially mediate educational fertility differences (Anderson and Kohler, 2013; Raymo and Iwasawa, 2008; Yoo, 2016). These countries have experienced ultra-low fertility primarily as a result of voluntary postponement driven by educational expansion and labour

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market pressures. China's policy-driven transition, by contrast, constrained the extent to which educational postponement could translate into fertility differentials. Higher educated Chinese women still postponed their first birth, but this timing difference contributed little to the overall reduction in fertility compared with other mechanisms. This contrast underscores how institutional settings, and not just socioeconomic incentives, shape the demographic pathways to low fertility.

It is worth noting that these historical patterns differ markedly from the challenges facing contemporary Chinese adults of prime reproductive age, whose fertility decisions are shaped less by policy constraints than by economic and social pressures, such as high housing costs, educational competition and shifting gender norms. Whereas earlier cohorts navigated state-imposed limits on childbearing, today's cohorts confront structural and cultural barriers that have driven fertility to record lows across all socioeconomic groups.

Our second conclusion is that divergent patterns of first birth timing across historical cohorts have produced enduring socioeconomic and regional differences in intergenerational age structures, a previously overlooked dimension of inequality in old age. When urban and highly educated parents reach age 80, their children are on average one to 2.5 years younger than the children of rural and less educated parents. Although this gap may seem modest, its implications for eldercare are substantial within China's rigid retirement system and rapidly ageing population. For instance, the additional 2.5 pre-retirement caregiving years available to the children of highly educated parents represent roughly one-quarter of the typical intensive care period in later life. These timing gaps shape not only the *availability* of care, but also its *quality*: children in their early fifties are generally healthier, physically stronger and financially better positioned to provide or finance care than those nearing retirement. Such differences in caregiver capacity are particularly consequential in China's family-centred care system, where institutional options remain limited and most care is delivered informally within households.

These timing patterns also intersect with China's statutory retirement ages (historically 60 for men, 55 for women in white-collar/managerial positions and 50 for women in blue-collar/non-managerial positions, with a gradual upward adjustment phased in beginning 1 January 2025), generating distinct financial contexts for eldercare. Urban and educated families often reach peak earning capacity just as the parents' care needs intensify, allowing for greater flexibility in purchasing supplemental care or medical services. In contrast, rural and less educated families may face parental care demands precisely as the children exit the labour force and experience income reductions. This timing asymmetry thus constitutes a structural, timing-based dimension of inequality in old age support, one that operates independently of absolute income differences and underscores how demographic histories shape contemporary caregiving capacity.

Meanwhile, the more favourable eldercare timing among urban and highly educated parents should not be interpreted as an unqualified advantage for the offspring generation. To the extent that fertility timing is transmitted across generations, the children of more educated parents are also likely to postpone childbearing themselves, increasing their chances of facing overlapping responsibilities for raising young children while caring for ageing parents, and thus of belonging to the so-called "sandwich generation".

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Under these conditions, parental care needs may coincide with peak work and family demands. Delayed fertility may also reduce opportunities for grandparental support, as older parents may experience declining health before their grandchildren are born or reach ages when such support is most valuable. From this perspective, delayed childbearing may redistribute caregiving pressures across the life course, creating intergenerational trade-offs that do not necessarily favour the offspring generation. Although examining these trade-offs is beyond the scope of this study, our caregiving metrics should be interpreted as capturing timing alignment rather than the overall caregiving burden or well-being.

Limitations

Despite these contributions, our study has several limitations. First, our analysis cannot fully disentangle the effects of state fertility policies from voluntary socioeconomic influences on first birth timing. Although we observe distinct timing patterns across cohorts exposed to different policy regimes, the precise causal mechanisms driving these patterns remain difficult to isolate. Future research could address this limitation by linking fertility histories with local-level policy implementation data or by exploiting regional policy variation to better distinguish policy effects from socioeconomic or cultural factors.

Second, our measure of completed fertility is based on the number of *living* children reported at the time of the interview and excludes respondents without surviving offspring. This approach inevitably conditions fertility outcomes on child survival. Because child mortality declined substantially after the 1950s (Feeney and Yuan, 1994; Zeng et al., 2001; Zhao et al., 2014), this likely results in a modest underestimation of completed fertility for the oldest cohort, who experienced reproduction before the mortality decline. However, socioeconomic and urban–rural differences in child survival were relatively modest for later cohorts (Cai, 2012; Zeng et al., 2002; Zhao et al., 2014), suggesting that survival bias is unlikely to drive major socioeconomic patterns in these cohorts. Nonetheless, older, less educated and rural respondents were somewhat more likely to experience child loss, which may lead us to slightly understate their completed fertility and overstate convergence across groups. Accordingly, our estimates should be interpreted as reflecting gradients in *surviving* rather than *total* children. Future research could reconstruct full parity histories or integrate historical mortality data to yield more accurate estimates of completed fertility across cohorts.

Third, our conceptualisation of fertility timing focuses exclusively on the age at first birth and does not capture other key dimensions of fertility tempo. Birth spacing, or the interval between successive births, represents an equally important component that our analysis cannot address. This limitation is particularly relevant in the Chinese context, where the *later, longer, fewer* campaign of the 1970s explicitly regulated birth intervals, and where variation in spacing could have affected completed fertility independently of first birth timing. We also do not examine the age at last birth or the overall duration of the childbearing period, both of which shape fertility outcomes and intergenerational structures. Rural families permitted to have two or more children may have exhibited

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different spacing and stopping patterns than urban families, offering additional pathways through which socioeconomic factors may have influenced family size. The finding that first birth timing explains only a modest portion of socioeconomic fertility differences suggests that these unmeasured aspects of fertility tempo, together with preferences for family size, likely play important roles. Future research incorporating complete fertility schedules, including birth intervals and stopping behaviour, would provide a more comprehensive understanding of how tempo effects operate across socioeconomic groups in China's policy-constrained setting.

Fourth, our eldercare metrics assume that both parents and their children survive to age 80, an assumption that may not hold equally across socioeconomic groups. Higher educated and urban residents typically have longer life expectancies, making them more likely to reach advanced ages at which care needs intensify. Their children also tend to experience better survival and health outcomes, potentially amplifying observed disparities in caregiving availability. Future research should account for differential mortality patterns to produce more accurate projections of eldercare capacity across socioeconomic and regional contexts.

Finally, while we find systematic differences in intergenerational age structures, we cannot directly observe how these differences translate into actual caregiving behaviour. Our metrics capture potential care availability but not realised care provision, which depends on factors such as migration, financial resources, gender roles and cultural expectations. Longitudinal studies following families over time could help to clarify how demographic potential translates into observed caregiving arrangements and the extent to which socioeconomic and regional inequalities in family structure manifest as unequal care in later life.

Despite these limitations, our findings point to the need for ageing and family policies that explicitly account for the demographic timing inequalities embedded in China's fertility transition. Differences in first birth timing across socioeconomic groups have produced uneven intergenerational age structures, meaning that parents' care needs and children's caregiving capacities no longer align uniformly across the population. Policies expanding community-based eldercare and long-term care insurance should therefore prioritise rural and lower educated adults, who are most likely to experience caregiving deficits when their children are already near or past retirement age. At the same time, the rise of delayed fertility among urban and educated populations implies that caregiving will increasingly coincide with midlife labour force participation. As China gradually raises the statutory retirement age, reforms that allow partial retirement, flexible caregiving leave and pension credits for family care could help reduce this life course tension. Because caregiving responsibilities remain heavily gendered, with women bearing the brunt of both eldercare and childcare duties, integrating childcare and eldercare policy – e.g. through workplace flexibility, care leave benefits and community-level service hubs – would support intergenerational care continuity and mitigate the compounding disadvantages faced by midlife women. Together, these directions suggest that effective responses to population ageing must move beyond fertility promotion or the provision of old age support in isolation to incorporate a coordinated life course approach that recognises how the timing of family formation shapes caregiving needs decades later.

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References

Anderson, T., and Kohler, H.-P. (2013). Education fever and the east Asian fertility puzzle: A case study of low fertility in South Korea. *Asian Population Studies*, *9*(2), 196–215. https://doi.org/10.1080/17441730.2013.797293

Basten, S., and Jiang, Q. (2015). Fertility in China: An uncertain future. *Population Studies*, *69*(sup1), S97–S105. https://doi.org/10.1080/00324728.2014.982898

Beaujouan, É., Zeman, K., and Nathan, M. (2023). Delayed first births and completed fertility across the 1940–1969 birth cohorts. *Demographic Research*, *48*, 387–420. https://doi.org/10.4054/DemRes.2023.48.15

Beck, K. C., Hart, R. K., and Flato, M. (2024). School starting age, fertility, and family formation: evidence from the school entry cutoff using exact date of birth. *Demography*, *61*(6), 1999–2026. https://doi.org/10.1215/00703370-11686231

Berrington, A., Stone, J., and Beaujouan, E. (2015). Educational differences in timing and quantum of childbearing in Britain: A study of cohorts born 1940–1969. *Demographic Research*, *33*, 733–764. https://doi.org/10.4054/DemRes.2015.33.26

Cai, Y. (2012). China's Demographic Reality and Future. *Asian Population Studies*, *8*(1), 1–3. https://doi.org/10.1080/17441730.2012.646803

Chan, K. W., and Zhang, L. (1999). The Hukou System and urban–rural migration in China: Processes and changes. *The China Quarterly*, *160*, 818–855. https://doi.org/10.1017/S0305741000001351

Fang, H., Eggleston, K. N., Rizzo, J. A., and Zeckhauser, R. J. (2013). Jobs and kids: female employment and fertility in China. *IZA Journal of Labor & Development*, *2*(1), 12. https://doi.org/10.1186/2193-9020-2-12

Feeney, G., and Feng, W. (1993). Parity progression and birth intervals in China: The influence of policy in hastening fertility decline. *Population and Development Review*, 61–101. https://doi.org/10.2307/2938385

Feeney, G., and Yuan, J. (1994). Below replacement fertility in China? A close look at recent evidence. *Population Studies*, *48*(3), 381–394. https://doi.org/10.1080/0032472031000147926

Frejka, T., Jones, G. W., and Sardon, J.-P. (2010). East Asian childbearing patterns and policy developments. *Population and Development Review*, *36*(3), 579–606. https://doi.org/10.1111/j.1728-4457.2010.00347.x

Frejka, T., and Sardon, J.-P. (2006). First birth trends in developed countries: Persisting parenthood postponement. *Demographic Research*, *15*(6), 147–180. https://doi.org/10.4054/DemRes.2006.15.6

Giuntella, O., Rotunno, L., and Stella, L. (2022). Globalization, fertility, and marital behavior in a lowest-low fertility setting. *Demography*, *59*(6), 2135–2159. https://doi.org/10.1215/00703370-10275366

Goisis, A., and Sigle-Rushton, W. (2014). Childbearing postponement and child well-being: a complex and varied relationship? *Demography*, *51*(5), 1821–1841. https://doi.org/10.1007/s13524-014-0335-4

Greenhalgh, S. (2008). *Just one child: Science and policy in Deng's China*. University of California Press. https://doi.org/10.1525/9780520941267

Gu, B., Wang, F., Guo, Z., and Zhang, E. (2007). China's local and national fertility policies at the end of the twentieth century. *Population and Development review*, 129–147. https://doi.org/10.1111/j.1728-4457.2007.00161.x

Guo, Z., Gietel-Basten, S., and Gu, B. (2019). The lowest fertility rates in the world? Evidence from the 2015 Chinese 1% sample census. *China Population and Development Studies*, *2*(3), 245–258. https://doi.org/10.1007/s42379-018-0012-1

Kohler, H.-P., Billari, F. C., and Ortega, J. A. (2002). The emergence of lowest-low fertility in Europe during the 1990s. *Population and Development Review*, *28*(4), 641–680. https://doi.org/10.1111/j.1728-4457.2002.00641.x

Lavely, W., and Freedman, R. (1990). The origins of the Chinese fertility decline. *Demography*, *27*, 357–367. https://doi.org/10.2307/2061373

Lesthaeghe, R. (2010). The unfolding story of the second demographic transition. *Population and Development Review*, *36*(2), 211–251. https://doi.org/10.1111/j.17284457.2010.00328.x

https://doi.org/10.1553/p-m8bg-h6pj

Li, L., Jin, G., Lai, X., Jing, R., and Zhu, H. (2024). A reassessment of trends and urban–rural/regional differences in the total fertility rate in China, 2000–2020: analyses of the 2020 national census data. *Scientific reports*, *14*(1), 8601. https://doi.org/10.1038/s41598-024-59177-2

Li, W., and Liang, Z. (1993). The change of fertility patterns in rural and urban China, 1970–1989. *China Population Today*, *10*(5), 13–15. http://www.ncbi.nlm.nih.gov/pubmed/12319407

Margolis, R., and Myrskylä, M. (2011). A global perspective on happiness and fertility. *Population and Development Review*, *37*(1), 29–56. https://doi.org/10.1111/j.1728-4457.2011.00389.x

Neels, K., and De Wachter, D. (2010). Postponement and recuperation of Belgian fertility: How are they related to rising female educational attainment? *Vienna Yearbook of Population Research*, *8*, 77–106. https://doi.org/10.1553/populationyearbook2010s77

Niu, J., and Qi, Y. (2020). The educational differential in fertility in transitional China: Temporal and regional variation. *Demographic Research*, *42*, 657–688. https://doi.org/10.4054/DemRes.2020.42.22

Piotrowski, M., and Tong, Y. (2016). Education and fertility decline in China during transitional times: A cohort approach. *Social Science Research*, *55*, 94–110. https://doi.org/10.1016/j.ssresearch.2015.10.001

Raymo, M. R., and Iwasawa, M. (2008). Changing family life cycle and partnership transitions: Gender roles and marriage patterns. In *The demographic challenge: A handbook about Japan* (pp. 255–276). Brill. https://doi.org/10.1163/ej.9789004154773.i-1199.103

Rendall, M., Couet, C., Lappegard, T., Robert-Bobée, I., Rønsen, M., and Smallwood, S. (2005). First births by age and education in Britain, France and Norway. *Population Trends*, *121*, 27–34.

Tropf, F. C., and Mandemakers, J. J. (2017). Is the association between education and fertility postponement causal? The role of family background factors. *Demography*, *54*(1), 71–91. https://doi.org/10.1007/s13524-016-0531-5

Van Bavel, J. A. N. (2010). Choice of study discipline and the postponement of motherhood in Europe: the impact of expected earnings, gender composition, and family attitudes. *Demography*, *47*(2), 439–458. https://doi.org/10.1353/dem.0.0108

Wang, F., and Mason, A. (2008). The demographic factor in China's transition. In L. Brandt and T. G. Rawski (Eds.), *China's Great Economic Transformation* (pp. 136–166). Cambridge University Press.

Wu, X., and Treiman, D. J. (2004). The household registration system and social stratification in China: 1955–1996. *Demography*, *41*(2), 363–384. https://doi.org/10.1353/dem.2004.0010

Yoo, S. H. (2016). Postponement and recuperation in cohort marriage: The experience of South Korea. *Demographic Research*, *35*, 1045–1078. https://doi.org/10.4054/DemRes.2016.35.35

Zeng, Y., and Vaupel, J. W. (2003). Oldest old mortality in China. *Demographic Research*, *8*, 215244. https://doi.org/10.4054/DemRes.2003.8.7

Zeng, Y., Vaupel, J. W., Xiao, Z., Zhang, C., and Liu, Y. (2001). The healthy longevity survey and the active life expectancy of the oldest old in China. *Population: an English selection*, 95116.

Zeng, Y., Vaupel, J. W., Zhenyu, X., Chunyuan, Z., and Yuzhi, L. (2002). Sociodemographic and health profiles of the oldest old in China. *Population and Development Review*, *28*(2), 251–273. https://doi.org/10.1111/j.1728-4457.2002.00251.x

Zhang, Z., and Zhao, Z. (2023). Women's education and fertility in China. *China Economic Review*, *78*, 101936. https://doi.org/10.1016/j.chieco.2023.101936

Zhao, Y., Hu, Y., Smith, J. P., Strauss, J., and Yang, G. (2014). Cohort profile: The China Health and Retirement Longitudinal Study (CHARLS). *International Journal of Epidemiology*, *43*(1), 61–68. https://doi.org/10.1093/ije/dys203

Zhao, Z., Chen, W., Zhao, J., and Zhang, X. (2014). Mortality in China: data sources, trends and patterns. In Attané, I., Gu, B. (eds) *Analysing China's Population: Social Change in a New Demographic Era* (pp. 205–225). INED Population Studies, vol *3*. Springer. https://doi.org/10.1007/978-94-017-8987-5_11

Zhao, Z., and Zhang, G. (2018). Socioeconomic factors have been the major driving force of China's fertility changes since the mid-1990s. *Demography*, *55*, 733–742. https://doi.org/10.1007/s13524-018-0662-y

Zheng, Z. (2024). Revisiting fertility transition in China. *China Population and Development Studies*, *8*, 356–371. https://doi.org/10.1007/s42379-024-00169-0

https://doi.org/10.1553/p-m8bg-h6pj

Appendix A. Detailed formulas for eldercare implication metrics

This appendix provides the detailed formulas and rationales for the eldercare implication metrics used in our analysis. While the primary metric (Child's Age When Parent Reaches 80) is presented in the main text, the following three supplementary metrics capture additional dimensions of intergenerational support structures that may be affected by delayed fertility patterns.

Potential Caregiving Years

The Potential Caregiving Years metric is calculated as:

$$\text{Potential Caregiving Years} = 60 - \text{Child's Age When Parent Reaches } 80 + 5$$

where 60 represents the typical retirement age in China, Child's Age When Parent Reaches 80 = 80 - Mother's Age at First Birth, The addition of five years accounts for the period of parental care needs beginning at approximately age 75.

This metric estimates the number of pre-retirement years available for the eldest child to provide care during the parent's period of highest need (approximately ages 75–80). Higher values indicate more potential caregiving capacity before the child faces their own retirement transition. For example, a value of 10 indicates that the child will have approximately 10 years between the onset of their parent's intensive care needs (around age 75) and their own retirement (age 60), potentially allowing for more consistent caregiving support.

Care Overlap Index

The Care Overlap Index is calculated as:

$$\text{Care Overlap Index} = \max(0, \text{Child's Age When Parent Reaches } 80 - 55 + 10)$$

where 55 represents the early retirement/late career threshold in China, 10 represents approximately 10 years of parental high care needs (from age 75–85) and $\max(0, x)$ ensures the index cannot be negative.

This index measures the number of years when the parent requires intensive care while the child is simultaneously approaching or is in retirement, and is thus potentially facing their own health limitations or competing responsibilities. The formula accounts for parental care needs beginning around age 75 and continuing until approximately age 85, while considering that children above age 55 may begin to face their own age-related constraints on their caregiving capacity. Higher values indicate more problematic timing with greater competing demands. For example, a value of 15 indicates that for approximately 15 years, the parent will require care while the child is in the late career/retirement transition phase, potentially placing significant strain on the caregiving relationship.

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Care Timing Quality Index

The Care Timing Quality Index is calculated as:

$$\text{Care Timing Quality Index} = 100 - |50 - \text{Child's Age When Parent Reaches 80}|$$

where 50 represents the theoretically optimal age for caregiving capacity, and $|x|$ represents the absolute value function.

This index produces a score from 0–100, with 100 representing optimal timing (the child is age 50 when the parent is age 80). The formula is based on research suggesting that middle-aged adult children (around age 50) may be at an optimal caregiving life stage, as they have likely established their career and potentially completed their childrearing responsibilities, but are not yet facing significant health limitations themselves. The index decreases linearly as the child's age deviates in either direction from this optimal age. Higher values indicate more favourable care timing. For example, a value of 95 indicates that the child will be close to the optimal caregiving age when the parent reaches advanced age, while a value of 70 indicates a substantial deviation from optimal timing.

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