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The Rise of Sonless Families in Asia and North Africa

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ABSTRACT A neglected consequence of declining fertility is the likely rise of families with children of one sex—only sons or only daughters. Increases in such families present important demographic shifts that may weaken patrilineal family systems. We assess whether sons-only and daughters-only families rose in Asia and North Africa from the early 1990s to around 2015. Using 88 surveys and two censuses, we examine how the number and sex composition of children of mothers aged 40–49 changed across 20 countries, representing 87% of the region's population and 54% of the global population. We also compare observed trends to sex-indifferent counterfactuals, quantify contributions of fertility declines with decompositions, and investigate subnational trends in China and India. Increases in sons-only families were universal where numbers of children fell. Growth of daughters-only families was suppressed in patrilineal contexts, but these sonless families still rose significantly in 13 of 18 countries where numbers declined. By 2015, over a quarter of families in the region had only sons and nearly a fifth only daughters. There was considerable variation across countries: recent levels ranged from 28.3% to 3.4% daughters-only and from 40.1% to 6.0% sons-only. China and the rest of East Asia had the highest shares.

KEYWORDS Sex composition • Fertility • Demographic transition • Gender • Sonless families

Introduction

Recent fertility declines signal the end of the demographic transition for much of the world. Demographic transitions unfurl an array of population changes, including migration, urbanization, aging, and shifting sex ratios (Coleman 2006; Dyson 2011; Hesketh and Xing 2006). In turn, these population changes have vast consequences for social and economic life, as well as biodiversity and the environment. For instance, demographic dividends posed by temporary bulges in working ages may benefit economic growth, while growing numbers of elderly pose social and economic challenges (Bloom and Williamson 1998; Lutz et al. 2019).

A neglected consequence of fertility decline is the rise of families with children of one sex. If a family has a small number of children, the probability of having only daughters or only sons is high. Parents can ensure children of both sexes, or a child of their preferred sex, by continuing childbearing or using sex-selective abortion

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(Clark 2000; Guilmoto 2009). However, if many parents do not engage in these practices, sons-only and daughters-only families would rise as fertility falls. Increases in daughters-only families, in particular, may pose a gendered demographic dividend that erodes patrilineal family systems (Allendorf 2020). Growth of these sonless families could counterbalance, and perhaps eventually outweigh, opposing demographic pressure fueling greater harm of girls and women (Bongaarts and Guilmoto 2015; Diamond-Smith and Rudolph 2018; Jayachandran 2017).

We assess whether daughters-only and sons-only families rose as fertility declined in Asia and North Africa in recent decades. Specifically, we examine how the number and sex composition of children of mothers aged 40–49 changed across 20 countries from the early 1990s to around 2015. We also quantify the contribution of fertility decline using decompositions, compare observed trends to counterfactual scenarios in which parents were indifferent to children's sex, and investigate differences between patrilineal and bilateral contexts.

We focus on Asia because the region is largely patrilineal and experienced recent fertility declines. We add North Africa because it fits these criteria and is often grouped with parts of Asia. (The Middle East and North Africa (MENA) subregion spans West Asia and North Africa.) By contrast, fertility remains high in sub-Saharan Africa and Latin America is largely bilateral. Europe and its diaspora in North America and Oceania are also primarily bilateral and experienced earlier fertility declines. The sheer size of Asia and North Africa also make the region of global significance. With 4.9 billion people, it is home to nearly two thirds of the world's population (United Nations 2019).

While this region pairs recent fertility declines with patrilineal family systems, Asia and North Africa also provide variation in both fertility and family systems. In 2015–2020, East Asia had the lowest fertility in the world, total fertility rates were above three children per woman in much of the MENA, and most countries were in between these extremes (United Nations 2019). Regarding family, Southeast Asia stands apart with largely bilateral family systems (Raymo et al. 2015; Yeung et al. 2018). Further, while the rest of Asia and North Africa are patrilineal, there is variation within these family systems. For instance, primogeniture, polygyny, and consanguineous marriage are customary in some places, but not in others (Das Gupta et al. 2003; Dyson and Moore 1983; Lindholm 1986).

We use the term patrilineal to characterize family systems in which descent and inheritance pass down the male line and residence is patrilocal. In these contexts, family lineages and wealth transfer from father to son and young couples customarily reside with, or near, the husband's family after marriage. In patrilineal systems, sons customarily determine continuity of the family, fulfill material responsibilities, and hold great cultural and religious significance (Das Gupta 1999; Das Gupta et al. 2003; Kandiyoti 1988). By contrast, daughters leave their natal families at marriage and become members of their husband's family.

Background

Three decades ago, Sen (1990) famously declared more than 100 million of the world's women were missing. He used "missing women" to highlight the fatal neglect of girls. Excess female mortality was causing sex ratios of some patrilineal contexts to

skew toward males. China and India—especially Northwest India—gained notoriety for large numbers of missing females because they paired skewed sex ratios with large populations. In the 1990s, for instance, there were 118 boys aged 0–6 in China and 114 in Northwest India for every 100 girls (Das Gupta et al. 2009). From 1970 to 2010, annual female excess deaths ranged from 1.7 to 2 million globally, with 71% of these in China and India (Bongaarts and Guilmoto 2015).

While Sen (1990) pointed to excess mortality as the cause of missing women, many were increasingly "missing" because they were never born. From the 1980s onward, the spread of prenatal sex-selection technology—ultrasounds and abortion—allowed families to identify and abort unwanted female fetuses (Arnold et al. 2002; Guilmoto et al. 2018). Hence, sex ratios at birth skewed male in many patrilineal contexts, rising above normal levels of about 105 boys born per 100 girls (Guilmoto 2009, 2017). Most recently, in 2017, sex ratios at birth were elevated across much of Asia, peaking at 113 in East Asia (Chao et al. 2019). These imbalances translated into 45 million missing female births from 1970 to 2017, including 23.1 million from China and 20.7 million from India (Chao et al. 2019).

Fertility decline is a crucial driver of these changes in sex composition. As parents increasingly pursue small numbers of children, their chances of having a son within the desired number of births fall. In response to such fertility squeezes, parents increasingly tamper with sex composition of their children (Guilmoto 2009). Many continue childbearing until securing a son, while others use sex-selective abortion to ensure a son within one or two births (Bongaarts and Guilmoto 2015; Clark 2000; Goodkind 1996). These practices contribute to poor health and excess mortality among girls even when parents do not purposely favor sons over daughters. Selective stopping of childbearing and greater use of sex-selective abortion among wealthier families lead to girls being born disproportionately into larger and poorer families (Anukriti 2018; Kashyap 2019). Living in more disadvantaged family circumstances contributes to higher mortality and worse health among girls overall (Kashyap and Behrman 2020).

We contribute to this rich literature by using the family as the unit of analysis and assessing whether fertility decline created increases in sons-only and daughters-only families. Such changes would represent an important aspect of shifting sex composition and may yield further consequences. Many gendered social processes, such as marriage markets, are shaped by the sex composition of a population overall or of specific age-groups (Anderson and Kohler 2015; Gupta 2014; Trent and South 2012). The sex composition of families is likely to be influential as well, especially for intrafamilial processes, such as elder care. Further, changing sex composition of families may be how these demographic shifts are understood and experienced by ordinary people. For child mortality, Smith-Greenaway and Trinitapoli (2020) argued parents view the risk of a child dying not from the perspective of each individual child, but from the perspective of a parent who may experience the death of any one of their children. Similarly, sex composition may be primarily understood from the perspective of parents evaluating the collective composition of their own children as mixed, sons only, or daughters only.

Assessing the rise of sonless families is particularly important because the presence of substantial numbers of such families may weaken patrilineal family systems (Allendorf 2020). While many families use selective stopping or sex-selective abortion

to secure sons, other families likely do not because they are unwilling, unable, or unsuccessful. Families that remain sonless will be forced to rely on daughters to fulfill sons' customary responsibilities or go outside the family. For instance, Indian mothers changed their expectations of old-age support in response to their children's sex in just this way (Allendorf 2020). Mothers of sons kept or further embraced patrilineal expectations of a son providing support, while sonless mothers gave up patrilineal expectations, with about half turning to daughters and half to other sources. When sonless families are rare, such adjustments may be inconsequential. When sonless families represent a sizable share of families, however, many will be unable to follow patrilineal practices. Families' transformative adjustments may be largely reluctant, at least at first, but may cascade into an erosion of patrilineal norms and practices in the long term.

Data and Methods

Data

We use nationally representative data for 20 Asian and North African countries, comprising 88 surveys and two censuses collected between 1987 and 2017. These 20 countries represented 87% of Asia and North Africa's population and 54% of the global population in 2020. We use Demographic and Health Surveys (DHS) for 16 Asian and North African countries for which two or more waves of data were available.[1] Since DHS does not cover East Asia, we used other sources for China, Taiwan, South Korea, and Japan. These sources include Chinese censuses from IPUMS International, Chinese and Japanese General Social Surveys, and the Korean National Survey on Fertility, Family Health & Welfare. A complete list of data sources appears in the online appendix.

We proxy families with analytic samples of women 40–49 years old with at least one living child at the time of survey.[2] We focus on mothers this age because their childbearing is largely complete. Data on children of women aged 50 or older, whose childbearing is fully complete, are not available in DHS. Equating one mother with one family may overestimate the proportions of families with children of one sex if substantial numbers of these mothers lived with other women of the same generation in laterally extended or polygynous families. However, slippage between mothers and families appears to be minimal. The highest share of women with co-wives was in Yemen, at 12.3%, and only four other countries had high percentages of 7–8%. Further, only 1–2% of these mothers were sisters-in-law of the household head or had other relationships to the head potentially compatible with a laterally extended family.[3]

[1] DHS data for countries were accessed directly from the DHS website (dhsprogram.com), while DHS data for Indian states were accessed through IPUMS (idhsdata.org) (Heger Boyle et al. 2019).

[2] For DHS, we further limited analytic samples to usual members of households, dropping temporary visitors, so we could assess if mothers were part of laterally extended family households.

[3] These percentages residing with one or more co-wives were taken from DHS Statcompiler. DHS included questions about co-wives in only nine countries in our sample, but such questions are asked in all countries where polygyny is believed to be sizable. We were not able to assess the extent to which women were in laterally extended families in East Asia.

Observed Trends

We examine how the mean number of children and proportions of mothers aged 40–49 with only sons or only daughters changed over time. The residual, mixed-sex, category is not shown, but can be inferred.[4] Our measures are based on mothers' reports of the number and sex of their children alive at the time of survey, regardless of whether the children lived with the mother. The measure of time is the survey wave, or year of data collection, when mothers were 40–49 years old. At the time of survey, their children were largely young adults, but ranged in age from infants to mid-30s.

We track trends over two to three decades, starting in the late 1980s or early 1990s and ending around 2015. However, the data cover only five years for Vietnam and Tajikistan, and for Kazakhstan, the data cover a mere four years and end in 1999. At the other extreme, we trace four decades in China, from 1975 to 2015. The 1990 Chinese census provides data on women up to age 64, which allowed us to assess earlier periods when the older women were 40–49. Specifically, we proxy results for 1975, 1980, and 1985 using data for women with at least one child aged 55–64, 50–59, and 45–54, respectively, in the 1990 census. Results for China should be viewed with caution since children, especially daughters, were underreported in these censuses (Goodkind 2011). Underreporting may be minimal in our analytic sample though, since most children were born many years before the censuses.[5]

Decompositions

We quantify contributions of fertility decline to increases in sons-only and daughters-only families using Kitagawa decompositions (Kitagawa 1955; Li 2017; Preston et al. 2001). We decompose changes between first and last waves in proportions sons-only, as well as proportions daughters-only, into two components—a numbers component and a sons-only (or daughters-only) component. The sum of these two components equals the total change in proportion sons-only (or daughters-only). The numbers component maps onto fertility decline by capturing changes in composition of families by the number of children. If fertility declined, proportions of families with smaller numbers of children increased, while proportions with larger numbers decreased. The second, sons-only (or daughters-only) component captures

[4] Some children are born intersex and others identify as transgender or gender nonconforming later in life. These complexities point to potential inaccuracies with simple categorizations of families as sons-only, daughters-only, or mixed sex. However, intersex births, as well as transgender and gender nonconforming adults, are rare. Prevalence of intersex infants is estimated at 0.1% or less of live births (Aydin et al. 2019), and 0.5% percent of American adults identified as transgender or gender nonconforming in 2014–2016 (Lagos 2018). The use of binary sex measures available in DHS and other surveys does not present significant misclassifications of sex, or even gender, composition of children in families.

[5] For 2015 in Japan, the analytic sample comprises couples who had been married 15–19 years and had at least one child. We used this comparable, but not identical, analytic sample because we did not have access to the raw data. These results are based on calculations from cross-tabulations provided in Table 17.1 of the Japanese-language version of the Japanese National Fertility Survey report (National Institute of Population and Social Security Research 2017).

changes in *number-specific* proportions sons-only (or daughters-only). For instance, changes in proportions of one-child families with a son, proportions of two-child families with two sons, proportions of three-child families with three sons, and so on. This second component captures contributions of everything besides numbers composition, chiefly including parents' interference with sex composition through sex-selective abortion and selective stopping of childbearing. Selective stopping is embedded in both components, however, because it affects numbers of children, as well as number-specific sex composition.

Counterfactual Scenarios

We compare observed trends to counterfactual scenarios in which families had the same number of children and were indifferent to their sex. These counterfactuals are the proportions sonless or daughterless that would have occurred if mothers had observed numbers of children, but the sex of each child was independent with a .4878 probability of being female. We calculated these counterfactual scenarios using classic standardization techniques (Preston et al. 2001:21–30). The counterfactual proportion (*CP*) of families with only sons or only daughters for country–wave *j* is

$$CP_j = \sum_{i=1}^{\infty} (\pi^i \cdot C_{ij}),$$

where *i* indicates number of children, C_{ij} denotes observed proportion of families with *i* children for country–wave *j*, and π is the probability of the relevant sex. For the counterfactual proportion daughters-only, $\pi = .4878$, and for sons-only, $\pi = .5122$ $(1 - .4878)$.

We assume families had observed numbers of children because it allows us to assess if parents actively shaped sex composition. If discrepancies between observed and counterfactual proportions are not due to differences in numbers, they are likely due to parents' interference. For instance, parents ensuring sons through selective stopping and sex-selective abortion would push observed proportions daughters-only below counterfactuals. As an estimate of how many daughterless and sonless families there would have been in an alternate reality where parents had been sex indifferent, however, these counterfactuals are conservative. As noted earlier, pursuing more births to avoid being sonless (or daughterless) pushes fertility higher. If parents had been sex indifferent, observed numbers of children would have been smaller and proportions sonless and daughterless larger.

Our calculations also simplify some complexities. The .4878 probability of a child being female is based on a biologically normal sex ratio at birth of 105. Normal sex ratios at birth are indeed 105 in South and West Asia, as well as North Africa, but are slightly higher at 106 in Central, Southeast, and East Asia (Chao et al. 2019). Apart from its role in determining observed numbers of children, we also ignore mortality. Sex differentials in mortality likely play a negligible role though. It is generally later-born daughters who experience higher mortality, not first-born daughters or sons (Altindag 2016; Arnold et al. 1998; Riswick and Hsieh 2020). Sex differentials in mortality should largely push numbers of daughters toward one, not zero.

Subnational Trends

We also calculated observed trends, decompositions, and counterfactual scenarios at subnational levels for China and India. For India, we calculated trends for the 15 largest states and the Northeast from 1992 to 2015.[6] For China, we assessed trends for all 31 provinces from 1975 to 2000. The Chinese subnational analysis ends earlier than the national analysis because our post-2000 data source, the Chinese General Social Survey, does not have sufficiently large sample sizes to calculate province-level estimates. We include subnational analyses because both countries have considerable variation in fertility. Further, Indian states and Chinese provinces are just as large, if not larger, than many countries. Populations of these Indian states ranged from 25 to 210 million in 2011 (Chandramouli 2013), while Chinese provinces ranged from 3 to 104 million in 2010 (National Bureau of Statistics (China) 2020).

We also include a simpler subnational analysis of Indonesia, comparing patrilineal and bilateral provinces. Following Guilmoto (2015), we divide Indonesian provinces into patrilineal and bilateral groups based on patrilocal residence. Guilmoto (2015) classified provinces as patrilocal if 60% or more of coresiding married children younger than 50 lived with the husband's family, rather than the wife's family. We lowered this threshold to 55%, classifying three provinces close to the original 60% cutoff as patrilocal, including Kalimantan (58.6%), North Sumatra (58.4%), and Jakarta (57.2%). In 2010, 22% of Indonesia's population lived in these patrilocal provinces.

Results

We begin the description of results with recent levels, describing how proportions of families with only sons and only daughters varied across Asia and North Africa at the last wave, around 2015. We then turn to trends, assessing whether sonless and daughterless families rose as numbers of children fell and quantifying the contribution of fertility decline with decompositions. Next, we examine the relationship between numbers of children and proportions of families with children of one sex across all 290 waves, including Indian state–waves, Chinese province–waves, and country–waves for the other 18 countries. We also investigate differences in this relationship between sons-only and daughters-only families and compare patrilineal and bilateral contexts. Finally, we turn to subnational results, highlighting noteworthy findings from Chinese provinces and Indian states.

We present point estimates of mean numbers of children and proportions sons-only and daughters-only for first and last waves in Table 1 for all 20 countries. For 11 countries, we also present graphs with estimates for all waves alongside counterfactual scenarios; these countries have at least three waves, a reduction of at least one in the mean number of children, and a mean below four children at the last wave.

[6] Allendorf (2020) previously provided estimates for large Indian states in 1992 and 2015, but did not provide estimates for 1995 and 2005, nor counterfactuals and decompositions. Indian states that divided after 1992 were recombined to provide consistent borders from 1992 to 2015. Northeast India consists of Arunachal Pradesh, Nagaland, Manipur, Mizoram, Tripura, Meghalaya, and Sikkim.

In these graphs, observed trends appear as solid lines with surrounding shading depicting 95% confidence intervals. Counterfactual scenarios are represented with dashed lines. The circles, squares, and triangles marking point estimates also depict statistical significance of changes over time: solid shapes indicate changes between first and last waves are statistically significant at the .05 level, while hollow shapes indicate changes are not significant. We provide graphs for all countries, Chinese provinces, and Indian states in the online appendix. Results from the decompositions are also provided in the appendix.

Recent Levels

At the last wave, around 2015, 43.9% of families in these 20 countries had children of only one sex—with 26.6% having only sons and 17.3% only daughters. These estimates, which are country averages weighted by 2020 population sizes, indicate families with children of one sex are prevalent and sons-only families are more common than daughters-only families. However, there is considerable heterogeneity across these 20 countries.

We consider variation in sonless, or daughters-only, families first. Shares of families with only daughters ranged from 28.3% to 3.4% (Table 1). The highest shares were in East Asia, where more than a fifth of families in all four countries were sonless. China had the highest share, at 28.3%, followed by Japan at 26.1%, South Korea at 23.1%, and Taiwan at 21.3%. Sizable shares of sonless families—more than 10% daughters-only—were present in Southeast Asia, as well as Turkey and Kazakhstan. Nearly a fifth of families in Indonesia (18.3%) and Kazakhstan (18.0%) were sonless, while Turkey was a few percentage points behind at 15.4%. The other countries of Southeast Asia were closer to a tenth, with the Philippines at 12.9%, Cambodia at 12.0%, and Vietnam at 11.0%.

Levels of daughters-only families were relatively low in South Asia, the MENA, and the rest of Central Asia, comprising a tenth or less at the last wave. Four countries hovered at about 10% sonless families: Kyrgyz Republic (10.7%), Bangladesh (10.3%), India (9.8%), and Morocco (9.6%). The remaining countries fell below that threshold with small, or even negligible, proportions: Egypt (8.0%), Tajikistan (7.7%), Jordan (7.1%), Nepal (6.2%), Pakistan (5.8%), and Yemen (3.4%).

Next, we turn to the more prevalent sons-only families, which ranged from 40.1% to 6.0% of families across the 20 countries. East Asia was again home to the highest levels, with China recording 40.1% of families with only sons. South Korea, Japan, and Taiwan were markedly below China, but above all other countries, at 26.6–29.1% sons-only. The next group clustered around a fifth, comprising India (22.3%), Turkey (21.4%), Kazakhstan (20.3%), and Indonesia (19.9%).

Ten countries held a middle ground with between 20% and 10% of families with only sons. This middle group included Nepal, Vietnam, and the Philippines at 17.0–17.5%, as well as Kyrgyz Republic, Tajikistan, and Bangladesh at 14.6–14.9%. Closer to a 10% threshold were Egypt (13.8%), Jordan (12.0%), Cambodia (11.0%), and Morocco (10.3%). Only Pakistan (7.7%) and Yemen (6.0%) fell below a tenth sons-only.

Table 1 Mean number of children and proportions with only sons and only daughters for mothers aged 40–49 in the first and last waves for all 20 countries

	Wave			Mean Number of Children			Proportion Only Sons			Proportion Only Daughters			
Country	First	Last	Years	First Wave	Last Wave	Absolute Change	First Wave	Last Wave	Absolute Change	First Wave	Last Wave	Absolute Change	Only Sons Change Minus Only Daughters Change
China	1975	2015	40	4.56	1.59	−2.96	.094	.401	.306	.053	.283	.229	.077
South Korea	1991	2015	24	2.89	1.97	−0.92	.229	.291	.062	.111	.231	.120	−.058
Japan	1990	2015	25	2.14	2.07	−0.08	.243	.279	.036	.248	.261	.014	.022
Taiwan	1991	2016	25	3.12	2.16	−0.96	.160	.266	.106	.118	.213	.095	.011
Indonesia	1987	2017	30	4.76	2.79	−1.97	.103	.199	.097	.098	.183	.084	.012
Kazakhstan	1995	1999	4	3.06	2.84	−0.22	.192	.203	.010	.169	.180	.011	.000
Turkey	1993	2013	20	4.04	2.93	−1.12	.135	.214	.079	.085	.154	.069	.010
India	1992	2015	22	4.13	3.06	−1.06	.132	.223	.091	.077	.098	.021	.070
Kyrgyz Rep.	1997	2012	15	4.15	3.33	−0.82	.106	.149	.043	.088	.107	.019	.024
Vietnam	1997	2002	5	3.94	3.38	−0.56	.137	.172	.035	.073	.110	.037	−.002
Nepal	1996	2016	20	4.53	3.47	−1.06	.114	.175	.061	.059	.062	.003	.057
Bangladesh	1994	2014	20	5.17	3.48	−1.69	.067	.146	.079	.051	.103	.052	.027
Philippines	1993	2017	24	4.92	3.63	−1.29	.090	.170	.080	.083	.129	.046	.034
Tajikistan	2012	2017	5	4.23	3.64	−0.59	.107	.148	.041	.054	.077	.023	.018
Cambodia	2000	2014	14	4.89	3.69	−1.20	.081	.110	.030	.086	.120	.035	−.005
Egypt	1988	2014	26	4.85	3.76	−1.09	.086	.138	.053	.071	.080	.008	.044
Jordan	1990	2017	27	7.86	4.43	−3.42	.032	.120	.088	.027	.071	.044	.044
Morocco	1987	2003	16	6.21	4.61	−1.60	.058	.103	.045	.049	.096	.046	−.002
Pakistan	1991	2018	27	5.78	4.87	−0.91	.055	.077	.022	.049	.058	.009	.013
Yemen	1991	2013	22	6.28	6.36	0.08	.062	.060	−.001	.055	.034	−.021	.020

Notes: Gray shading indicates that change between waves is *not* statistically significant ($p \geq .05$). Countries are ordered from lowest to highest mean number of children at the last wave.

Country-Level Trends

Next, we turn to trends, addressing whether these recent estimates present increases over previous levels. First, however, we establish the extent to which fertility declined across the cohorts of mothers observed here. We expect rises in sonless and daughterless families only where fertility declined. Mean numbers of children did fall significantly in 18 of 20 countries. At the earliest wave, in the late 1980s and early 1990s, means generally ranged from four to six children. These means typically fell by one or two by the last wave. Jordan and China experienced steeper declines, with reductions of 3.4 and 3.0, respectively.

The two exceptions to declining fertility are Yemen and Japan. Yemen's mean stayed around 6.3 in 1991 and 2013, while Japan's held steady just above two children from 1990 to 2015. Total fertility rates have declined in Yemen, but not until the late 1990s (United Nations 2019). This decline was too late to be captured here because most children of mothers aged 40–49 in 2013 were born before the late 1990s. Conversely, Japan's fertility decline was much too early to be captured. Its total fertility rate reached two children per woman in 1957 (Raymo et al. 2015).

While numbers of children fell in 18 countries, varying paces and starting points led to sizable variation at the last wave. East Asia stands out with the smallest numbers, ranging from a mean of 1.6 in China to 2.2 in Taiwan. Indonesia, Kazakhstan, Turkey, and India come next, with means just below and above three children. Other South, Southeast, and Central Asian countries, as well as Egypt, had means between 3.3 and 3.8 children. The rest of the MENA and Pakistan still had high mean numbers of children, ranging from 4.4 in Jordan to 6.4 in Yemen.

These fertility declines translated into virtually universal rises in sons-only families, with statistically significant increases in 17 of the 18 countries with declining numbers of children (see Table 1). The most dramatic increase was in China: as the mean fell from 4.6 children in 1975 to 1.6 in 2015, the share of families with only sons rose 31 percentage points from 9.4% to 40.1% (Figure 1). Taiwan, Indonesia, India, and Jordan had the next largest increases of about 10 percentage points.[7] The other countries experienced increases of two to eight percentage points.

Decompositions confirm fertility decline was overwhelmingly responsible for this growth of sons-only families. As shown in the online appendix, declining numbers of children account for the entire increase in 10 countries, including South Korea, China, and Indonesia. Declining numbers explain nearly all of the increases in Bangladesh and India, accounting for 96% and 94%, respectively, of their rises. For the remaining five countries with growing shares sons-only, fertility decline accounts for most of the increase, ranging from 89% of Jordan's rise to 62% of Tajikistan's.

The apparent exception to the increase in sons-only families is Kazakhstan. Point estimates indicate sons-only families rose by just over a percentage point from 19.2% to 20.3%, but it is not statistically significant at the .05 level (see Table 1). This tiny rise is consistent, however, with the small reduction in mean numbers

[7] Taiwan's proportion sonless reached a high of 27.6% a decade earlier, in 2006. However, this early high may be a product of sampling error. The 2006 result does not match the longer time trend and is within the 95% confidence interval, which is wide because of small sample sizes (see Figure 1).

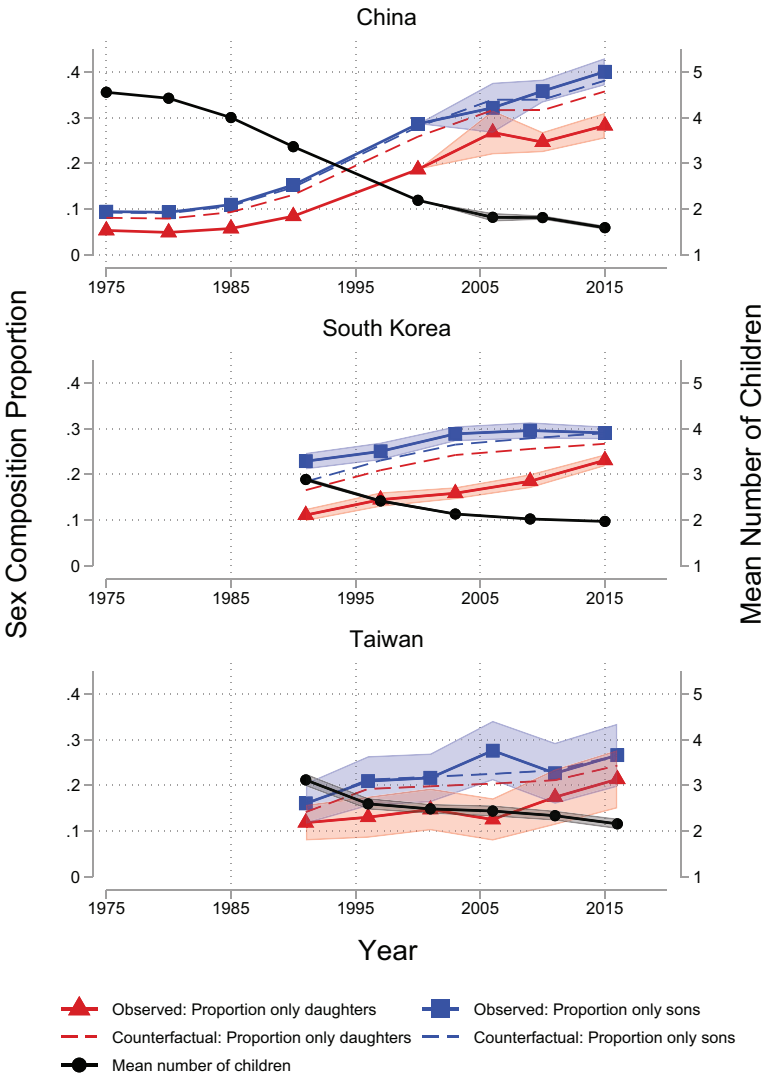

Fig. 1 Mean number of children for mothers aged 40–49 and proportions with only sons and only daughters by survey wave for China, South Korea, and Taiwan. Shaded areas indicate 95% confidence intervals. Solid symbols indicate the difference between first and last waves is statistically significant ($p < .05$).

of children, from 3.06 to 2.84, during the four years we observed Kazakhstan. The decomposition indicates this slight decline would result in a rise of only 1.2 percentage points.

Recent estimates of proportions of families with only daughters present widespread, but not universal, increases. There were statistically significant rises in sonless families in 13 of the 18 countries with fertility declines. China again is a remarkable outlier. The share daughters-only rose from 5.3% to 28.3% in China—an absolute increase of 23 percentage points and a quintupling of relative size. Nearby

South Korea and Taiwan also experienced large increases of 12 and 10 percentage points, respectively. In relative terms, these increases roughly doubled proportions sonless. Indonesia and Turkey's increases in sonless families are also notable at 8 and 7 percentage points, respectively, comprising near doublings. Another eight countries experienced modest rises, ranging from two to five percentage points.

Decompositions confirm fertility decline was also responsible for most of the rises in daughters-only families. Declining numbers account for the entire rise in seven of the 13 countries with increases, including India and Indonesia. Additionally, in China and Taiwan, declining numbers accounted for nearly all of the increase, explaining 95% and 94%, respectively, of the total changes in sonless families. In another four countries, declining numbers were responsible for most of the increase, ranging from 88% of Bangladesh's rise to 61% of Tajikistan's. Declining numbers contributed roughly half of South Korea's sizable increase in sonless families and Vietnam's modest increase. In these two countries, changes in number-specific proportions daughters-only also contributed substantially to the growth of sonless families.

The five countries where numbers of children declined, but shares of families that were sonless did not rise significantly, are Kazakhstan, Kyrgyz Republic, Nepal, Egypt, and Pakistan (see Table 1). Estimates for changes in daughters-only families in these countries range from 0.3 to 1.9 percentage points and are not statistically significant at the .05 level. The positive direction is consistent with tiny rises, but they may well be due to sampling error. In Kazakhstan, the lack of a statistically significant rise of daughters-only families appears to be due to its small fertility decline—just as with sons-only families. The decomposition indicates its declining numbers translate into a rise of 1.1 percentage points, which is identical to the observed increase. Similarly, Kazakhstan's observed proportion sonless did not differ from counterfactuals.

Parents' interference with sex composition prevented (larger) rises of sonless families in Kyrgyz Republic, Nepal, Egypt, and Pakistan. Observed proportions daughters-only are significantly below counterfactuals for these countries. Further, decompositions indicate changes in proportions daughters-only counterbalanced larger rises that would have occurred due to declining numbers of children alone. For example, Egypt's declining fertility would have pushed up the share daughters-only by 2.3 percentage points. However, decreases in numbers-specific daughters-only families reduced the proportion sonless by 1.5 percentage points, holding Egypt to a rise of 0.8 percentage points (Figure 2).

Relationship With Numbers of Children

Proportions of families with children of one sex did rise as numbers declined, but the relationship is not a simple linear one. The relationship is curvilinear, as shown in scatterplots of the mean number of children by proportions of families with only sons and only daughters (Figure 3). Each of the 290 dots in these plots represents a Chinese province–wave, Indian state–wave, or country–wave for the other 18 countries. The curvilinear pattern is driven by biological constraints. Under a sex-indifferent counterfactual scenario, the shares of families with only sons or only daughters are each less than 5% in families with five or more children. As the number declines to three and then two children, shares sons-only and daughters-only rise to over a

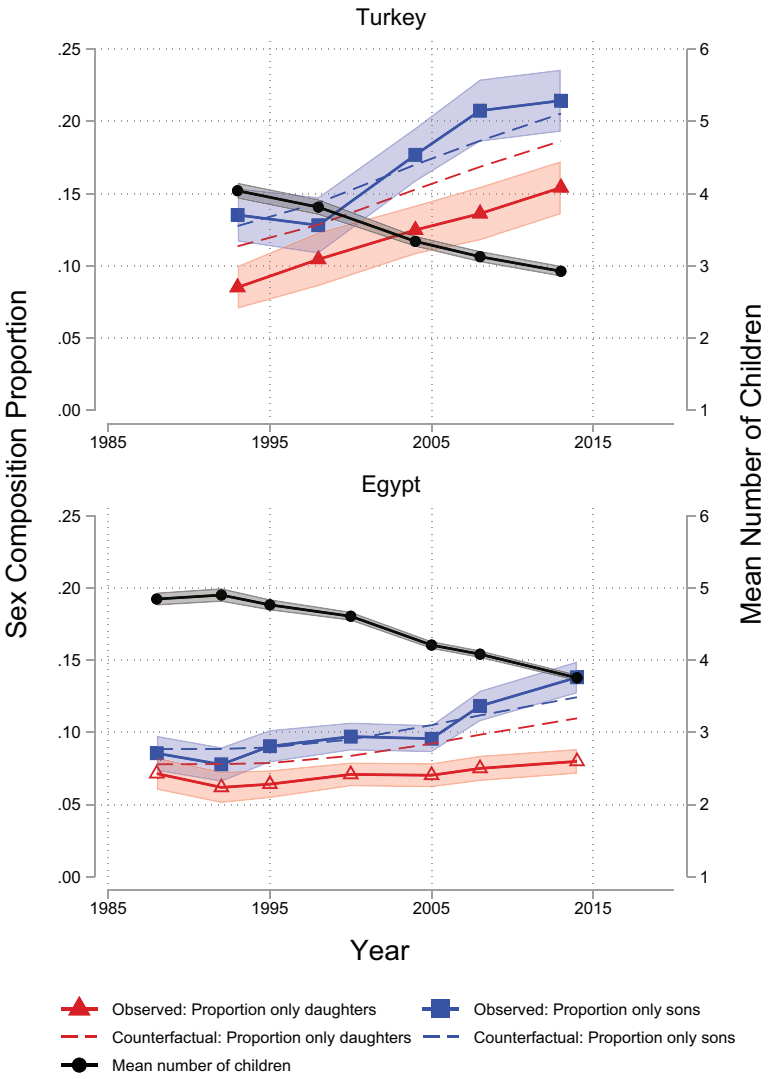

Fig. 2 Mean number of children for mothers aged 40–49 and proportions with only sons and only daughters by survey wave for Turkey and Egypt. Shaded areas indicate 95% confidence intervals. Solid symbols indicate the difference between first and last waves is statistically significant ($p < .05$); hollow symbols indicate the difference is *not* statistically significant ($p \geq .05$).

tenth and then jump to a quarter. All one-child families have children of only one sex, with roughly half sons and half daughters.

This curvilinear relationship means the endpoint, as well as the amount of fertility decline, shapes the extent to which sonless and daughterless families increase. For instance, declines from four to three children and from three to two, on average, represent reductions of one child. However, ending at two children, on average, rather than three, results in substantially larger numbers of families with children of one sex. This point is illustrated empirically by comparing Pakistan, Taiwan, and Turkey.

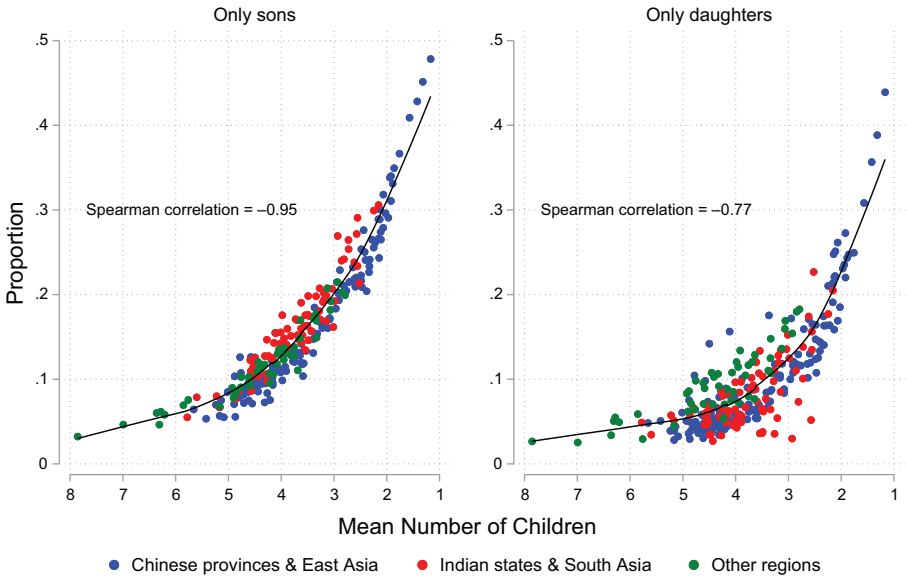

Fig. 3 Scatterplots of mean numbers of children by proportion of mothers aged 40–49 with only sons and only daughters for all waves (n=290)

These three countries' means all fell by about one child, but the increases in sons-only families varied markedly (see Table 1). A decline of about one child pushed Taiwan from 16.0% to 26.6% sons-only, while Turkey rose more modestly from 13.5% to 21.4%, and Pakistan rose only slightly from 5.5% to 7.7%. These disparate increases in sons-only families match their endpoints, with Taiwan dropping to the lowest mean of 2.2 children, Turkey falling to an intermediate 2.9, and Pakistan remaining high at 4.9.

The relationship between numbers of children and proportions of families with one sex is stronger for sons-only families than daughters-only families (see Figure 3). In the sons-only plot, waves are clustered tightly together in a curvilinear pattern. The Spearman correlation of –.95 between the mean number of children and proportion sons-only is also incredibly close to (negative) one. In the daughters-only plot, the waves are scattered more loosely in a curvilinear pattern with a Spearman correlation of –.77.

Empirically, lower fertility was also required for daughters-only families to reach the same levels as sons-only families. This difference is illustrated by locally weighted regression lines showing the best-fitting (curvilinear) relationship. For sons-only families, this best-fitting line crosses a 10% threshold at just under a mean of five children. For daughters-only families, the line crosses 10% at a lower mean of 3.5 children. Similarly, the sons-only best-fitting line reaches 20% at a mean of three children, while it required a mean of nearly two children for daughters-only families to reach this 20% threshold.

Differences between sons-only and daughters-only families reflect parents' interference with sex composition. Even without such interference, however, mean numbers of children and proportions with one sex would not be perfectly correlated.

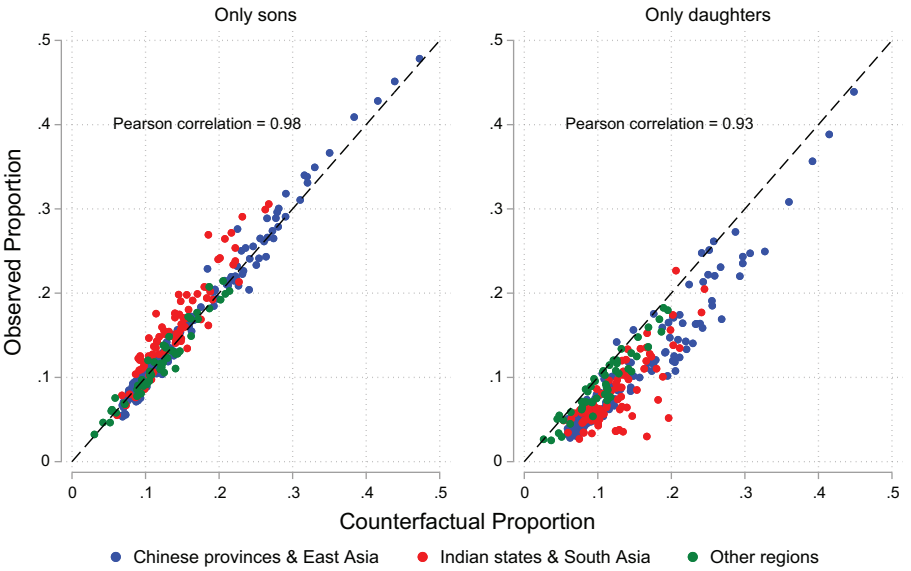

Fig. 4 Scatterplots of observed and counterfactual proportions of mothers aged 40–49 with only sons and only daughters for all waves ($n = 290$)

Identical means arise from different compositions and sex-indifferent counterfactual proportions are determined by composition, not means. For instance, a population in which equal numbers of families have two, three, and four children has a mean of three. A population in which 10% of families have two children, 80% have three children, and 10% have four children also has a mean of three. The first population's counterfactual proportion daughters-only is 13.7%, while the second population's is 12.2%.

To adjust for this slight mismatch between means and composition, we examined the relationship between observed and counterfactual proportions (Figure 4). The associations of observed proportions with counterfactual proportions are stronger, but marked differences between sons-only and daughters-only families remain. Waves in the sons-only plot cluster tightly along the diagonal line marking where observed and counterfactual proportions are identical. These observed and counterfactual proportions sons-only have a nearly perfect Pearson correlation of .98. For daughters-only families, many waves are farther from the diagonal line and the Pearson correlation is .93.

These scatterplots of observed versus counterfactual proportions also highlight the gendered nature of families' interference with sex composition. Strikingly, waves in the daughters-only plot are positioned on or under the diagonal line, with several observed proportions falling markedly below the counterfactual. This pattern indicates sizable numbers of families ensured sons through additional births or sex-selective abortion. Such behavior was common enough to suppress sonless families in the broader population. By contrast, sons-only families were largely at or slightly above counterfactuals. In the sons-only plot, most waves do cluster tightly on the diagonal, but waves with greater distance from the line tend to be above, rather than below, it.

The Role of Family Systems

Comparisons across countries point to the importance of family systems in shaping these patterns. In bilateral Southeast Asian countries, prevalence of sons-only and daughters-only families is a simple function of fertility levels. In Indonesia, Cambodia, and the Philippines, observed trends are remarkably close to counterfactual scenarios (Figure 5). Observed proportions sons-only and daughters-only are generally within a percentage point of counterfactuals for Indonesia and Cambodia and within two for the Philippines. These small differences are not statistically significant. Further, decompositions indicate that fertility decline, as captured in the number composition component, accounts for virtually all the increases in daughters-only and sons-only families in these three countries. The only slight exception is for sons-only families in the Philippines, where fertility decline accounts for 79% of the rise. Overall, families in bilateral contexts appear to leave sex composition of children largely up to chance.

Suppression of sonless families is widespread in the rest of the region, where patrilineal family systems prevail. Observed proportions daughters-only are significantly below counterfactuals in 14 countries. These patrilineal gaps of generally two to eight percentage points were present in South Asia (India, Nepal, Bangladesh, Pakistan), East Asia (China, South Korea, Taiwan), Central Asia (Kyrgyz Republic, Tajikistan), and the MENA (Egypt, Jordan, Yemen), as well as Turkey and Vietnam. For instance, in 2013, Turkey's proportion daughters-only stood at 15.4%, which was 3.2 percentage points below the counterfactual of 18.7% (see Figure 2).

Patrilineal gaps between observed and counterfactual proportions sonless often widened as fertility declined further. Such widening was most dramatic in India and Nepal, where gaps between observed and counterfactual proportions sonless doubled from three to seven percentage points. For instance, in 1992, India had a mean of 4.1 children and stood at 7.7% sonless, which was 2.9 percentage points below the sex-indifferent counterfactual of 10.6% (Figure 6). In 2015, India's mean dropped to 3.1 children and the percentage sonless rose to 9.8%, but this observed share was now 7.1 percentage points below the new counterfactual of 16.9%. Less dramatic, but still visible, expansions of this gap occurred in China, Egypt, and Bangladesh (see Figures 1, 2, and 6, respectively). Notably, South Korea shows initial widening from 1991 to 2003, followed by a narrowing to 2015, in which the proportion sonless rose closer to the counterfactual (see Figure 1). Taiwan suggests a similar, but less definitive, trend of widening followed by narrowing with much wider confidence intervals.

These gaps widened as fertility squeezes tightened and families increasingly interfered with sex composition in response. Decompositions indicate that even larger rises in sonless families were suppressed. The daughters-only component is negative for several countries, indicating declining number-specific proportions daughters-only pulled down the total proportion daughters-only. This suppression is most marked in Egypt (–.015), Nepal (–.015), India (–.016), and Yemen (–.021), where it reduced total changes in sonless shares by two percentage points. As noted earlier, this interference prevented statistically significant rises of sonless families in Egypt, Nepal, and Pakistan as fertility declined. (In Yemen, it caused sonless families to decrease as fertility held steady.) In other countries, rising sonlessness was suppressed, but not avoided entirely. For example, in India, if families' interference with sex composition had stayed at 1992 levels, fertility decline alone would have pushed up daughters-only

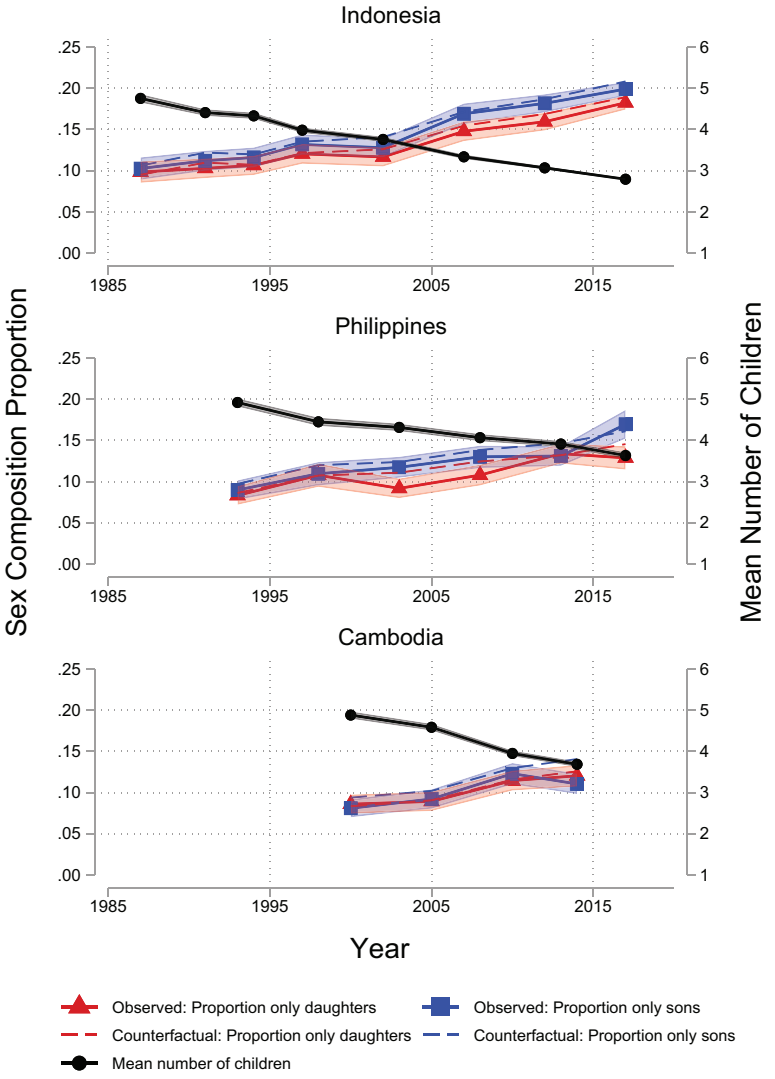

Fig. 5 Mean number of children for mothers aged 40–49 and proportions with only sons and only daughters by survey wave for Indonesia, the Philippines, and Cambodia. Shaded areas indicate 95% confidence intervals. Solid symbols indicate the difference between first and last waves is statistically significant ($p < .05$).

families by four percentage points from 1992 to 2015. However, reductions in proportions daughters-only in one-child, two-child, and three-child families cut that potential rise in half, holding it to two percentage points.

While suppression of daughters-only families was widespread across patrilineal countries, elevation of sons-only families was also present in a few. Proportions sons-only were consistently two to four percentage points above counterfactual levels in India and Nepal (see Figure 6). For instance, in 2015 India, the percentage sons-only stood at 22.3%, nearly four points above the counterfactual of 18.7%. Similarly, in

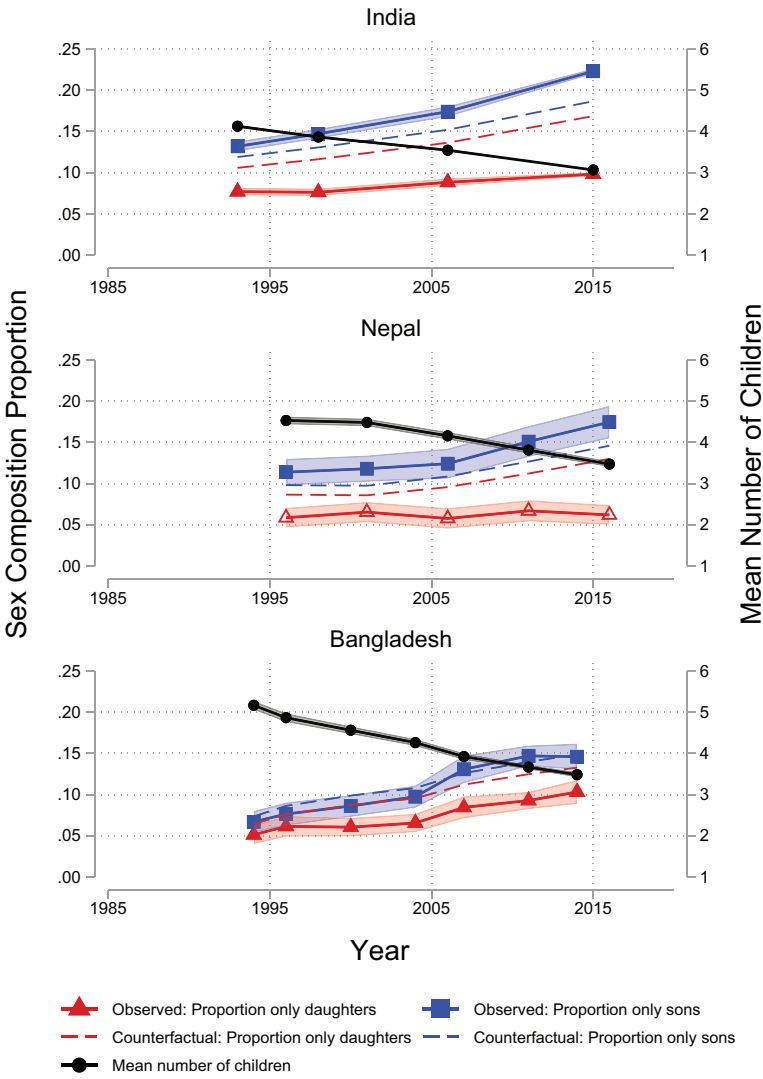

Fig. 6 Mean number of children for mothers aged 40–49 and proportions with only sons and only daughters by survey wave for India, Nepal, and Bangladesh. Shaded areas indicate 95% confidence intervals. Solid symbols indicate the difference between first and last waves is statistically significant ($p < .05$); hollow symbols indicate the difference is *not* statistically significant ($p \geq .05$).

2016, 17.5% of Nepali families had only sons, which was three percentage points higher than the counterfactual of 14.6%. Sons-only families were also elevated in South Korea in the 1990s and early 2000s (see Figure 1). In 1991, for instance, 22.9% of South Korean families had only sons, more than four percentage points above the counterfactual of 18.4%. This elevated share of sons-only families subsided and then disappeared in the 2000s, however. In 2015, South Korea's observed and counterfactual percentages sons-only were nearly identical at 29.1% and 29.0%, respectively. Sons-only families were not elevated in other patrilineal countries with

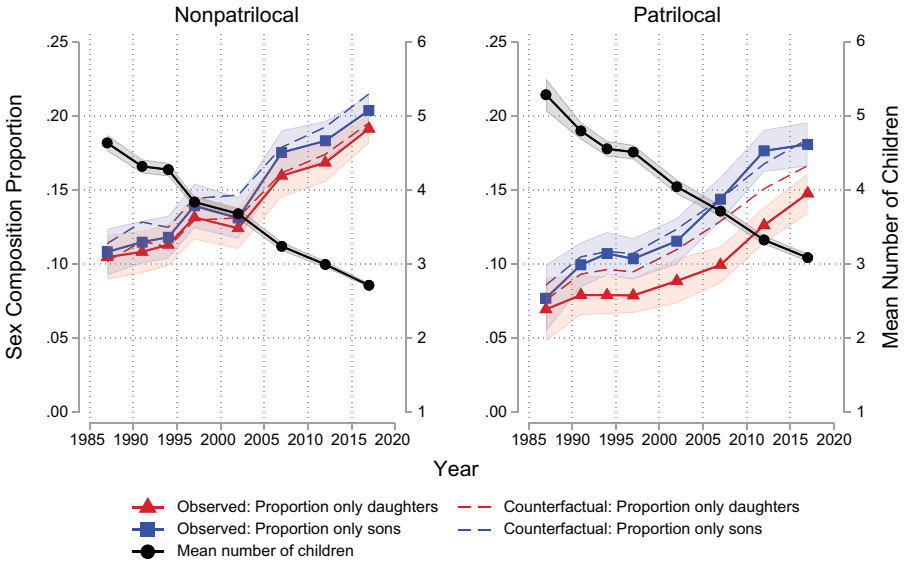

Fig. 7 Mean number of children for mothers aged 40–49 and proportions with only sons and only daughters by survey wave in patrilocal and nonpatrilocal provinces of Indonesia. Shaded areas indicate 95% confidence intervals. Solid symbols indicate the difference between first and last waves is statistically significant ($p < .05$).

sizable fertility declines. By contrast, proportions of families with only sons generally stayed at or near counterfactual levels in China, Taiwan, Bangladesh, and Turkey.

South Korea also stands out as the only country where patrilineal gaps between observed and counterfactual proportions narrowed for both sons-only and daughters-only families (see Figure 1). From the mid-1990s onward, more and more South Korean families had left sex composition up to chance. This reduction in parents' interference aided the growth of daughters-only families. In 1991, proportions daughters-only were markedly below biologically normal levels in one-child, two-child, and three-child families. By 2015, these proportions had risen to normal levels in two-child and three-child families, but not one-child families. In turn, as noted earlier, half of the 12-percentage-point rise in daughters-only families is due to increasing number-specific proportions daughters-only. Reductions in parents' interference with sex composition also suppressed the rise of sons-only families. Fertility decline would have pushed up sons-only families by 14 percentage points if number-specific proportions sons-only remained at 1991 levels. Instead, greater sex indifference appears to have held the increase in sons-only families to six percentage points as families increasingly left sex composition up to chance. This suppression of sons-only families is due largely to changes in two-child families. In 1991, 39.3% of two-child families in South Korea consisted of two sons, but in 2015, this percentage plunged to 25.9%, consistent with a biologically normal level.

Subnational analysis of Indonesia replicates differences between patrilineal and bilateral countries, reinforcing the importance of family systems. In nonpatrilocal provinces, the rise of sonless and daughterless families followed counterfactuals even more closely than Indonesia as a whole (Figure 7). In patrilocal provinces, however,

suppression of sonless families appears. Observed proportions daughters-only fell significantly below sex-indifferent counterfactual levels from 1991 onward as mean numbers of children declined. However, the proportion sons-only was not higher than the counterfactual. Patrilocal Indonesia is more similar to China and Bangladesh than to India and Nepal.

Outside bilateral Southeast Asia, there are only three countries in which sonless families were not suppressed. In Morocco, Kazakhstan, and Japan, differences between observed and counterfactual proportions daughters-only were never statistically significant. Morocco still had relatively high fertility with a mean of 4.6 children at the last wave. Suppression of sonless families may emerge in the future when fertility dips lower, although suppression of sonless families was present in other countries with higher fertility than Morocco. In Japan, suppression of sonless families may have occurred in the past when fertility first dipped to low levels.

Subnational Trends in China and India

Subnational trends for China and India reinforce, but also extend, the country-level results. The subnational analysis of China shows empirical levels of single-sex families have already approached the theoretical maximum. The share of families with only sons was close to half in urban provinces as a result of famously high numbers of one-child families. Shanghai had the highest proportions, at 47.8% sons-only and 43.9% daughters-only in 2000. Beijing was close behind with 45.1% sons-only and 38.8% daughters-only.

Other Chinese provinces still had comparatively low levels of sonless and daughterless families in 2000. At the low end, many provinces were similar to 2015 India, with about 20% sons-only and 10% daughters-only, including Fujian, Guangxi, Guizhou, Henan, Jiangxi, Ningxia, and Qinghai. Subnational trends also matched the national pattern of suppression of sonless families with little or no elevation of sons-only families. For nearly all provinces, the proportion sonless was below sex-indifferent counterfactuals, while proportions sons-only were at or near counterfactual levels.

The India subnational analysis highlights just how far observed trends can depart from sex-indifferent counterfactuals. Like neighboring Nepal, several North Indian states avoided rises in sonless families. Sonless families held steady in Punjab, Haryana, Rajasthan, Gujarat, Maharashtra, Madhya Pradesh, Bihar, and Jharkhand as fertility declined. Punjab is the most extreme case. As mean numbers of children fell from 3.9 to 2.6 in Punjab, daughters-only families stayed at 4–5%, even as the counterfactual doubled from 9.7% to 19.6% (Figure 8). Elevation of sons-only families was striking in these northern states as well. In Punjab, for instance, the share sons-only ballooned to 27.2%, rising more than five percentage points above the counterfactual of 21.7%. In Uttar Pradesh and Uttarakhand, families' interference caused sonless families to fall, rather than rise, as fertility declined. The mean number of children declined from 4.6 in 1992 to a still high 4.0 in 2015, while the share of families with only daughters decreased slightly, but significantly, from 5.8% to 4.5%.

The Indian subnational analysis also suggests the inexorable grip of a fertility squeeze can uncover son preference even in relatively egalitarian states. Kerala and

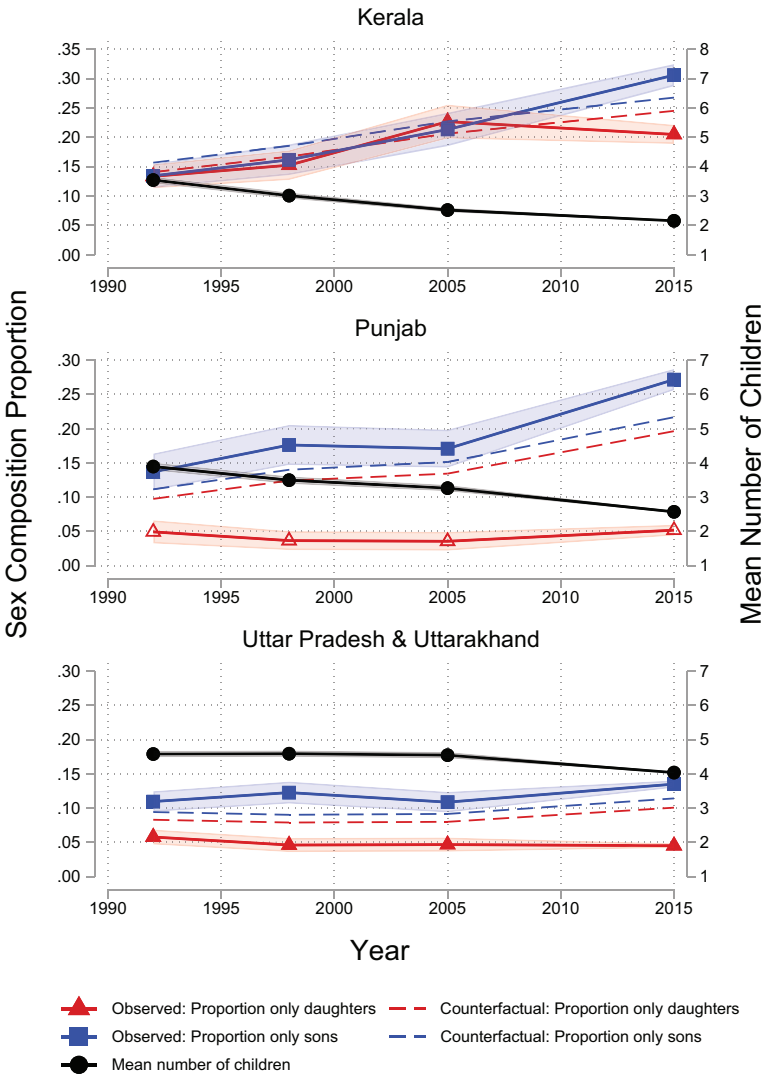

Fig. 8 Mean number of children for mothers aged 40–49 and proportions with only sons and only daughters from 1992 to 2015 for selected Indian states. Shaded areas indicate 95% confidence intervals. Solid symbols indicate the difference between first and last waves is statistically significant ($p < .05$); hollow symbols indicate the difference is not statistically significant ($p \geq .05$).

Tamil Nadu—southern states where fertility declined early—stand out from the rest of India with much higher sonless levels, approaching a fifth of families (Allendorf 2020). Unlike much of India, Kerala and Tamil Nadu's trends in proportions daughterless and sonless were close to the counterfactuals from 1992 to 2005 as mean numbers of children declined from over 3 to 2.8. In these states, proportions sons-only were even slightly lower than earlier counterfactuals, hinting at suppression of sons-only families. When mean numbers of children fell further to 2.2 in 2015, however,

the all-India pattern emerged. In 2015, proportions sons-only rose four percentage points above counterfactuals in Kerala and Tamil Nadu, while proportions daughters-only fell four and six percentage points, respectively, below counterfactuals. Further, decompositions indicate parents' interference with sex composition contributed to these states' rises in sons-only families, making proportions sons-only even higher in 2015 than they would have been from fertility decline alone.

Discussion and Conclusion

The proportions of families with children of one sex rose in Asia and North Africa in recent decades as fertility declined. Among 18 countries with declining fertility, sons-only families increased significantly in 17 countries and daughters-only families in 13. The Kyrgyz Republic, Egypt, Nepal, and Pakistan, as well as several Indian states, avoided rises in sonless families as fertility declined. Kazakhstan is the remaining, less meaningful, exception. Tiny rises in sons-only and daughters-only families in Kazakhstan were not statistically significant, but were consistent with its small fertility decline.

By 2015, families with children of one sex were a sizable presence in the region—collectively more than a quarter of families had only sons and nearly a fifth only daughters in these 20 countries. In keeping with its low fertility, these families were most common in East Asia, reaching highs of 40.1% sons-only and 28.3% daughters-only in China. Numbers were also notable in Indonesia, Turkey, and Kazakhstan, where a fifth or more of families had only sons and more than 15% only daughters. At 22%, India also stands out with a large share sons-only, but not daughters-only. Proportions daughterless and sonless generally made up a tenth or more of families in other countries, but numbers remained small where high fertility persisted.

Differences between sons-only and daughters-only families were stark. Increases in sons-only families were not only universal, but often larger than those for daughters-only families. Sons-only families also rose at higher levels of fertility. Reaching a tenth of families with only sons generally occurred at a mean of over four children, while it required a mean of about three children for daughters-only families. Further, while only a handful of countries avoided rises in daughters-only families, suppression of these sonless families was widespread. Numbers of sons-only families were also elevated above counterfactual levels in India, Nepal, and South Korea.

These gendered differences mapped onto family systems. Shares of daughters-only families lagged below sex-indifferent counterfactuals in nearly all patrilineal countries. By contrast, levels of both sons-only and daughters-only families largely matched sex-indifferent counterfactuals in bilateral Southeast Asia. This country-level pattern was replicated at the subnational level in Indonesia; marked suppression of sonless families emerged in patrilocal provinces, while trends in nonpatrilocal provinces matched counterfactuals. These differences across family systems are consistent with previous research on imbalanced sex ratios, which emphasize the importance of fertility declines when combined with son preference in patrilineal contexts (Chakraborty and Kim 2010; Das Gupta et al. 2003; Guilmoto 2009).

These family changes illustrate that fertility decline, and the demographic transition more broadly, creates changes in sex composition that extend beyond sex ratios.

Further, just as shifting sex ratios profoundly shape marriage markets and other extrafamilial processes (Kashyap et al. 2015; Porter 2016; South and Trent 2010), these shifts in family composition may lead to profound changes in gendered intrafamilial processes, such as elder care. More broadly, these large shares of families with only daughters may erode patrilineal family systems (Allendorf 2020). In East Asia, where numbers of sonless families are highest, son preference, patrilocal residence, and patrilineal financial exchanges already appear to be weakening (Chen and Jordan 2018; Lei 2013; Lin 2009). In Japan, son preference disappeared several decades ago as fertility reached low levels (Fuse 2013; Yamamura 2013). Urbanization, educational expansion, and rising living standards explain some, but not all, of these changes (Choi and Hwang 2020; Chung and Das Gupta 2007; Kashyap and Villavicencio 2016; Yoo et al. 2017). The rise of sonless families may well be another contributing factor. Constraints posed by sonless families may be part of the self-correcting dynamic of changing sex ratios during a demographic transition (Diamond-Smith and Bishai 2015; Guilmoto 2009).

New research should track these trends into the future and examine the theorized implications. Sons-only and daughters-only families will likely rise more in much of the region as fertility declines further. Even in 2015–2020, period total fertility rates neared two children per woman in much of the region, including rates of 2.4 in South Asia and 2.2 in Southeast Asia (United Nations 2019). Apart from those in East Asia, the most recent cohorts tracked here, those aged 40–49 around 2015, had higher fertility—typically three or more children. These cohorts were just approaching fertility levels that translate into sizable, and perhaps socially meaningful, levels of sonless families. What share would be socially meaningful, or indeed if any share is meaningful, remains an open question. We only show sonless families—and, to an even larger extent, daughterless families—rose across the region in recent decades. The extent to which this profound shift sparks further change remains speculative. Future research should investigate if substantial numbers of sonless families do weaken patrilineal family systems. ■

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References

Allendorf, K. (2020). Another gendered demographic dividend: Adjusting to a future without sons. *Population and Development Review, 46,* 471–499.

Altindag, O. (2016). Son preference, fertility decline, and the nonmissing girls of Turkey. *Demography, 53,* 541–566.

Anderson, T., & Kohler, H.-P. (2015). Low fertility, socioeconomic development, and gender equity. *Population and Development Review, 41,* 381–407.

Anukriti, S. (2018). Financial incentives and the fertility-sex ratio trade-off. *American Economic Journal: Applied Economics, 10*(2), 27–57.

Arnold, F., Choe, M. K., & Roy, T. K. (1998). Son preference, the family-building process and child mortality in India. *Population Studies, 52,* 301–315.
Arnold, F., Kishor, S., & Roy, T. K. (2002). Sex-selective abortions in India. *Population and Development Review, 28,* 759–785.
Aydin, B. K., Saka, N., Bas, F., Bas, E. K., Coban, A., Yildirim, S., . . . Darendeliler, F. (2019). Frequency of ambiguous genitalia in 14,177 newborns in Turkey. *Journal of the Endocrine Society, 3,* 1185–1195.
Bloom, D. E., & Williamson, J. G. (1998). Demographic transitions and economic miracles in emerging Asia. *World Bank Economic Review, 12,* 419–455.
Bongaarts, J., & Guilmoto, C. Z. (2015). How many more missing women? Excess female mortality and prenatal sex selection, 1970–2050. *Population and Development Review, 41,* 241–269.
Chakraborty, T., & Kim, S. (2010). Kinship institutions and sex ratios in India. *Demography, 47,* 989–1012.
Chandramouli, C. (2013). *Census of India 2011: Primary census abstract, data highlights* (Report). New Delhi: Office of the Registrar General & Census Comissioner, India. Retrieved from https://censusindia.gov.in/2011census/population_enumeration.html
Chao, F. Q., Gerland, P., Cook, A. R., & Alkema, L. (2019). Systematic assessment of the sex ratio at birth for all countries and estimation of national imbalances and regional reference levels. *Proceedings of the National Academy of Sciences, 116,* 9303–9311.
Chen, J., & Jordan, L. P. (2018). Intergenerational support in one- and multi-child families in China: Does child gender still matter? *Research on Aging, 40,* 180–204.
Choi, E. J., & Hwang, J. (2020). Transition of son preference: Evidence from South Korea. *Demography, 57,* 627–652.
Chung, W., & Das Gupta, M. (2007). The decline of son preference in South Korea: The roles of development and public policy. *Population and Development Review, 33,* 757–783.
Clark, S. (2000). Son preference and sex composition of children: Evidence from India. *Demography, 37,* 95–108.
Coleman, D. (2006). Immigration and ethnic change in low-fertility countries: A third demographic transition. *Population and Development Review, 32,* 401–446.
Das Gupta, M. (1999). Lifeboat versus corporate ethic: Social and demographic implications of stem and joint families. *Social Science & Medicine, 49,* 173–184.
Das Gupta, M., Chung, W., & Li, S. (2009). Evidence for an incipient decline in numbers of missing girls in China and India. *Population and Development Review, 35,* 401–416.
Das Gupta, M., Jiang, Z., Li, B., Xie, Z., Chung, W., & Hwa-Ok, B. (2003). Why is son preference so persistent in East and South Asia? A cross-country study of China, India and the Republic of Korea. *Journal of Development Studies, 40*(2), 153–187.
Diamond-Smith, N., & Bishai, D. (2015). Evidence of self-correction of child sex ratios in India: A district-level analysis of child sex ratios from 1981 to 2011. *Demography, 52,* 641–666.
Diamond-Smith, N., & Rudolph, K. (2018). The association between uneven sex ratios and violence: Evidence from 6 Asian countries. *Plos One, 13,* e0197516. https://doi.org/10.1371/journal.pone.0197516
Dyson, T. (2011). The role of the demographic transition in the process of urbanization. *Population and Development Review, 37*(Suppl.), 34–54.
Dyson, T., & Moore, M. (1983). On kinship structure, female autonomy, and demographic behavior in India. *Population and Development Review, 9,* 35–60.
Fuse, K. (2013). Daughter preference in Japan: A reflection of gender role attitudes? *Demographic Research, 28,* 1021–1051. https://doi.org/10.4054/DemRes.2013.28.36
Goodkind, D. (1996). On substituting sex preference strategies in East Asia: Does prenatal sex selection reduce postnatal discrimination? *Population and Development Review, 22,* 111–125.
Goodkind, D. (2011). Child underreporting, fertility, and sex ratio imbalance in China. *Demography, 48,* 291–316.
Guilmoto, C. Z. (2009). The sex ratio transition in Asia. *Population and Development Review, 35,* 519–549.
Guilmoto, C. Z. (2015). Mapping the diversity of gender preferences and sex imbalances in Indonesia in 2010. *Population Studies, 69,* 299–315.
Guilmoto, C. Z. (2017). Gender bias in reproductive behaviour in Georgia, Indonesia, and Vietnam: An application of the own-children method. *Population Studies, 71,* 265–279.
Guilmoto, C. Z., Dudwick, N., Gjonca, A., & Rahm, L. (2018). How do demographic trends change? The onset of birth masculinization in Albania, Georgia, and Vietnam 1990–2005. *Population and Development Review, 44,* 37–61.

Gupta, B. (2014). Where have all the brides gone? Son preference and marriage in India over the twentieth century. *Economic History Review, 67,* 1–24.
Heger Boyle, E., King, M., & Sobek, M. (2019). *IPUMS Demographic and Health Surveys: Version 6* [Data set]. IPUMS and ICF. https://doi.org/10.18128/D080.V6
Hesketh, T., & Xing, Z. W. (2006). Abnormal sex ratios in human populations: Causes and consequences. *Proceedings of the National Academy of Sciences, 103,* 13271–13275.
Jayachandran, S. (2017). Fertility decline and missing women. *American Economic Journal: Applied Economics, 9*(1), 118–139.
Kandiyoti, D. (1988). Bargaining with patriarchy. *Gender & Society, 2,* 274–290.
Kashyap, R. (2019). Is prenatal sex selection associated with lower female child mortality? *Population Studies, 73,* 57–78.
Kashyap, R., & Behrman, J. (2020). Gender discrimination and excess female under-5 mortality in India: A new perspective using mixed-sex twins. *Demography, 57,* 2143–2167.
Kashyap, R., Esteve, A., & Garcia-Roman, J. (2015). Potential (mis)match? Marriage markets amidst sociodemographic change in India, 2005–2050. *Demography, 52,* 183–208.
Kashyap, R., & Villavicencio, F. (2016). The dynamics of son preference, technology diffusion, and fertility decline underlying distorted sex ratios at birth: A simulation approach. *Demography, 53,* 1261–1281.
Kitagawa, E. M. (1955). Components of a difference between two rates. *Journal of the American Statistical Association, 50,* 1168–1194.
Lagos, D. (2018). Looking at population health beyond "male" and "female": Implications of transgender identity and gender nonconformity for population health. *Demography, 55,* 2097–2117.
Lei, L. (2013). Sons, daughters, and intergenerational support in China. *Chinese Sociological Review, 45*(3), 26–52.
Li, J. (2017). Rate decomposition for aggregate data using Das Gupta's method. *Stata Journal, 17,* 490–502.
Lin, T.-c. (2009). The decline of son preference and rise of gender indifference in Taiwan since 1990. *Demographic Research, 20,* 377–402. https://doi.org/10.4054/DemRes.2009.20.16
Lindholm, C. (1986). Kinship structure and political authority: The Middle East and Central Asia. *Comparative Studies in Society and History, 28,* 334–355.
Lutz, W., Cuaresma, J. C., Kebede, E., Prskawetz, A., Sanderson, W. C., & Striessnig, E. (2019). Education rather than age structure brings demographic dividend. *Proceedings of the National Academy of Sciences, 116,* 12798–12803.
National Bureau of Statistics (China). (2020). *China statistical yearbook 2019*. Retrieved from http://www.stats.gov.cn/tjsj/ndsj/2019/indexeh.htm
National Institute of Population and Social Security Research. (2017). *The fifteenth Japanese National Fertility Survey in 2015*. Tokyo, Japan: Department of Population Dynamics Research.
Porter, M. (2016). How do sex ratios in China influence marriage decisions and intra-household resource allocation? *Review of Economics of the Household, 14,* 337–371.
Preston, S. H., Heuveline, P., & Guillot, M. (2001). *Demography: Measuring and modeling population processes*. Malden, MA: Blackwell Publishers.
Raymo, J. M., Park, H., Xie, Y., & Yeung, W.-j. J. (2015). Marriage and family in East Asia: Continuity and change. *Annual Review of Sociology, 41,* 471–492.
Riswick, T., & Hsieh, Y.-H. (2020). Between rivalry and support: The impact of sibling composition on infant and child mortality in Taiwan, 1906–1945. *Demographic Research, 42,* 615–656. https://doi.org/10.4054/DemRes.2020.42.21
Sen, A. (1990). More than 100 million women are missing. *New York Review of Books, 37*(20), 61–66.
Smith-Greenaway, E., & Trinitapoli, J. (2020). Maternal cumulative prevalence measures of child mortality show heavy burden in sub-Saharan Africa. *Proceedings of the National Academy of Sciences, 117,* 4027–4033.
South, S. J., & Trent, K. (2010). Imbalanced sex ratios, men's sexual behavior, and risk of sexually transmitted infection in China. *Journal of Health and Social Behavior, 51,* 376–390.
Trent, K., & South, S. J. (2012). Mate availability and women's sexual experiences in China. *Journal of Marriage and Family, 74,* 201–214.
United Nations. (2019). *World population prospects 2019* (Report). New York, NY: United Nations Department of Economic and Social Affairs, Population Division.

Yamamura, E. (2013). Effects of sex preference and social pressure on fertility in changing Japanese families. *Journal of Socio-Economics, 46,* 97–104.
Yeung, W.-J. J., Desai, S., & Jones, G. W. (2018). Families in Southeast and South Asia. *Annual Review of Sociology, 44,* 469–495.
Yoo, S. H., Hayford, S. R., & Agadjanian, V. (2017). Old habits die hard? Lingering son preference in an era of normalizing sex ratios at birth in South Korea. *Population Research and Policy Review, 36,* 25–54.

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