

Son Preference at the Crossroads: A Comparison of Parity Progressions Across Birth Cohorts of Women in the Middle East and North Africa, Central Asia, and South Asia

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This publication appears under special circumstances: the author recently passed away and was therefore unable to see his work through to its final publication. The inclusion of this article is thus posthumous, in recognition of Konstantin Kazenin's valuable scientific contributions and his dedication to the field of population studies. We proceeded with the publication with the consent of the author's family. By publishing this work, we wish to ensure that Konstantin's insights remain accessible to the scientific community.

Since Konstantin was no longer able to respond to reviewers' comments, we decided not to continue with the standard review process. Instead one referee decided whether the paper (as it was) is publishable. The published paper is the version Konstantin originally submitted (without any changes, not even language editing). This was only possible because the paper was already in a very good shape.

The editors

Abstract: The paper studies cross-cohort changes of son preference effects upon parity progressions. In many countries of South Asia, Central Asia, the Middle East and North Africa women are more likely to have another child when they do not have a living son. However, little is known about how son preference in parity progressions changes over time or across birth cohorts of women in those countries. Understanding these changes is crucial, as son preference in parity progressions contributes to higher fertility rates and reinforces gender inequalities within families. The paper concentrates on son preference in parity progressions across 1950-89 birth cohorts of women in eight countries of the studied regions: Bangladesh, Egypt, Jordan, Nepal, Türkiye, Pakistan, Tajikistan and Uzbekistan. The studied cohorts were in their reproductive period in the time of fertility decrease in the process of the First Demographic Transition. Particularly, rates of transition to the 3rd child were consistently decreasing from the older to the younger cohorts. Birth histories from World Fertility Surveys and Demographic and Health Surveys are analyzed using event history techniques. Results show that the importance of not having a son increased for progression to the 3rd child in more recent cohorts. Having no daughter was not associated with higher progression risk in any of the cohorts. Son preference therefore persists despite social changes that may be expected to balance the value

of sons and daughters, such as urbanization and the growth of women's educational levels. In this aspect the studied countries are in sharp contrast with countries of Western and Northern Europe in the time of the First Demographic Transition, where son preference effects in parity progressions disappeared in the process of fertility decrease. Possible reasons for the stability of son preference in the countries under study are discussed. The cross-cohort dynamics of son preference in parity progressions are also compared to dynamics of sex-selective abortions in other countries of Asia known from earlier studies. Son preference in parity progressions appears to be generally more stable than sex-selective abortions, another manifestation of a higher value of sons, likely because the societal consequences of sex-selective abortions are more visible and widely recognized.

Keywords: Fertility · Gender preferences for children · Parity progressions · Low and middle income countries

1 Introduction

Son preference is a well-known phenomenon in different parts of the world. In recent decades, the effects of son preference in fertility have been detected in Central Asia, South Asia, South-Eastern Asia, and the Middle East and North Africa (MENA). Son preference has two different manifestations in fertility behavior. First, it can be achieved by sex-selective abortions, which result in an exacerbated sex ratio at birth (SRB; *Bongaarts 2013; Guilmoto 2009*). Second, son preference can impact parity progressions, so that women who have not reached the desired proportion of sons have a higher propensity to have an additional child or to progress to the next child more quickly than other women at the same parity (*Arnold 1997*).

The aim of the present paper is to explore the dynamics of son preference in parity progressions across birth cohorts of women in those countries where son preference effects are mainly observed in parity progressions. Studying this issue is crucial, as son preference in parity progressions has significant social implications. When dissatisfaction with the current number of sons makes additional childbearing more likely, this increases total fertility rates, especially in societies where fertility control is widely used (*Cleland et al. 1983*). In addition, when girls are born in such contexts, mothers tend to progress to the next birth more quickly, which means that girls are more likely to be disadvantaged during their childhood and participate in the care of younger siblings (*Clark 2000; Basu/de Jong 2010*). In some countries, son preference in parity progressions is also linked to very short birth intervals, which presents risks for maternal health (*Pimentel et al. 2020*).

Despite the socially important consequences of son preference effects in parity progressions, we know relatively little about the persistence of these effects in countries where they have been observed in recent decades. Socio-demographic changes in these countries differ in their expected impact on son preference (see Section 3.2 for details). On the one hand, the total fertility decrease associated

with the First Demographic Transition is expected to strengthen the role of gender preferences in fertility decisions, as decisions about having an additional child generally become more conditional when fertility rates decrease (*Bongaarts 2013*). On the other hand, various social transformations, such as urbanization and increasing educational attainment among women, are expected to narrow the gap in the perceived value of sons and daughters (*Dubuc 2018*). This, in turn, may make the effects of son preference weaker, possibly replacing son preference with a preference for children of both sexes or gender-neutral preferences.

In this context, son preference in actual fertility practices finds itself at a crossroads from which it can follow a number of different trajectories. The dynamics of son preference in parity progressions is a rare example of competition between different factors, some of which support the growth of a phenomenon and some of which suppress it. This situation highlights the importance of studying how son preference in parity progressions changes over time.

To fill the gap existing in the literature on this issue, the present paper focuses on countries where son preference regularly manifests through parity progressions, while sex-selective abortions are generally not common practice. The rise and fall of sex-selective abortions has received more attention in the literature (see Section 2.2 for details and references). As will be argued below, there are reasons to expect that son preference in parity progressions can be more stable over time than sex-selective abortions. Comparing the results of the present analysis with existing studies on the dynamics of sex-selective abortions allows for an assessment of the extent to which this expectation is borne out.

This paper uses a cohort perspective to compare son preference effects in parity transitions from 1950-1989 among birth cohorts of women in eight countries of Central and South Asia and MENA¹: Bangladesh, Egypt, Jordan, Nepal, Pakistan, Tajikistan, Türkiye, and Uzbekistan (see Section 3.1 for details on why the countries were chosen). Fertility rates in the studied countries exhibited a marked decline during the reproductive periods of these cohorts. During the same period, certain social changes that were expected to weaken son preference also took place in these countries, though the pace varied from one country to another (see Section 3.2 for details).

A comparison of women's birth cohorts makes it possible to answer two questions: (1) did the role of the gender composition of existing children for parity progressions become stronger with fertility decline? and (2) was son preference replaced by a less "male-oriented" preference for children with social changes that support greater gender equality, such as the preference to have at least one daughter and at least one son?

¹ In many studies, the term "differential stopping behavior" is used to describe sex preferences in parity progressions, indicating that the decision to stop childbearing depends on the sex composition of existing children. This term is avoided in the present paper, because the son preference effects in parity progressions considered here concern not only the fact of transition to the next child, but also the timing of this event.

2 Son preference in actual fertility practices: background

2.1 Social conditions of son preference

In general, son preference can be linked to any gender asymmetries resulting in the privileged position of men in a society (see *Jayachandran* 2015 for an overview of possible sources of son preference in low and middle income countries in recent decades). However, existing studies have highlighted a number of factors that are more closely associated with son preference in actual fertility practices.

These factors include the perceived advantages of having sons and the perceived disadvantages of having daughters, both of which lead to a higher value of sons than daughters. The advantages of having sons may be based on economic factors, as a family's financial stability may depend on having enough men in the family. In this case, parents expect to receive more support in their old age from sons than from daughters (*Das Gupta et al.* 2003). Sons also may be more valued in the context of patrilocal kinship and inheritance institutions, where daughters are normally "married off" to other families, which is especially characteristic for a number of countries of East Asia and South Asia (*Das Gupta et al.* 2003; *Jejeebhoy/Sathar* 2001). Additionally, women living in patriarchal societies may be motivated to have sons to achieve a higher social status within their husband's family (*Zimmermann* 2018). The perceived disadvantages of having daughters may include special responsibilities for parents. These include obligations to safeguard a daughter's honour and virginity until marriage. In countries where a dowry is required from the parents of a bride, having a daughter brings significant financial obligations (cf. *Arnold et al.* 2002).

The widespread urbanization observed in most low and middle income countries in recent decades is expected to make at least some of the factors contributing to son preference less pronounced. In agricultural contexts, men tend to play a central role in the family economy, whereas in cities, women may achieve greater financial independence due to better employment opportunities and more gender-egalitarian systems of property transmission (*Guilmoto* 2015: 204). Additionally, patriarchal kinship norms that require women to join their husband's family line after marriage generally tend to be weaker in urban populations (*Lei/Pals* 2011). The growth of women's educational attainment in low and middle income countries is another factor that may make son preference less prominent (*Dubuc* 2018). Higher educational attainment is likely to make a woman less dependent on her husband and his relatives, providing more employment opportunities and allowing for greater economic independence. Women with higher educational attainment may also be more able to support their parents. All of these changes can be expected to raise the perceived value of having daughters. Even if gender preferences do remain strong, a shift may take place to a more balanced preference for children of both sexes.

2.2 Dynamics of son preference

The most consistent finding from existing studies on changes in son preference effects in parity progressions over time is that they tend to emerge as fertility

declines, spreading from higher to lower parities (Channon 2015). However, the question of how stable son preference effects in parity progressions remain after their emergence has seldom been addressed. Among the few studies addressing this issue, *Asadullah et al.* (2021) showed that son preference effects remained stable in parity progressions in Bangladesh in recent decades, despite clear shifts towards reported balanced gender composition ideals among the younger generations. *Javed/Mughal* (2022) showed that in Pakistan, son preference was more prominent in progressions to certain parities among women interviewed between 2017–2018 compared to those interviewed in 1990–1991.

Son preference in parity progressions stands in sharp contrast to sex-selective abortions, as the dynamics of that practice have been studied in a relatively large number of countries (*Guilmoto* 2009; *Bongaarts* 2013; *Guilmoto et al.* 2018). The rise in sex-selective abortions has also been shown to occur after a significant decline in fertility: in low-fertility regimes, continuing childbearing until a son is born becomes unsustainable, leading parents to employ pre-birth sex-selection when the tools are available (*Bongaarts* 2013). However, countries where sex-selective abortions become a frequent practice exhibit different subsequent trends. In some countries, including Albania, Armenia, Georgia, Singapore, South Korea, and Montenegro, the prevalence of this practice decreased after one or two decades (*Guilmoto* 2009; *Guilmoto/Rahm* 2021 for an overview; *Robitaille/Milla*, 2022: 10 for Albania; *Guilmoto et al.* 2018 for Georgia; *Den Boer/Hudson* 2017; *Chun/Das Gupta* 2022 for South Korea). However, in other countries, sex-selective abortions persisted for over two decades (*Aksan* 2021 for India; *Becquet/Guilmoto* 2018 for Vietnam).

There are several reasons to expect son preference in parity progressions to be generally more stable than sex-selective abortions. First, skewed SRBs caused by sex-selective abortions have a significant consequence, which is described in the literature as the “marriage squeeze”, i.e., a critical surplus of men in the marriage market (*Guilmoto* 2009; *Huang* 2014). In some countries, such as South Korea, this marriage squeeze led to active policy measures against sex-selective abortions (*Den Boer/Hudson* 2017). In other countries that did not employ such measures, a decrease in sex-selective abortions may have resulted from an understanding of their harmful consequences to society (*Guilmoto et al.* 2018 for Georgia; but cf. *Song et al.* 2022 for China). In contrast, son preference in parity progression does not result in skewed SRB if it is calculated for children of all orders (*Basu/de Jong* 2010; *Bongaarts* 2013), and its social implications are far less noticeable than the marriage squeeze. Therefore, there are no reasons to expect a significant reaction to this phenomenon on the part of the state or society at large.

Second, intensive use of sex-selective abortions has been shown to be correlated with special conditions, including the cultural acceptance of abortions (*Bongaarts* 2013; *Guilmoto* 2009). Societies where abortions are less accepted may be characterized by stronger religious or ethnic traditions. In such contexts, the traditional male-oriented family practices, including son preference in parity progressions, can be more stable.

However, there are also a number of factors that may result in changes in son preference in parity progressions over time. As mentioned, in low and middle

income countries, the fertility transition is known to coincide with social changes such as urbanization and the increase in women's educational attainment, which can make it less important to have a son. In a number of countries where son preference was observed in actual fertility practices in recent decades, intentions for the next child and gender composition ideals have shifted towards gender-neutrality or the preference to have at least one son and one daughter (*Bhatnagar 2023; Channon/Karki 2018; Kazenin 2024*). These changes in ideals and intentions may precede changes in actual fertility practices in a way that reduces son preference patterns.

3 Studied countries: selection criteria and fertility trends

3.1 Selection criteria

The countries included in the analysis satisfy the following criteria, which are essential for the purposes of the study. First, survey data provide birth histories of women born between the 1950s and 1980s in these countries. This enables cross-cohort comparisons. Second, among the countries for which these data are available, countries were selected where son preference in actual fertility practices has been documented in recent decades, but where there is no substantial evidence of frequent sex-selective abortions.

The main reason for the latter criterion is that when sex-selective abortions are frequent, a decrease in son preference effects in parity progressions for a cohort does not necessarily mean that son preference will become weaker. Instead, it may be the case that sex-selective abortions are the main tool for achieving desired gender composition of children for that cohort, which would complicate cross-cohort comparisons. Further, if sex-selective abortions occur at a high frequency, problems arise in the interpretation of results concerning the spacing between births. If a couple wants a son but conceives a daughter and decides to undergo an abortion, the interval to the next birth will be longer. In this way, the accelerating impact of son preference on parity progressions will be biased downward (*Robitaille/Milla 2024*). Finally, if sex-selective abortions are frequent in a society, the gender composition of children born to women who have reached a given parity may be associated with their gender preferences for children, in which case the gender composition parameter is not exogenous, and the analysis may be biased.

Countries for which surveys cover all birth cohorts included in the study and son preference in parity progressions has been reported include Bangladesh (*Asadullah et al. 2021*), Egypt (*Vignoli 2006*), Nepal (*Leone et al. 2003*), Pakistan (*Javed/Mughal 2022*), Türkiye (*Altindag 2016*), and Uzbekistan (*Spoorenberg 2018*). For Jordan, gender preferences in actual fertility practices have not been explored in the available literature, but son preference in childbirth preferences has been documented since the 1976 World Fertility Survey (*Jordan Fertility Survey 1976: 9-73*). In addition to these seven countries, Tajikistan – another country where son preference in actual fertility practices is prevalent (*Spoorenberg 2018*) – was included in the study, though data for this country are only available for women born in the 1960s and later. The

study therefore covers a total of eight countries from different regions of Asia and North Africa.

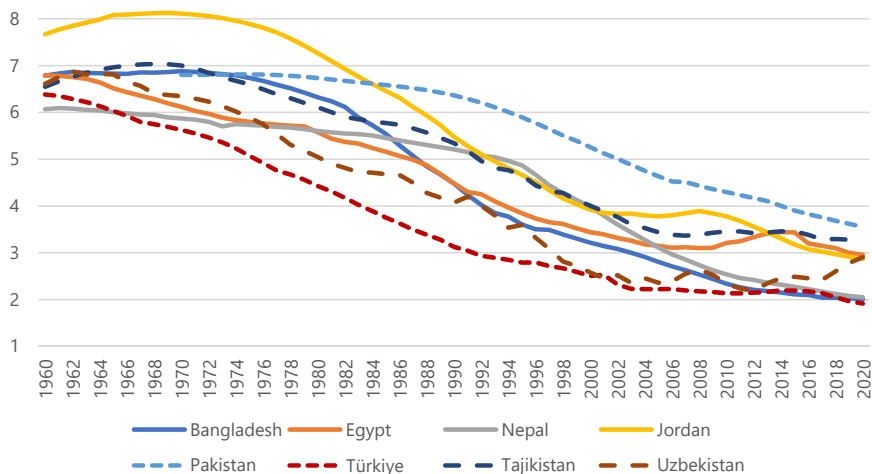
Estimates from the United Nations World Population Prospects 2024 (UN 2024) indicate that SRBs have been within the biological norm in all countries for the last 50 years, except Pakistan between 1995 and 2005 and Uzbekistan from the 2010s to the early 2020s, where the SRB reached 108 boys per 100 girls. Although these levels could be interpreted as an indication of an increase in sex-selective abortions (cf. *Guilmoto* 2009 for Pakistan), they are much lower than in societies where abortions are the primary means of implementing son preference, where SRBs are higher than 110 boys per 100 girls (*Bongaarts* 2013). Additionally, the skewed SRBs in these countries were observed only for a limited part of the reproductive period of the studied cohorts.

In the literature available for the eight countries, the question about sex-selective abortions has been addressed for Bangladesh (*Kabeer et al.* 2014), Pakistan (*Zaidi/Morgan* 2016), and Türkiye (*Altindag* 2016). None of these studies found evidence for the widespread use of this practice to achieve the desired sex composition. Several studies of son preference in Nepal note that sex-selective abortions were also rare in that country in recent decades (*Brunson* 2010; *Leone et al.* 2003). *Guilmoto* (2024) presents evidence of increasing sex-selective abortions in Nepal in the 2010s; however, in the cohorts included in the present study, only women born in the second half of the 1970s and the 1980s were of reproductive age at that time. It is therefore appropriate to include Nepal in the study, with the caveat that special caution is needed when interpreting the results for the younger cohorts.

Overall, it can be concluded that in the eight countries chosen for the analysis, son preference effects were mainly seen in parity progressions in recent decades. Sex-selective abortions, if they occurred at all, were not widespread. Countries that were not included in the analysis despite the availability of data for the studied cohorts and prevalence of son preference effects include Albania and India. The reason these countries were excluded was the high frequency of sex-selective abortions (*Jha et al.* 2011; *Chaudhuri* 2012 for India; *Robitaille/Milla* 2024 for Albania).

3.2 Fertility trends and social changes

Fertility declined significantly across all countries in the study during the reproductive years of the observed cohorts. Figure 1 shows TFR trends in these countries between 1960 and 2020. At the start of this period, fertility in all of the countries was above six children per woman, and a clear decrease was only observed in Türkiye. In the 1980s, however, a gradual reduction in fertility rates was observed in all of the countries, confirming that the First Demographic Transition had started in each of them by that time. However, it is only in Bangladesh, Nepal, and Türkiye that the TFR reached a level of about two children per woman by the end of the period in question. Compared to these three countries, all of the other countries regularly had higher TFRs starting from the mid-2000s (except Uzbekistan, where the TFR showed significant fluctuations). Starting in the 1980s, Pakistan consistently had the highest fertility rate. In all of the countries except for Bangladesh and Pakistan, periods of

Fig. 1: TFR in the studied countries, 1960-2020

Source: UN 2024.

stalling or reversal in the fertility decline were observed at some point between 2000 and 2020 (for a detailed overview of fertility dynamics in recent decades, see *Bora et al. 2023* for Bangladesh; *Al Zalak/Goujon 2017* for Egypt; *Krafft et al. 2021* for Jordan; *Brunson 2010* for Nepal; *Sathar 2007* for Pakistan; *Greulich et al. 2016* for Türkiye; *Spoorenberg 2017* for Tajikistan and Uzbekistan).

The fertility decrease in the countries under study occurred in line with social changes that are typically associated with the First Demographic Transition, which are expected to raise the social position of women. A rapid increase in the urban population occurred in most of the countries between 1960 and 2020 (Table 1). The exceptions are Egypt and Tajikistan. In the latter country rural-to-urban migration has been less common in recent decades, possibly due to intensive labor migration

Tab. 1: Proportion of urban population in the studied countries

	1960	1970	1980	1990	2000	2005	2010	2015	2020
Egypt	37.8	41.4	43.8	43.4	42.7	43.0	43.0	42.7	42.7
Bangladesh	5.1	7.5	14.8	19.8	23.5	26.8	30.4	34.3	38.1
Jordan	50.8	55.9	60.0	73.2	78.2	79.4	86.0	90.2	91.4
Nepal	3.5	4.0	6.1	8.9	13.4	15.1	16.8	18.6	20.6
Pakistan	22.1	24.8	28.0	30.5	32.9	33.9	34.9	36.0	37.1
Türkiye	31.5	38.2	43.7	59.2	64.7	67.8	70.8	73.6	76.1
Tajikistan	33.1	36.8	34.2	31.6	26.5	26.5	26.5	26.7	27.5
Uzbekistan	33.9	36.7	40.7	41.3	46.1	48.5	50.9	50.7	50.4

Source: World Bank 2023.a

Tab. 2: Female-to-male secondary school enrolment ratios in the studied countries

	1980	1990	2000	2010	2019
Egypt	0.60	0.78	0.93	0.97	0.99
Bangladesh	0.33	0.51	1.03	1.11	1.14
Jordan	0.91	1.03	1.05	1.04	1.02
Nepal	N/A	0.40	0.70	1.00	1.10
Pakistan	0.37	0.42	N/A	0.77	0.87
Türkiye	0.48	0.50	0.72	0.91	0.96
Tajikistan	N/A	N/A	0.85	0.87	N/A
Uzbekistan	N/A	N/A	0.97	1.00	0.99

Note: N/A not available.

Source: *World Bank* 2023b.

to rural population to Russia (*Rocheva/Varshaver* 2018). Another social change clearly observed in the countries was an increase in educational attainment among women. As Table 2 shows, in 1980, the proportion of boys attending secondary school was much higher than for girls in all countries except Jordan. However, by 2010, the gap between boys and girls was much smaller or non-existent (for Uzbekistan and Tajikistan, the indicator shown in Table 2 was available only for the post-Soviet period; however, gender-egalitarian school education was introduced in those countries during the early Soviet time, cf. *Tudge* 1991).

4 Research objectives

The overall goal of the study is to compare the effects of son preference on the transition to the third parity among women born between 1950 and 1989 in the selected countries.

Given this goal, the primary objective at the preliminary stage of this study is to show how third parity transition probabilities changed across these cohorts. The total fertility trends discussed in the previous section suggest that progression to the third parity became less probable from older to younger cohorts, possibly at a different rate across the countries, as total fertility declined to different levels in each country. This cross-cohort decrease in third parity progression probabilities is crucial: only during this decrease are son preference effects placed at the “crossroads”, where fertility dynamics potentially strengthen gender preference effects, while social changes occurring at the country level potentially motivate parents to adopt more “balanced” gender preferences or to “neutralize” these preferences.

After demonstrating that the probability of transitioning to the third parity decreased from older to younger cohorts, these cohorts are compared based on the impact of not having a son or not having a daughter on that transition. This cross-cohort comparison answers two questions. First, do the cohorts of women differ on

the role of gender composition of children already born for transition to the third child? Second, do the cohorts differ in specific gender composition(s) of children which make the transition to the next child more probable?

The transition to the third parity, which is the focus of this study, offers certain advantages over transitions to alternative parities. Specifically, studying the transition to the second parity would be problematic because in many of the countries in the study, total fertility levels were well above two children throughout the reproductive periods of the studied cohorts (Fig. 1). Therefore, the transition of women to the second parity would generally be more unconditional and therefore also less dependent on gender preferences. For the transition to the fourth parity, the opposite issue arises: in the countries where total fertility was about two children per woman in the 2000s through the 2010s, women having at least three children are likely to be selected into high fertility. Since this kind of selectivity is expected to be lower in the older, more fertile cohorts, cross-cohort comparison would be complicated.

5 Data and method

Ten-year birth cohorts of women are delineated in the analysis (1950-59, 1960-69, 1970-79, 1980-89). Birth histories are pooled from the World Fertility Surveys (WFS) and the Demographic and Health Surveys (DHS), held in the countries under study between 1975 and 2022 (Table A1 enumerates all the surveys used in the study). For Uzbekistan, birth histories available from the UNICEF Multiple Indicators Cluster Survey (MICS) are also used, since they are the only accessible source on birth histories of women born in the 1980s in that country. For Tajikistan, data on women born in the 1950s were not available.² All the surveys offered birth histories at a monthly precision level. In the analysis of progressions to third parity, women who had twins at previous births are not included. This is justified because twins often require more intensive investments of parents in children within a limited period of time, which can have a postponing effect upon subsequent births.

Event history models are estimated separately for each country for transition to third parity. Conception of a child which resulted in live birth is the modelled event. Modelling conception rather than birth allowed to take into account sex composition of children which a woman had in the time when decision for the next birth was taken. Between the conception and the birth, change of sex composition of children was possible because of high infant mortality (see on it below in the present section). The month of conception is calculated as the month of birth minus nine months. If the gap between the analyzed birth and the preceding one is less

² The MICS surveys conducted in Tajikistan in 2000 and 2005, as well as the MICS surveys available for the other countries, could not be used because birth histories available from them, unlike birth histories in Uzbekistan MICS 2021-2022, do not contain all children who lived separately from their mothers or who had died by the time of the survey.

than nine months, seven months are subtracted instead of nine. This approximating procedure of calculating the month of conception was adopted because length of gestational period is not provided in the data, which is a limitation of the analysis. For the last nine months before the interview, it is not possible to assess conceptions resulting in life births. Therefore, all observations are right-censored nine months before the interview, and women who reached previous parity less than nine months before the interview are not included in the analysis of transitions to the next parity. Right-censoring also takes place for all women 120 months after the previous birth (since resuming childbearing after a break of 10 or more years is very infrequent for women in these national samples), or at the time of the interview if it took place earlier.

The binary parameter indicating having a son and the binary parameter indicating having a daughter are the key independent variables, included in the models one by one.³ Piecewise exponential models are estimated, which divide time at risk into several intervals and allow risks to vary across these intervals (see *Allison* 1984 for a general characterization of such models, and *Mussino et al.* 2019 for their use in analysis of gender preference effects upon fertility). This type of models was chosen because at least for some of the countries, existing research showed that women with no sons tended to have the next birth earlier, which means that son preference effects were stronger at a certain time interval after the previous birth than in later periods (see *Khan et al.* 2016 for Bangladesh; *Javed/Mughal* 2022 for Pakistan). Piecewise models allow to capture such effects of son preference.

The timeline of 120 months is divided into six intervals (months 1-12, 13-24, 25-36, 37-48, 49-60 and 61-120 from the month of the second birth). To distinguish son preference effects across these intervals and across cohorts, the binary parameter of having at least one son or the binary parameter of having at least one daughter is interacted with interval and with the variable which distinguishes decennial birth cohorts: *having a son*time interval after the second birth*birth cohort*.

Mortality among children born to the sampled women was generally quite high (see Table 3). Due to child mortality, the parameter of having no sons is time-varying during the risk period of conception and reflects the sex composition of children surviving at the beginning of every given month. If all children born to a woman are dead, after the last child's death that woman is treated as having no sons. Another time-varying parameter is a dummy indicating whether a woman has at least one dead child of any sex. Including that parameter as a control is necessary because studies on a number of low and middle income countries have shown that death of a child increases risks of transition to next parity (*van Soest/Saha* 2018). For calculation

³ The alternative variant would be to estimate models with the gender composition parameter indicating if a woman had only sons, only daughters or both. Using this parameter, however, would be problematic for modelling transition to the 3rd child as long as the binary parameter of having at least one dead child is used in the models (see below): if a woman has two children ever born and one of them is dead, she cannot have living children of both sexes, so that the sex composition parameter and the parameter of having a dead child will be correlated.

of both parameters, ages of children at death (in months) contained in the survey data are used.⁴

The following time-constant control variables are included in the models:

- Education. The fourfold distinction between women having no education (the reference category), primary, secondary and higher education is followed for all of the countries except for the two post-Soviet ones, where school education was compulsory for the birth cohorts under study (for Tajikistan, primary education is the reference category; for Uzbekistan, due to very low proportions of women with primary education, primary and secondary education is considered as one level and used as the reference category); the countries differed in their systems of educational categories, but for comparative purposes the generalized educational parameter with the four meanings offered in DHS datasets is used;
- Woman's age at the previous birth.

The data used in the study contained only educational levels at the time of the survey. However, treating education as a time-constant parameter should not be problematic for transitions to the third parity, because continuing education after becoming a parent was rare for women in the studied cohorts. In fact, stopping education after marriage remained typical for women in most low and middle income countries at least until the 2000s (see *Mensch et al.* 2005 for an overview of the education-nuptiality nexus in these countries).

Based on the estimated models, predicted hazards of transition to the third parity are calculated separately for women of each cohort in each time interval with and without a son, and then separately for women with and without a daughter. The hazards are estimated at the means of the control variables in the sample of a given country. In Section 6, the results are visualized by plotting predicted hazards. Full models are contained in the Appendix.

Apart from the models with the parameter of having at least one son or daughter, models are estimated which contain only the control variables, and predicted hazards of parity progressions are calculated for each cohort based on them. These models allow to observe how the propensity to transition to the third parity changed between the studied 10-year cohorts of women.

⁴ In most of the DHS and WFS samples, the proportions of children who died by the ages of 12, 24, 36 etc. months are abnormally high (often they constitute about 90 percent of all children who died at all ages above 11 months). This suggests that the months for which a child lived after the last birthday often are not taken into account in the data. Therefore, for all children whose age at death in months is divisible by 12, six months are added to that age, on the assumption that on average these children lived half a year after their last birthday. As a robustness check, models were estimated without this recalculation of the month of death. Their results had no sizeable differences from the models presented below.

6 Results

Table 3 contains numbers of women by birth cohorts in the pooled country samples and means of the explanatory parameters. The countries differ in educational levels of women: the proportions of women with secondary or higher education were largest in Egypt, Jordan and Tajikistan, and smallest in Nepal and Pakistan. Proportions of women who have reported to have at least once experienced death of a child were highest in Bangladesh and Pakistan and lowest in Jordan and the post-Soviet countries of Central Asia. A more detailed summary of the distribution of the gender composition parameter in the studied countries is offered in Appendix A4.

Figure 2 plots predicted hazards of having a third child for each country by the birth cohorts of women, regardless of the sex composition of children. Figure 3 compares predicted hazards of having a third child for women with and without a son, separately for each of the ten-year birth cohorts. The most clear tendency observed in all the eight countries based on Figures 2 and 3 is that third birth hazards decrease and effects of son preference increase from women of the 1950-59 birth cohort to women of the younger cohorts. In the 1980-89 birth cohort effects of son preference are observed for all the countries. Türkiye was the country with the earliest decrease of the transition hazards, as they were lower in Türkiye than in the other countries for the 1950-59 cohort. At the same time, Türkiye was the only country where already in the 1950-59 cohort statistically significant son preference effects were consistently observed across most periods after the second birth. Conversely, in Pakistan the transition hazards were decreasing slower across the cohorts than in the other countries, and the son preference effects became significant later than in the other countries.

In most of the countries a cohort can be distinguished for which the transition hazards decreased especially seriously compared to the preceding cohort. In that cohort the gap between hazards of women having and not having a son became larger than in the preceding cohort(s) as well. This is the case for the 1970-79 cohort in Egypt, Jordan, Nepal, Tajikistan and Uzbekistan, for the 1960-69 cohort in Türkiye, for the 1980-89 cohort in Pakistan. In countries where effects of son preference appeared earlier than in the others (Egypt, Türkiye), in the 1980-89 cohort absolute differences between predicted hazards for women with and without a son became somewhat smaller than in the 1970-79 cohort. At least in the case of Egypt it can be explained with a decrease of both predicted hazards in the youngest cohort. Statistical significance of differences between the predicted hazards for women with and without a son, however, persisted in the youngest cohorts of these two countries.

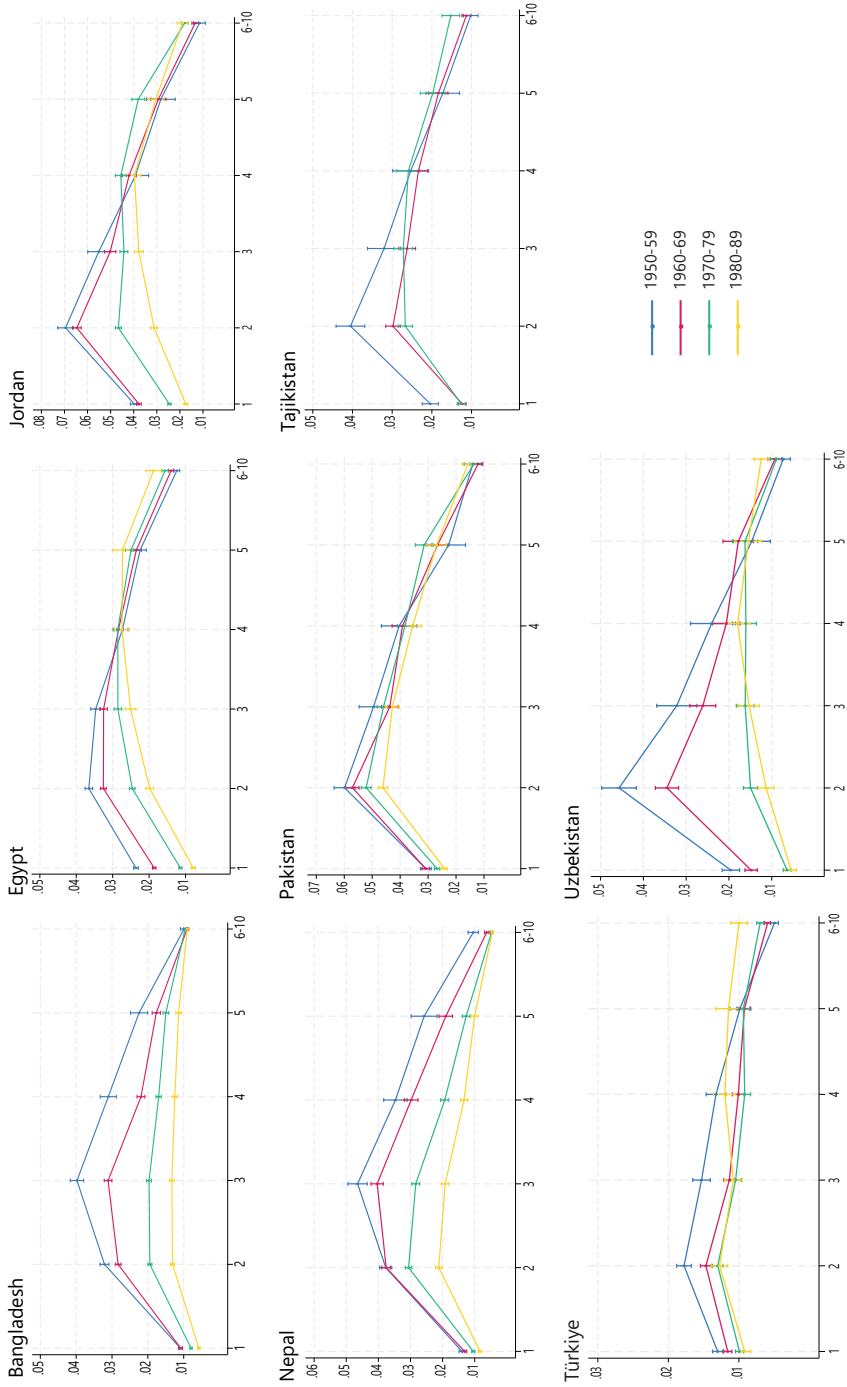
In general, the differences in the third parity progression hazards between women with and without a son concerned quantum more than timing: in most cases, the hazards of women with and without a son are distributed similarly across the time intervals. The only exceptions are the 1970-79 and 1980-89 cohorts in Jordan, where the fertility peak for women with a son shifted to later intervals compared to women without a son, and the same cohorts in Nepal, where the hazards of women with a son peaked in the second year after the previous births, but hazards of women without a son were nearly equally distributed between the 2nd-4th years.

Tab. 3: Distribution of the parameters included in the analysis in the risk samples of the countries

	Bangladesh	Egypt	Jordan	Nepal	Pakistan	Tajikistan	Türkiye	Uzbekistan
<i>Birth cohort, %</i>								
1950-59	12.51	25.05	11.51	12.91	10.13	-	20.09	21.12
1960-69	26.93	35.55	30.68	25.15	23.17	16.97	33.33	30.92
1970-79	35.45	26.95	37.68	36.38	35.51	41.51	32.16	29.95
1980-89	25.11	12.45	20.23	25.56	31.19	41.52	14.42	18.01
<i>Education, %</i>								
no	40.87	40.96	8.28	68.02	63.78	4.67	22.94	-
primary	31.80	19.21	12.07	16.58	12.64		56.35	87.66
secondary	22.66	32.26	54.70	13.20	14.94	75.81	15.04	
higher	4.67	7.57	24.85	2.20	8.64	19.52	5.67	18.34
<i>Having a dead child, %</i>	20.77	14.00	5.37	13.72	15.27	8.00	11.95	10.13
<i>Mean age at the 2nd birth, years</i>	21.32	23.39	23.92	22.64	23.22	24.41	23.80	24.26
<i>Gender composition of children already born, %</i>								
two sons	26.16	26.46	26.68	25.82	27.43	27.92	26.09	26.58
daughter and son	50.15	50.11	50.01	50.16	49.30	49.56	50.27	49.77
two daughters	23.69	23.43	23.31	24.02	23.27	22.52	23.64	23.65
N	67,394	72,393	45,809	36,610	29,281	9,446	27,551	7,038

Source: Own calculations. For a list of data sources please refer to Tab. A1.

Fig. 2: Predicted hazards of transition to the third child for women of 1950-59, 1960-69, 1970-79 and 1980-89 birth cohorts, by years after the second birth, with 95% confidence intervals



Source: Own design. For a list of data sources please refer to Tab. A1.

Fig. 3: Predicted hazards of transition to the third child for women having vs. not having a son, by years after the second birth, with 95% confidence intervals

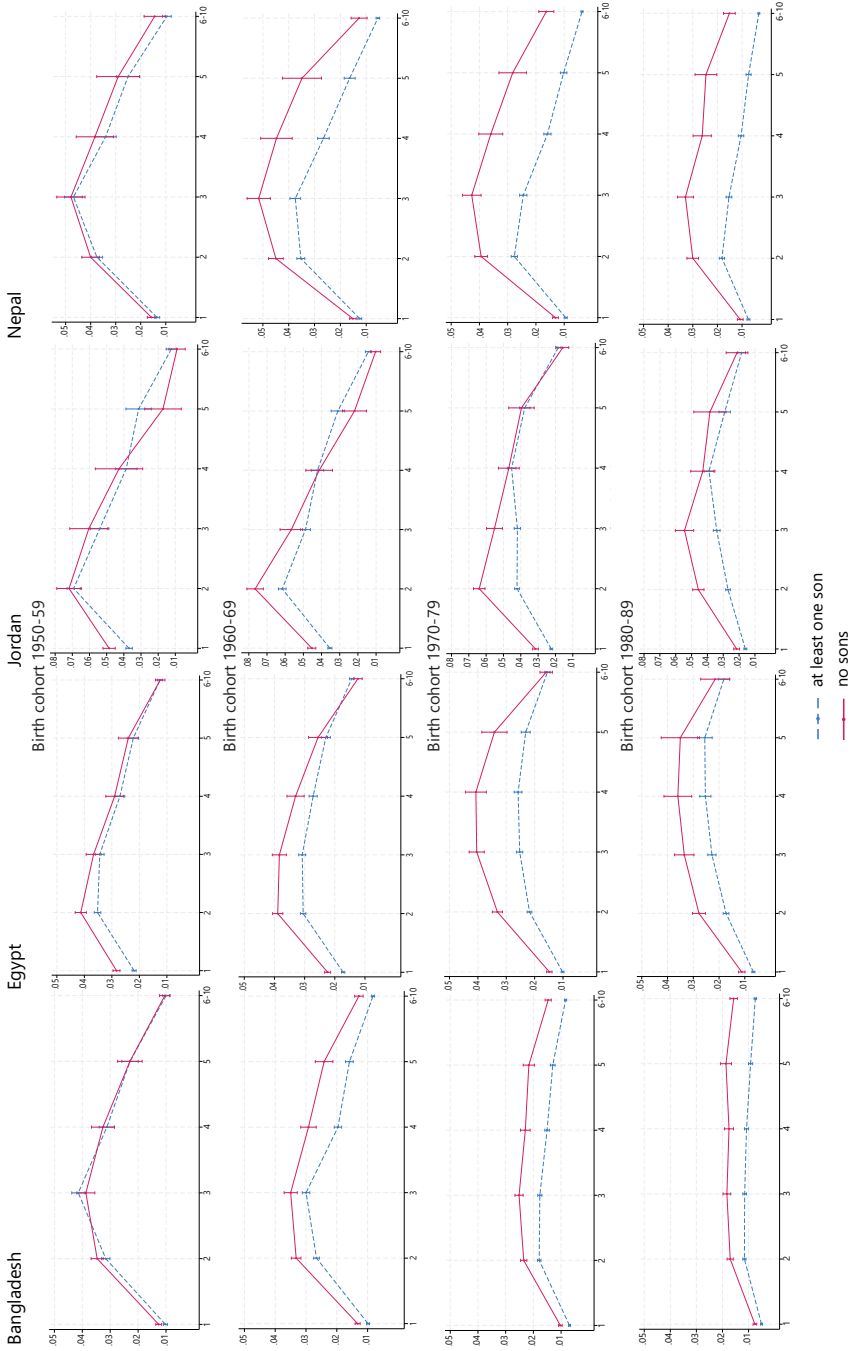
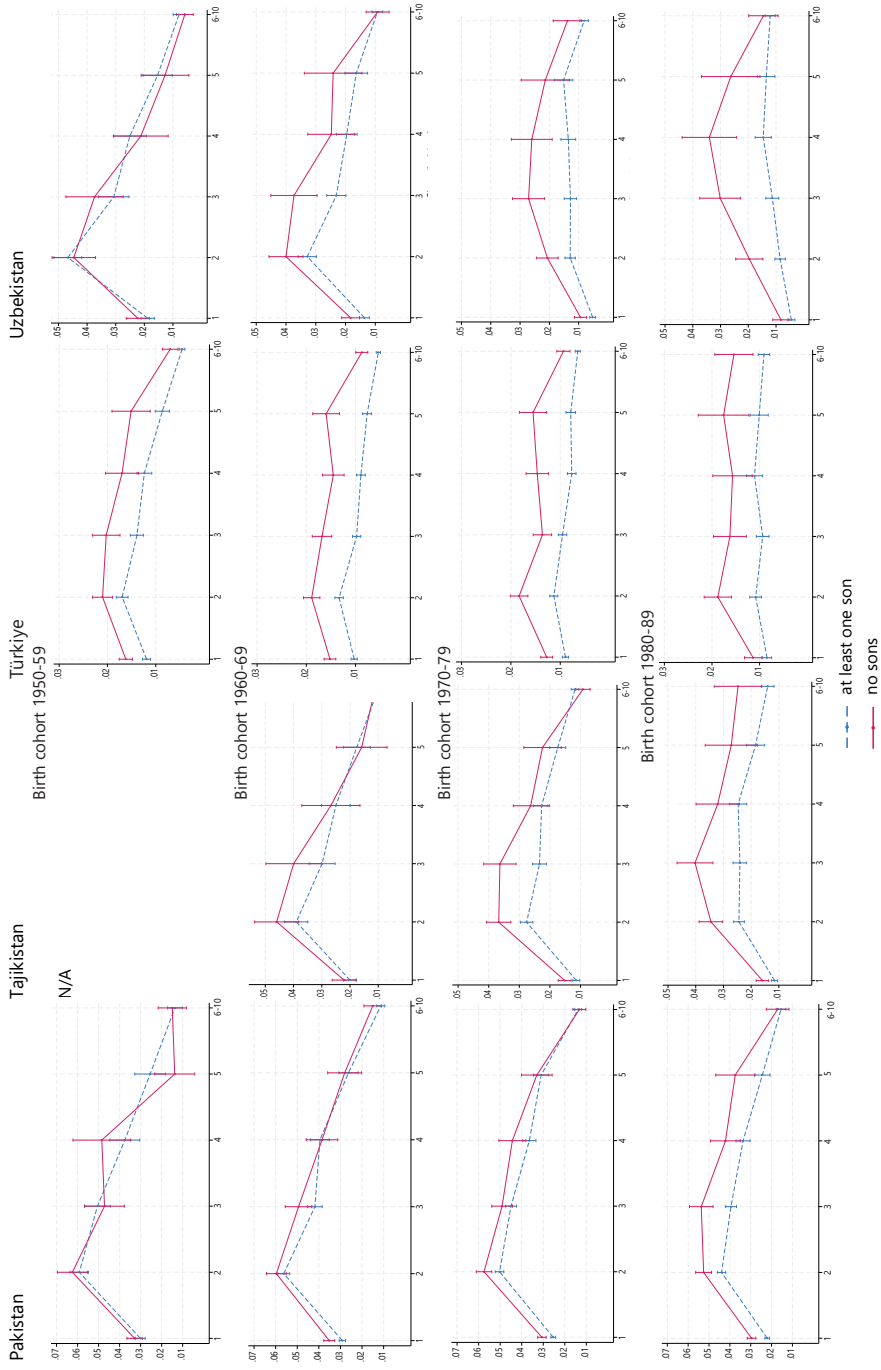


Fig. 3: Continuation



Source: Own design. For a list of data sources please refer to Tab. A1.

Figure 4 compares the predicted hazards of transitions to the third child for women having and not having at least one daughter. In none of the countries and none of the cohorts were hazards significantly higher when a woman had no daughter. In fact, the opposite tendency prevailed: in several cases hazards were higher when at least one of the first two children was a daughter. However, confidence intervals of the hazards for the most part overlapped, except for Nepal, where having a daughter was consistently associated with higher hazards of the transitions to the third parity across the cohorts. Even for the countries where differences between predicted hazards of women having and not having a son became somewhat smaller in the youngest cohort (Egypt, Türkiye), no increased hazards are observed for women having no girl in that cohort.

All in all, the analysis has shown that son preference effects are regularly observed in the considered countries, and that they become stronger from the older to the younger cohorts. There are no signs of a “reversal” disappearance of son preference in the younger cohorts even in those countries where son preference effects were present already in the oldest cohort. Having no sons raised predicted hazards of progression to the next parity, but for most part did not correlate with serious differences in timing of the next birth. Having no daughter, however, never had a clear positive effect upon transition to the third child.

Tables A2 and A3 of the Appendix show the full models (for having no son and for having no daughter, respectively), including effects of the control variables. Quite predictably, higher education makes the hazards of parity transition smaller, and having at least one dead child makes them higher. Older age at previous birth also decreases hazards of transition to the third child.

7 Limitations

One limitation of the analysis presented above is that it does not take into account marital status of women. The reason for this is that DHS data do not contain full marital histories, what does not allow for constructing a time-varying parameter indicating the marital status of women during the risk period. As a robustness check, the same models were estimated for only those women who reported themselves as being in their first union at the time of the survey. No meaningful differences between the results of these models and the models considered above were detected.

Another limitation concerns the selectivity effect potentially biasing the proposed analysis: it can be expected that women dissatisfied with the gender composition of their children tend to transit to the next child quicker. For example, among women whose firstborn child is a girl, those with stronger son preference can progress to the second parity within a shorter period of time, which can result in selection of women into the second parity on son preference (cf. *Asadullah et al.* 2021, discussing similar issues for Bangladesh). In the present analysis, it is assumed that including woman’s age at second birth at least partly controls for this potential bias.

Finally, a data limitation comes from the possibility of underreporting births of girls in some of the countries (see e.g. *Channon* 2017: 100). Although the potential

Fig. 4: Predicted hazards of transition to the third child for women having vs. not having a daughter, by years after the second birth, with 95% confidence intervals

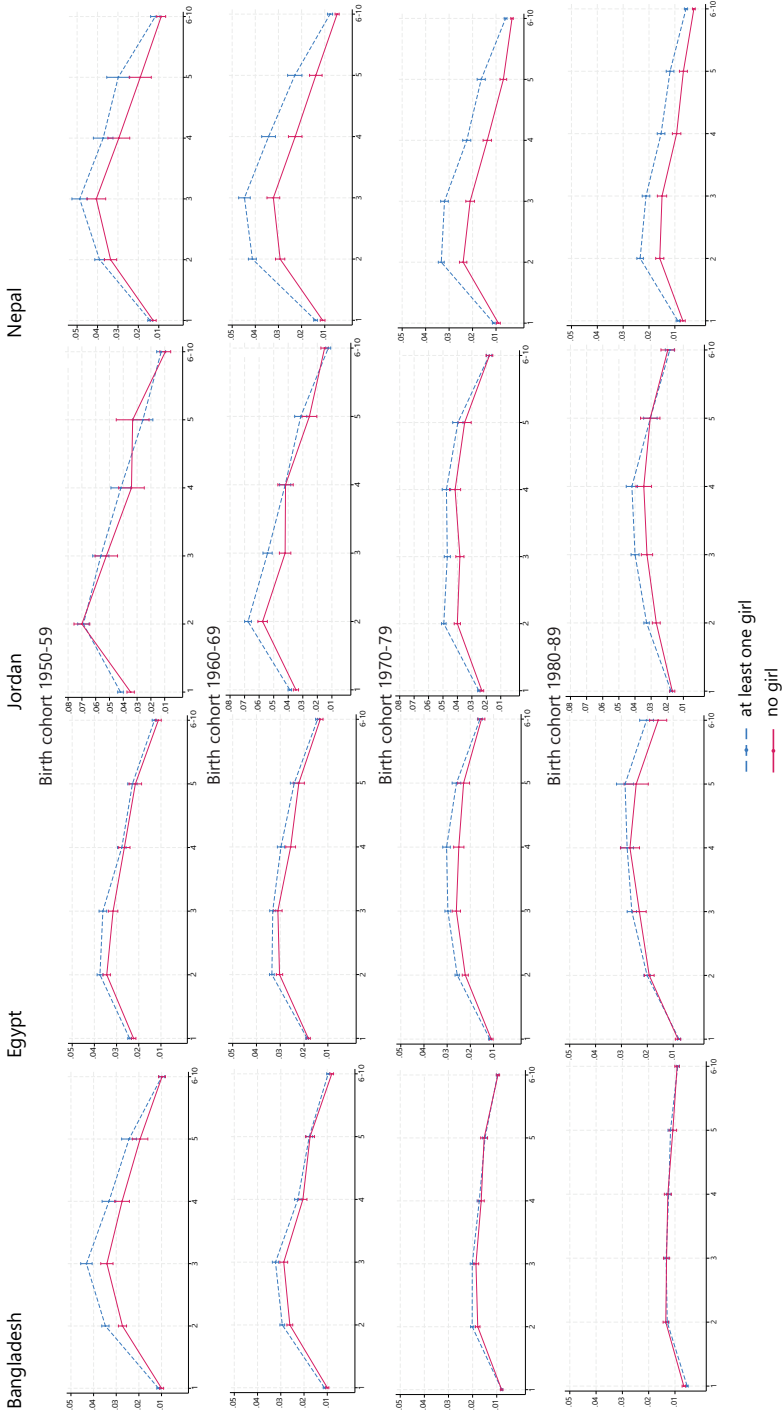
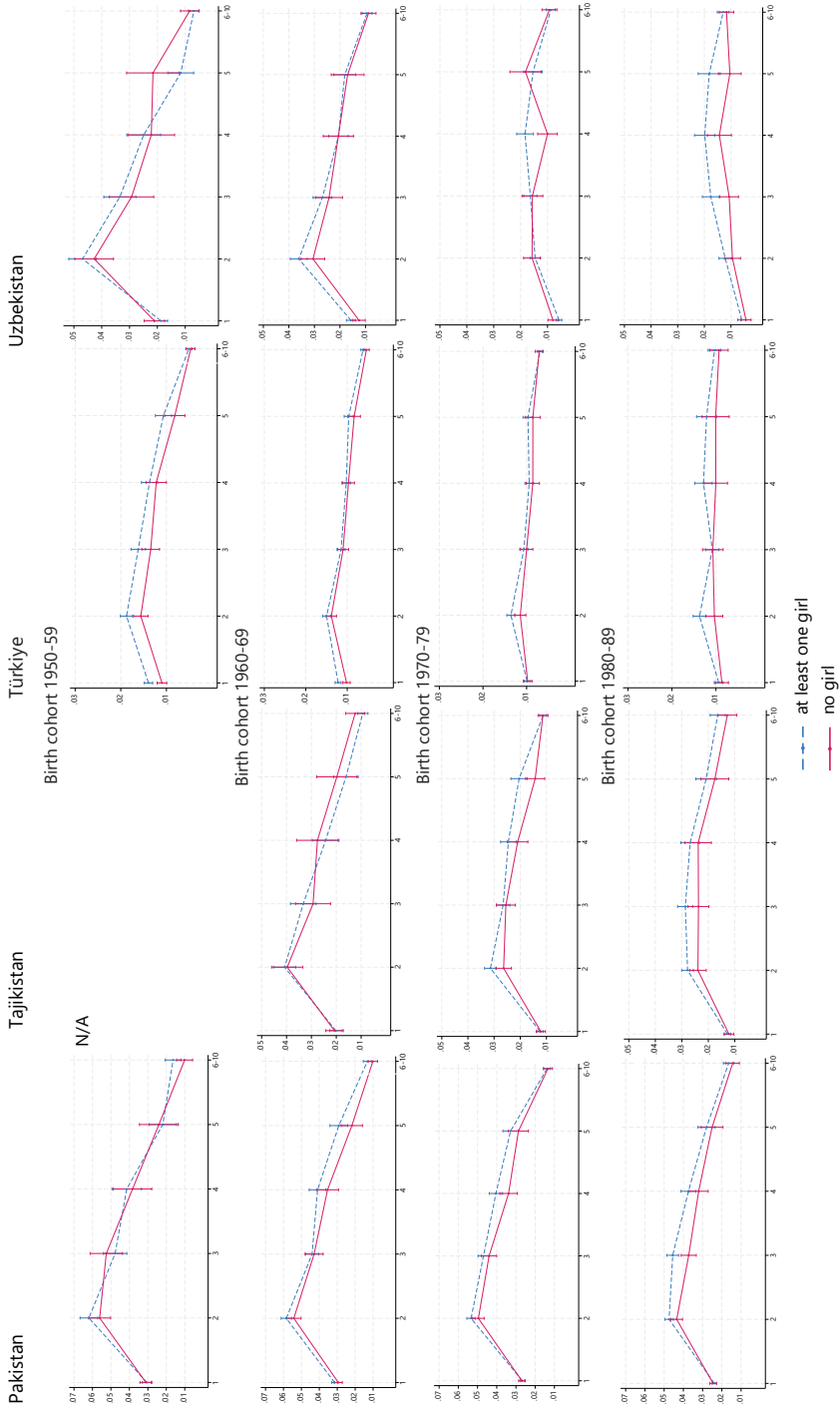


Fig. 4: Continuation



Source: Own design. For a list of data sources please refer to Tab. A1.

biasing effect of this underreporting never can be excluded, it is worth pointing out that only one country included in the study, Pakistan, is evaluated as having poor quality of DHS fertility data (*Schoumaker* 2014: 16; Tajikistan DHS are not included in that evaluation). This suggests that underreporting is not a major threat to the reliability of the cross-country conclusions made in the present study.

8 Discussion and conclusions

This study explores the dynamics of son preference in transitions to the third parity as a part of the First Demographic Transition. It focuses on eight countries of the Middle East, South Asia, and Central Asia using data that enables comparisons between cohorts born from the 1950s to the 1980s. The study demonstrates that the effects of son preference intensified from older to younger cohorts, coinciding with a decline in hazards of transition to third births. These effects primarily affected the probabilities of parity progressions rather than their timing: in most cases, when women without a son had higher predicted hazards for progressions, the distribution of the hazards between the time intervals after the second birth was similar in the two groups. Notably, no parallel effects of the preference to have at least one daughter emerged with fertility decline. Therefore, sex preferences in fertility practices, which were more prevalent in the younger cohorts, remained strictly “asymmetric”.

The analysis highlights both a similarity and a difference in the current dynamics of the two major manifestations of son preference: sex-selective abortions and “son dependent” parity progressions. The similarity lies in the conditions under which both manifestations emerge: both appear under fertility decline. The difference, however, concerns their stability after emergence. As noted in Section 2.2, in a number of countries where sex-selective abortions became widespread in recent decades, their frequency declined after a 10-20 years period of growth or after reaching a plateau. However, in none of the countries where son preference effects in parity progressions were observed for several 10-year cohorts was a similar tendency towards their subsequent disappearance observed. This result supports the expectation that son preference effects in parity progressions are potentially more stable than sex-selective abortions.

For the reasons outlined in Section 4, the analysis focused on the transition to the third parity. It cannot be excluded *a priori* that, at transitions to other parities, other trends, including a decrease in son preference effects, would be observed from older to younger cohorts. However, for the transition to the second parity, son preference effects in the older cohorts appear highly unlikely, as fertility levels in these cohorts across all the countries were much higher than two. Because of this, one can expect that transitions to the second parity in the older cohorts would be “unconditional” and not dependent on the sex of the first child, at least in terms of fertility quantum. In fact, this expectation was confirmed for all cohorts included in the study: models run for the transition to the second child for the same four 10-year cohorts show that transition hazards for all cohorts in most cases were not statistically associated

with the sex of the first child. Regarding the transition to parities higher than the third one, there is a general reason not to expect that son preference effects would weaken in these transitions if they do not do so in transition to the third parity. In many low and middle income countries in the recent half-century, higher fertility was associated with stronger gender asymmetries and a more subordinate role for women within families (see *Upadhyay et al.* 2014 for a comprehensive literature overview). Given this tendency, a shift away from son preference among women with three or more children, while son preference remains stable among women with only two children, appears highly improbable. However, our interpretation of the results does not depend upon gender preferences manifested at transitions to the other parities. The example of transition to the third parity shows that at a given parity, a decrease of transition rates can coexist with persistence or even strengthening of the asymmetric preference to have at least one son.

For general demographic trends in the studied countries, the results of the study have several implications. First, they suggest that in countries where son preference influences parity progressions, there is a factor supporting overall fertility. This is because the desire for sons encourages sonless women to have another child. Another implication is the persistence of conditions that disadvantage daughters, as they are often involved in the care of their younger siblings (*Basu/de Jong* 2010). At the same time, the weak effect of lacking a son on the timing of the next birth suggests that a related consequence reported in the literature – short birth intervals after having daughters – is not a significant concern in the analysed countries, nor does it necessitate policy interventions.

The persistence of son preference in the analysed countries also raises the question of why it was not affected by social changes that took place during the reproductive periods of these cohorts (see Section 3.2). These changes would be expected to close the gap between the perceived value of daughters and sons, and therefore weaken son preference effects (Section 2.1). Moreover, the stability of son preference in parity progressions is at odds with its rather rapid disappearance during fertility declines in European countries, where it was detected at the initial stages of the First Demographic Transition. As shown by *Reher et al.* (2017) and *Sandström and Vikström* (2015), during the period of fertility decline observed in the last decades of the 19th century in a number of European countries, the transition to certain higher parities was more probable for parents with no son. However, that effect was not a long-standing one: son preference in parity transitions was replaced by a “balanced” preference to have at least one son and at least one daughter (for couples in Sweden married after 1990, see *Reher et al.* 2017: 16; for couples in Germany married after 1870, see *Sandström/Vikström* 2015). The levels to which fertility decreased in the European countries when son preference effects disappeared were much higher than the fertility levels at which son preference remains stable in the countries analysed in the present study. This also highlights the importance of explaining the stability of son preference in these countries.

One possible explanation for the above is the persistence of patrilineal inheritance laws and practices. As argued by *Den Boer and Hudson* (2017), a key factor in the reduction of son preference in actual fertility practices in South Korea at the turn of

the century was the introduction of state laws that equalized the shares of sons and daughters in inheritance and allowed women to be registered as household heads. Importantly, before these legal norms were put into action, South Korea experienced active urbanization and substantial shifts toward higher gender equality in education and in labor markets. However, these changes were not followed by a significant reduction in son preference, as the male-oriented inheritance system remained unchanged. For some of the countries considered in the present study, it has been demonstrated that the priority of sons in inheritance continued in recent decades. This could be expressed in certain asymmetries between men and women in formal inheritance laws, as in Jordan (*Alazzeah* 2017). Alternatively, the priority of sons could be supported by informal social practices, despite the fact that laws have stipulated equal rights for men and women in inheritance (see *Ahmad et al.* 2012 for Pakistan; *Hunt/Kasynathan* 2001 for Bangladesh). When formal or informal norms make it essential to have a son in order to preserve one's inheritance line, this can motivate couples to place special importance on having a male heir, irrespective of other social factors that increase the perceived value of daughters (cf. *Brunson* 2010).

Another potential reason for the persistence of son preference is that indicators showing that women's status is increasing may not reflect actual changes in gender equality. In some of the countries where women's educational attainment is increasing, education may serve more as a source of prestige for women's families than a reflection of women's own choices and a path to higher autonomy (cf. *Sathar et al.* 1988 for Pakistan). In the countries of Central Asia, the collapse of the Soviet Union devalued women's education, because the social networks in which women had been involved through their education and professional activities lost their significance (*Kandiyoti* 2007). In Egypt, it has been shown that the slowdown and temporary reversal of the fertility decline at the end of the 2000s and the beginning of the 2010s was largely related to the fact that women chose to be housewives after graduating from university or high school. This was mainly due to economic reforms under Hosni Mubarak's administration, which worsened women's position in the labor market (*Al Zalak/Goujon* 2017; see also *Ambrosetti et al.* 2021 for a discussion of other possible reasons for the reversal of the fertility decline).

One factor that may sustain son preference in countries of post-Soviet Central Asia is the growth of the role of large kinship-based groups in local political and economic life after the collapse of the Soviet Union. *Ismailbekova* (2018) studies this phenomenon for Kyrgyzstan, but she points to its emergence in other Central Asian societies as well. Having a son is crucial for securing membership in such groups, since they are built on the patrilineal principle.

Of course, explanations for the observed persistence of son preference may be specific to each country and will thus require an in-depth study in the individual countries. There may be more country-specific factors that support the observed general tendency.

To summarize, the present study has considered son preference manifested in transitions to third parity for women born from 1950 to 1989 in eight countries of South Asia, Central Asia, and MENA. Due to high levels of child mortality in some of these countries, time-varying parameters were used for the gender composition

of children. Comparisons of ten-year birth cohorts of women have shown that the effects of son preference generally are stronger for younger cohorts compared to older cohorts. The dynamics of son preference in parity progressions was not similar to the dynamics of sex-selective abortions in a large number of countries where the practice has been studied, showing that the two manifestations of son preference differ significantly in their trajectories over time. In all of the studied countries, the growth of son preference effects coincided with social changes that are associated with higher status for women. However, in none of the countries did these social changes reverse the growth of son preference in parity transitions or replace the preference for sons with a preference for a balanced sex composition. Whatever the reasons for this, the observed tendencies have predictable consequences for total fertility and for inequalities between sons and daughters in parental families.

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Appendix

Tab. A1: Surveys used in the study

Country	Surveys
Bangladesh	WFS1975-76, DHS1993-94, 1996-97, 1999-2000, 2004, 2007, 2011, 2014, 2017-18
Egypt	WFS1980, DHS1988, 1992, 1995, 2000, 2005, 2008, 2014
Jordan	WFS1976, DHS1990, 1997, 2002, 2007, 2009, 2012, 2017-18
Nepal	WFS 1976, DHS 1996, 2001, 2006, 2011, 2016, 2022
Pakistan	WFS1975, DHS1990-91, 2006-07, 2012-13, 2017-18
Tajikistan	DHS2012, 2017
Türkiye	WFS1978, DHS1993, 1998, 2003, 2008, 2013, 2018
Uzbekistan	DHS1996, 2002, MICS2021-22

Source: Own design

Tab. A2: Piecewise exponential models for transitions to third parity, women with and without a son

	Bangladesh		Egypt		Jordan		Nepal		Pakistan		Tajikistan		Türkiye		Uzbekistan	
	HR	p-value	HR	p-value	HR	p-value	HR	p-value	HR	p-value	HR	p-value	HR	p-value	HR	p-value
<i>Interval after the second birth</i>																
1st year	1		1		1		1		1		1		1		1	
2nd year	3.089	0.000	1.607	0.000	1.874	0.000	2.778	0.000	1.966	0.000	1.949	0.000	1.425	0.000	2.488	0.000
3rd year	4.049	0.000	1.570	0.000	1.463	0.000	3.474	0.000	1.679	0.000	1.492	0.000	1.168	0.011	1.634	0.000
4th year	3.050	0.000	1.236	0.000	1.046	0.608	2.522	0.000	1.246	0.034	1.249	0.063	1.039	0.597	1.335	0.031
5th year	2.239	0.000	1.014	0.777	0.849	0.184	1.858	0.000	0.846	0.272	0.880	0.399	0.726	0.001	0.818	0.268
6th-10th years	0.976	0.726	0.570	0.000	0.334	0.000	0.708	0.001	0.455	0.000	0.500	0.000	0.382	0.000	0.419	0.000
<i>At least one son</i>																
yes	1		1		1		1		1		1		1		1	
no	1.233	0.000	1.292	0.000	1.315	0.000	1.161	0.029	1.091	0.200	1.106	0.375	1.361	0.000	1.186	0.126
<i>Interval*At least one son</i>																
2nd year*no	0.890	0.084	0.908	0.019	0.790	0.001	0.920	0.337	0.967	0.731	1.065	0.677	0.911	0.249	0.806	0.150
3rd year*no	0.758	0.000	0.824	0.000	0.850	0.156	0.880	0.194	0.855	0.256	1.210	0.306	1.071	0.501	1.028	0.888
4th year*no	0.848	0.083	0.829	0.008	0.843	0.366	0.970	0.820	1.184	0.366	0.968	0.896	1.010	0.943	0.714	0.230
5th year*no	0.812	0.108	0.837	0.056	0.417	0.010	0.996	0.984	0.496	0.072	0.815	0.546	1.285	0.135	0.701	0.362
6th-10th years*no	0.847	0.176	0.768	0.002	0.555	0.048	1.302	0.161	0.999	0.997	1.007	0.977	1.134	0.384	0.626	0.130
<i>Cohort</i>																
1950-59	1		1		1		1		1		1		1		1	
1960-69	0.963	0.384	0.786	0.000	0.958	0.153	0.925	0.118	0.967	0.466	1		0.864	0.002	0.727	0.000
1970-79	0.682	0.000	0.464	0.000	0.606	0.000	0.702	0.000	0.842	0.000	0.570	0.000	0.752	0.000	0.279	0.000
1980-89	0.492	0.000	0.305	0.000	0.435	0.000	0.549	0.000	0.733	0.000	0.577	0.000	0.710	0.000	0.238	0.000
<i>Interval*Cohort</i>																
2nd year*1960-69	0.873	0.009	1.101	0.003	0.928	0.090	1.018	0.771	0.983	0.787	-		0.912	0.165	0.968	0.775
2nd year*1970-79	0.831	0.000	1.336	0.000	1.005	0.910	1.051	0.418	1.009	0.889	1.242	0.034	0.887	0.091	0.991	0.950
2nd year*1980-89	0.745	0.000	1.611	0.000	0.897	0.045	0.883	0.081	1.013	0.837	1.084	0.432	0.901	0.268	0.765	0.184
3rd year*1960-69	0.751	0.000	1.139	0.001	0.943	0.361	0.864	0.034	0.856	0.075	-		0.815	0.011	1.036	0.805
3rd year*1970-79	0.626	0.000	1.584	0.000	1.282	0.000	0.744	0.000	1.056	0.506	1.376	0.009	0.913	0.278	1.501	0.016
3rd year*1980-89	0.564	0.000	2.172	0.000	1.453	0.000	0.595	0.000	1.065	0.455	1.397	0.006	0.948	0.627	1.549	0.037

Tab. A2: Continuation

	Bangladesh		Egypt		Jordan		Nepal		Pakistan		Tajikistan		Türkiye		Uzbekistan	
	HR	p-value	HR	p-value	HR	p-value	HR	p-value	HR	p-value	HR	p-value	HR	p-value	HR	p-value
4th year*1960-69	0.653	0.000	1.276	0.000	1.140	0.179	0.843	0.063	1.088	0.484	-	-	0.835	0.054	1.076	0.672
4th year*1970-79	0.708	0.000	2.058	0.000	1.935	0.000	0.667	0.000	1.153	0.214	1.595	0.001	0.826	0.052	1.939	0.000
4th year*1980-89	0.702	0.000	3.069	0.000	2.322	0.000	0.557	0.000	1.224	0.088	1.711	0.000	1.263	0.052	2.445	0.000
5th year*1960-69	0.720	0.000	1.315	0.000	1.032	0.818	0.707	0.006	1.067	0.716	-	-	1.025	0.831	1.469	0.087
5th year*1970-79	0.833	0.032	2.248	0.000	1.985	0.000	0.579	0.000	1.443	0.026	1.738	0.002	1.214	0.098	3.544	0.000
5th year*1980-89	0.818	0.033	3.774	0.000	2.132	0.000	0.534	0.000	1.308	0.120	1.811	0.001	1.645	0.001	3.689	0.000
6th-10th years*1960-69	0.858	0.057	1.463	0.000	1.203	0.186	0.621	0.000	0.855	0.332	-	-	1.370	0.000	1.623	0.009
6th-10th years*1970-79	1.233	0.007	2.675	0.000	2.454	0.000	0.550	0.000	1.194	0.236	2.071	0.000	1.892	0.000	3.705	0.000
6th-10th years*1980-89	1.508	0.000	4.760	0.000	3.430	0.000	0.605	0.000	1.539	0.006	2.427	0.000	2.822	0.000	6.443	0.000
<i>Cohort*At least one son</i>																
1960-69*no	1.089	0.206	1.005	0.901	0.974	0.621	1.045	0.608	1.108	0.209	-	-	1.087	0.253	1.130	0.419
1970-79*no	1.195	0.009	1.129	0.015	1.071	0.211	1.191	0.038	1.106	0.200	1.205	0.190	1.048	0.558	1.515	0.024
1980-89*no	1.220	0.014	1.299	0.001	1.020	0.767	1.248	0.022	1.229	0.011	1.246	0.124	0.989	0.918	1.553	0.086
<i>Interval*At least one son*Cohort</i>																
2nd year*no*1960-69	1.044	0.603	1.083	0.156	1.228	0.016	1.141	0.222	0.908	0.404	-	-	1.051	0.648	1.127	0.552
2nd year*no*1970-79	1.001	0.989	1.147	0.041	1.365	0.000	1.121	0.280	0.979	0.848	0.937	0.729	1.248	0.059	1.108	0.668
2nd year*no*1980-89	1.098	0.356	1.056	0.594	1.597	0.000	1.240	0.077	0.922	0.480	0.964	0.848	1.413	0.031	1.551	0.175
3rd year*no*1960-69	1.146	0.141	1.164	0.029	1.065	0.639	1.292	0.038	1.142	0.415	-	-	1.084	0.550	1.173	0.532
3rd year*no*1970-79	1.275	0.009	1.330	0.000	1.098	0.465	1.435	0.003	1.058	0.716	0.963	0.867	0.934	0.636	1.144	0.629
3rd year*no*1980-89	1.396	0.002	1.063	0.586	1.398	0.017	1.691	0.000	1.187	0.278	1.003	0.989	1.205	0.335	1.404	0.325
4th year*no*1960-69	1.306	0.022	1.128	0.187	0.907	0.651	1.433	0.031	0.682	0.085	-	-	1.091	0.606	1.322	0.427
4th year*no*1970-79	1.218	0.083	1.303	0.007	0.873	0.508	1.686	0.001	0.851	0.439	0.898	0.712	1.327	0.105	1.497	0.259
4th year*no*1980-89	1.271	0.062	1.022	0.873	0.973	0.902	1.791	0.001	0.788	0.270	0.974	0.930	1.043	0.854	1.772	0.158
5th year*no*1960-69	1.391	0.032	1.023	0.849	1.319	0.467	1.759	0.016	1.780	0.176	-	-	1.100	0.642	1.570	0.334
5th year*no*1970-79	1.390	0.026	1.208	0.134	1.789	0.104	2.010	0.002	1.778	0.161	1.184	0.660	1.074	0.733	1.121	0.810
5th year*no*1980-89	1.655	0.002	0.976	0.886	2.361	0.022	2.327	0.000	2.303	0.047	1.314	0.498	1.007	0.979	1.510	0.420

Tab. A2: Continuation

	Bangladesh		Egypt		Jordan		Nepal		Pakistan		Tajikistan		Türkiye		Uzbekistan	
	HR	p-value	HR	p-value	HR	p-value	HR	p-value	HR	p-value	HR	p-value	HR	p-value	HR	p-value
6th-10th years*no*1960-69	1.367	0.030	0.860	0.170	1.015	0.963	1.473	0.106	1.100	0.765	-	0.969	0.856	1.184	0.674	
6th-10th years*no*1970-79	1.400	0.014	0.916	0.471	1.097	0.773	2.463	0.000	0.795	0.452	0.583	0.072	0.896	0.535	1.514	0.297
6th-10th years*no*1980-89	1.664	0.001	0.920	0.652	1.555	0.208	2.533	0.000	0.824	0.558	1.270	0.469	1.110	0.650	1.043	0.923
<i>Education</i>																
no	1		1		1		1		1		1		1			
primary	0.928	0.000	0.881	0.000	1.028	0.217	0.704	0.000	0.964	0.060			0.505	0.000		
secondary	0.689	0.000	0.700	0.000	0.891	0.000	0.445	0.000	0.800	0.000	0.962	0.510	0.293	0.000		
higher	0.454	0.000	0.604	0.000	0.790	0.000	0.247	0.000	0.618	0.000	0.676	0.000	0.249	0.000	0.738	0.000
<i>At least one child is dead</i>																
no	1		1		1		1		1		1		1			
yes	1.415	0.000	1.473	0.000	1.415	0.000	1.160***	0.000	1.159	0.000	1.852	0.000	1.978	0.000	2.047	0.000
<i>Age at the second birth</i>																
Age at the second birth	0.920	0.000	0.938	0.000	0.955	0.000	0.930***	0.000	0.962	0.000	0.931	0.000	0.912	0.000	0.900	0.000
Number of subjects	67,394		72,393		45,809		36,610		29,281		9,446		27,551		7,038	
Months at risk	2,897,129		2,306,464		1,071,394		1,382,730		706,417		345,527		1,316,025		287,678	
LogLikelihood	-79292.6		-90587.1		-57450.7		-42495.0		-38803.9		-11876.9		-33886.2		-8401.5	

Source: Own design. For a list of data sources please refer to Tab. A1.

Tab. A3: Piecewise exponential models for transitions to third parity, women with and without a daughter

	Bangladesh	Egypt	Jordan	Nepal	Pakistan	Tajikistan	Türkiye	Uzbekistan
	HR	p-value	HR	p-value	HR	p-value	HR	p-value
<i>Interval after the second birth</i>								
1st year	1	1	1	1	1	1	1	1
2nd year	3.069	0.000	1.641	0.000	2.026	0.000	1.346	0.000
3rd year	3.808	0.000	1.340	0.000	1.561	0.000	1.161	0.012
4th year	2.931	0.000	0.994	0.947	1.356	0.004	0.984	0.826
5th year	2.148	0.000	0.947	0.276	0.614	0.001	2.092	0.000
6th-10th years	0.873	0.063	0.537	0.000	0.298	0.000	0.819	0.064
0.534	0.000	0.554	0.000	0.464	0.000	0.365	0.000	
<i>At least one daughter</i>								
Yes	1	1	1	1	1	1	1	1
No	0.881	0.026	0.925	0.007	0.826	0.000	0.893	0.106
1.015	0.817	1.028	0.794	0.789	0.881	1.125	0.283	
<i>Interval*At least one daughter</i>								
2nd year*no	0.889	0.090	0.992	0.854	1.230	0.002	0.965	0.683
3rd year*no	0.897	0.149	0.943	0.249	1.126	0.263	0.933	0.482
4th year*no	0.937	0.490	1.036	0.601	0.988	0.945	0.889	0.378
5th year*no	0.907	0.439	1.018	0.834	1.560	0.060	0.715	0.073
6th-10th years*no	1.123	0.323	0.933	0.371	0.922	0.745	0.843	0.331
0.608	0.059	1.292	0.246	1.164	0.264	1.087	0.757	
<i>Cohort</i>								
1950-59	1	1	1	1	1	1	1	1
1960-69	0.990	0.812	0.775	0.000	0.927	0.009	0.979	0.662
1970-79	0.699	0.000	0.480	0.000	0.598	0.000	0.768	0.000
1980-89	0.474	0.000	0.322	0.000	0.420	0.000	0.621	0.000
<i>Interval*Cohort</i>								
2nd year*1960-69	0.852	0.001	1.154	0.000	1.059	0.204	1.081	0.202
0.184	0.830	0.000	1.428	0.000	1.198	0.000	1.113	0.072
2nd year*1970-79	0.786	0.000	1.666	0.000	1.134	0.020	0.968	0.633
2nd year*1980-89	0.755	0.000	1.183	0.000	1.039	0.570	0.936	0.337
3rd year*1960-69	0.668	0.000	1.712	0.000	1.396	0.000	0.854	0.019
3rd year*1970-79	0.653	0.000	2.234	0.000	1.691	0.000	0.700	0.000
3rd year*1980-89	1.221	0.025	1.361	0.012	0.995	0.960	1.653	0.010

Tab. A3: Continuation

	Bangladesh		Egypt		Jordan		Nepal		Pakistan		Tajikistan		Türkiye		Uzbekistan	
	HR	p-value	HR	p-value	HR	p-value	HR	p-value	HR	p-value	HR	p-value	HR	p-value	HR	p-value
4th year*1960-69	0.688	0.000	1.387	0.000	1.088	0.417	0.940	0.506	0.960	0.743			0.853	0.091	0.985	0.932
4th year*1970-79	0.743	0.000	2.283	0.000	1.906	0.000	0.786	0.007	1.117	0.346	1.639	0.001	0.965	0.709	2.416	0.000
4th year*1980-89	0.787	0.002	3.128	0.000	2.393	0.000	0.664	0.000	1.154	0.238	1.746	0.000	1.392	0.006	2.511	0.000
5th year*1960-69	0.736	0.001	1.362	0.000	1.313	0.090	0.785	0.057	1.291	0.197			1.032	0.782	1.864	0.014
5th year*1970-79	0.874	0.120	2.371	0.000	2.571	0.000	0.712	0.005	1.715	0.004	2.058	0.000	1.279	0.031	4.354	0.000
5th year*1980-89	1.014	0.887	3.892	0.000	2.812	0.000	0.640	0.000	1.635	0.012	2.043	0.000	1.692	0.000	4.932	0.000
6th-10th years*1960-69	0.982	0.832	1.428	0.000	1.076	0.628	0.673	0.003	0.787	0.146			1.390	0.000	1.631	0.013
6th-10th years*1970-79	1.397	0.000	2.552	0.000	2.403	0.000	0.659	0.001	0.970	0.844	1.955	0.000	1.918	0.000	4.181	0.000
6th-10th years*1980-89	1.909	0.000	4.874	0.000	3.506	0.000	0.784	0.055	1.290	0.120	2.776	0.000	3.016	0.000	5.928	0.000
<i>Cohort*At least one daughter</i>																
1960-69*no	1.009	0.896	1.053	0.200	1.080	0.160	0.876	0.137	0.920	0.297			1.057	0.472	0.709	0.029
1970-79*no	1.142	0.061	1.027	0.612	1.112	0.060	0.920	0.341	0.992	0.921	0.949	0.707	1.249	0.008	1.240	0.248
1980-89*no	1.405	0.000	1.133	0.130	1.159	0.038	0.872	0.188	1.012	0.879	0.930	0.605	1.169	0.183	0.655	0.132
<i>Interval*At least one daughter*Cohort</i>																
2nd year*no*1960-69	1.125	0.171	0.935	0.237	0.776	0.002	0.941	0.584	1.114	0.342			1.048	0.675	1.309	0.189
2nd year*no*1970-79	0.991	0.914	0.917	0.210	0.718	0.000	0.909	0.389	1.033	0.764	0.908	0.596	0.809	0.084	0.955	0.850
2nd year*no*1980-89	0.947	0.597	0.922	0.443	0.694	0.000	0.900	0.418	1.000	0.997	0.948	0.777	0.774	0.135	1.302	0.455
3rd year*no*1960-69	1.115	0.241	1.018	0.795	0.775	0.039	0.988	0.923	0.963	0.805			1.091	0.530	1.457	0.151
3rd year*no*1970-79	1.023	0.806	0.978	0.781	0.788	0.045	0.859	0.219	0.859	0.291	1.148	0.528	0.907	0.508	0.880	0.656
3rd year*no*1980-89	0.890	0.293	0.897	0.346	0.757	0.039	0.974	0.853	0.734	0.038	1.009	0.970	1.017	0.931	1.063	0.871
4th year*no*1960-69	1.086	0.477	0.855	0.073	1.129	0.525	0.955	0.780	1.016	0.940			1.003	0.984	1.586	0.159
4th year*no*1970-79	1.012	0.916	0.839	0.066	0.963	0.836	0.837	0.274	0.913	0.654	0.793	0.376	0.818	0.254	0.494	0.049
4th year*no*1980-89	0.884	0.342	0.885	0.353	0.871	0.483	0.878	0.480	0.917	0.679	0.840	0.514	0.748	0.198	1.239	0.599
5th year*no*1960-69	1.215	0.193	0.928	0.503	0.583	0.044	1.079	0.739	0.744	0.379			1.067	0.757	0.711	0.404
5th year*no*1970-79	1.121	0.430	0.912	0.436	0.616	0.054	0.717	0.144	0.804	0.486	0.600	0.124	0.923	0.714	0.512	0.100
5th year*no*1980-89	0.823	0.225	0.796	0.161	0.672	0.143	1.015	0.952	0.808	0.513	0.736	0.376	0.926	0.776	0.471	0.115

Tab. A3: Continuation

	Bangladesh		Egypt		Jordan		Nepal		Pakistan		Tajikistan		Türkiye		Uzbekistan	
	HR	p-value	HR	p-value	HR	p-value	HR	p-value	HR	p-value	HR	p-value	HR	p-value	HR	p-value
6th-10th years*no*1960-69	0.839	0.200	1.014	0.890	1.462	0.169	0.917	0.694	1.347	0.336			0.895	0.501	1.083	0.820
6th-10th years*no*1970-79	0.872	0.300	1.083	0.457	1.171	0.554	0.777	0.226	1.575	0.115	0.796	0.380	0.895	0.511	0.699	0.315
6th-10th years*no*1980-89	0.738	0.035	0.796	0.171	1.209	0.512	0.708	0.126	1.396	0.275	0.631	0.112	0.839	0.417	1.128	0.764
<i>Education</i>																
No	1		1		1		1		1		1		1		1	
Primary	0.924	0.000	0.880	0.000	1.029	0.193	0.702	0.000	0.962	0.045			0.509	0.000		
Secondary	0.691	0.000	0.700	0.000	0.891	0.000	0.446	0.000	0.799	0.000	0.967	0.570	0.299	0.000		
Higher	0.456	0.000	0.606	0.000	0.792	0.000	0.243	0.000	0.618	0.000	0.681	0.000	0.255	0.000	0.743	0.000
<i>At least one child is dead</i>																
No	1		1		1		1		1		1		1		1	
Yes	1.593	0.000	1.620	0.000	1.567	0.000	1.374	0.000	1.240	0.000	2.058	0.000	2.308	0.000	2.317	0.000
Age at the second birth	0.921	0.000	0.938	0.000	0.955	0.000	0.929	0.000	0.961	0.000	0.930	0.000	0.912	0.000	0.900	0.000
Number of subjects	67,394		72,393		45,809		36,610		29,281		9,446		27,551		7,038	
Months at risk	2,897,129		2,306,464		1,071,394		1,382,730		706,417		345,527		1,316,025		287,678	
LogLikelihood	-79838.8		-90990.1		-57681.8		-42865.6		-38860.3		-11929.783		-34149.4		-8479.3221	

Source: Own design. For a list of data sources please refer to Tab. A1.

Appendix 4: Sex compositions of children already born and probability of sex selective abortions in the studied countries

Tab. A4: Proportions of women of the risk samples with different sex compositions of the first and second children, 95% confidence intervals

	Two sons	Son, then daughter	Daughter, then son	Two daughters
Bangladesh	25.83-26.49	24.67-25.33	24.82-25.48	23.37-24.01
Egypt	26.14-26.78	24.81-25.44	24.67-25.30	23.12-23.72
Jordan	26.28-27.09	24.83-25.62	24.39-25.18	22.92-23.69
Nepal	25.37-26.27	24.07-24.95	25.20-26.10	23.58-24.45
Pakistan	26.92-27.94	24.43-25.42	23.88-24.86	22.79-23.76
Tajikistan	27.01-28.82	23.75-25.49	24.06-25.80	21.68-23.37
Türkiye	25.57-26.61	24.84-25.87	24.41-25.43	23.13-24.13
Uzbekistan	25.54-27.61	24.45-26.47	23.30-25.31	22.66-24.64
<i>The "norm"</i>	25.98-26.48	24.97-24.99	24.97-24.99	23.56-24.03

Source: Own design. For a list of data sources please refer to Tab. A1.

In Table A4 proportions of women in the risk samples for the third birth with different gender composition of first and second children are compared with the biological norm (both children alive and dead at the time of the survey are included in the calculation). The biological norm of 104-106 boys per 100 girls yields the probability of birth of a boy within the interval of 50.98-51.46 percent. The "normal" proportions of women with different gender compositions of the first and the second child are provided in the rightmost column of Table A4. In the other columns proportions of women of the country risk samples with different gender composition of children already born are given with 95% confidence intervals.

The purpose of the comparison is to see whether there are reasons to suppose considerable frequency of sex-selective abortions in any of these countries. If sex-selective abortions are frequent, then the expectation is that proportions of women having a son as the second child will be higher than the norm, as sex-selection is known to very seldom take place before the first birth (*Guilmoto* 2015).

There are only three countries where the proportion of women with some sex composition is outside the interval expected under the natural sex ratio at birth: Nepal, Pakistan and Tajikistan.

In Pakistan and Tajikistan, the proportions of women having two sons are higher than the norm. If one treats these proportions as an indication of sex-selective abortions, then one has to expect that the proportion of women having a son after a daughter would be elevated as well. Moreover, it is exactly this proportion that is first of all expected to be higher than the norm when sex-selective abortions are common, because sex-selection is known to be especially widely resorted to when the first child was a girl (see *Guilmoto* 2009: 533). However, neither in Pakistan nor in Tajikistan the proportion of women having a son after a daughter is higher than the biological norm; in fact, in Pakistan it is even lower than the norm.

A surplus of women having a boy after a girl is observed in Nepal, with the “mirror” sex composition falling there below the norm. However, if sex-selective abortions were actively practiced by respondents from this country, lower proportion of women having two girls would also be expected, what is not the case.

To conclude, the more detailed look at proportions of women with different gender composition of first and second children shows that, even in the countries where the proportions somewhat deviate from the biological norm, they do not give sufficient reasons to state that sex-selective abortions were common among women of the risk samples.

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