



RESEARCH ARTICLE

Son preference and children sex composition in Uttar Pradesh: An empirical analysis

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Abstract

This study aims to explore the effect of son preference on the sex composition of children in Uttar Pradesh, India's most populous state, using data from NFHS-IV (2015-16). While national-level estimates have been unable to detect the impact of son preference on the sex composition of children ever born across all families, this research seeks to uncover distinct and predictable patterns at the family level within Uttar Pradesh. The term son preference denotes a prevailing mindset wherein sons are accorded greater significance and value compared to daughters. By examining empirical evidence from Uttar Pradesh, this article highlights two primary effects of son preference on the children sex composition at the family level. Firstly, the data reveals that smaller families are significantly more likely to have sons, while girls tend to be found in larger households on an average. This suggests that families with a higher number of girl children tend to expand their size in an effort to have more sons. Secondly, the study confirms that son preference is associated with various factors, including the age of women, residence background, level of education, family structure, religion, survival status of the last child, and the sex of the last child born. Particularly, the preference for sons is found to be strongest among women, especially elderly women, with lower education levels, belonging to joint families, residing in rural areas of Uttar Pradesh, and being part of lower-caste and Muslim communities, and especially if their last-born child is female. Furthermore, it is established that when family size is controlled then characteristics of women/couples with strong son preference will be same as those women/couples with more sons and if family size is not controlled then the characteristics of women desiring a higher proportion of sons will slightly differ from those women who actually have a higher proportion of sons. These findings shed light on the complex interplay of cultural and socioeconomic factors that influence child sex composition and provide valuable insights for policy interventions aimed at addressing gender imbalances in Uttar Pradesh and beyond.

Keywords: Son preference, Sex composition, Family structure, Ideal proportion of sons, Actual son proportion.

Introduction

The prevailing term son preference encompasses the belief and attitude observed in several South Asian and Eastern countries like India, China, etc. where sons are ascribed greater importance and value in comparison to daughters. This preference is rooted in economic, religious, and social factors. For example, in India, adult sons are expected to

financially support their parents (Das 1984; Lahiri 1984; Miller 1981; ORG 1983). In contrast, daughters can become a significant financial burden, particularly in regions where dowry payments are customary for their marriages. The different communities residing in Uttar Pradesh attach economic, religious, and social significance to the sons, as socio-cultural beliefs and practices are largely male-oriented. This distinction in the treatment of sons and daughters has implications on the sex composition of children within families. Couples without sons may be inclined to continue childbearing, while those who have already achieved their desired number of sons might terminate the childbearing process. The intensity of parents' desire for more sons compared to daughters is likely correlated with the perceived value of sons over daughters within the family unit. This intricate relationship between son preference and its impact on children sex composition necessitates a thorough examination to comprehend the socio-cultural dynamics influencing family planning and gender imbalances in Uttar Pradesh and other similar regions.

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Various measures exist to assess the extent of son preference, and one straightforward approach involves determining woman's ideal number of sons and daughters, which is then converted into the desired(ideal) proportions of sons. The actual percentage of sons within a household is subject to variation, influenced by both the couple's fertility and the mortality rates of their sons and daughters. Previous research has highlighted that parents with a strong preference for sons may allocate fewer resources, such as limited food or inadequate healthcare, to their daughters, potentially elevating the risk of mortality for the female children. Consequently, this pattern of differential treatment could alter the sex composition of the surviving children (Bardhan 1974, 1982; Basu 1989; Chen, Huq, and D'Souza 1981; Das Gupta 1987; D'Souza and Chen 1980; Kynch and Sen 1983; Miller 1981; Sen and Sengupta 1983; Timaeus, Harris, and Fairbairn 1997: chap.7). It is crucial to note that despite harboring a strong preference for sons and desiring a higher number of male children, couples may encounter biological constraints that limit their ability to achieve this goal. These biological factors are beyond the couples' volitional control or alteration (Teitelbaum 1972). Consequently, these multifaceted aspects of son preference, coupled with biological realities, warrant comprehensive investigation to comprehend the intricacies of sex composition dynamics within families and the potential implications on gender imbalances in various societies.

The present study aims to investigate the implications of son preference on the sex composition of children in Uttar Pradesh, India's most populous state. Measures assessing the impact of son preference are frequently based on the sex composition of already-born children. Several authors have examined the parity progression ratio of couples in relation to the sex composition of their existing children (Arnold 1997; Das 1987; Feeney and Yi 1986; Wen 1992). Additionally, some researchers have utilized hazard models to gauge the implications of sex preference, revealing longer birth intervals before the next child for couples with more sons (Haughton and Haughton 1996; Pong 1994; Rahman and DaVanzo 1993; Arnold *et al.* 1998). Among the approaches to estimate the impact of sex preference, the stopping rule proposed by McClelland (1979) stands out as an intriguing attempt. This method addresses certain limitations present in other measures but may pose implementation challenges in less developed nations. One criticism of this approach is its focus on views towards hypothetical family compositions rather than actual family compositions, thereby overlooking the reality of the situation. An early empirical effort to quantify stopping rules was undertaken in the 1970s in Korea and Taiwan by Coombs and colleagues (1979) (Coombs and McClelland 1975; Coombs and Sun 1978). The researchers devised an ordinal scale to assess the couple's desire to have more children in order to attain their ideal number of sons

and the magnitude of their preference for sons. However, despite its utility, the Coombs index is seldom employed in demographic surveys, leading to a lack of contemporary usage of this method.

The majority of measures reliant on the sex composition of children have faced criticism on two fundamental grounds (Widmer, McClelland, and Nickerson, 1981; McClelland, 1979). Firstly, concerns have been raised regarding the appropriateness of these measures when dealing with heterogeneous sex preferences, as the utilization of aggregate measures may obscure significant individual variations. Secondly, these measures do not account for the possibility that sex preference could impact fertility outcomes, potentially leading to reduced fertility rates for certain individuals due to associated risks. Another point of contention pertains to the reliance of parity progression ratios is on retrospective data, which has also been subject to criticism. In light of the challenges associated with existing measures in capturing the impact of sex preference comprehensively, the present study focuses on a measure based on individual-level data. By addressing some or all of these aforementioned concerns, this approach seeks to provide a more nuanced and in-depth understanding of the influence of sex preference on childbearing behavior.

At the family level, couples may engage in differential stopping behaviors to attain their desired number of sons, thereby offering insights into the implications of sex preference, particularly son preference, on the sex composition of children. Shelley (2000) hypothesized that differential stopping behavior could lead to a decline in the proportion of sons within families as the total family size increases. Specifically, households with early-born sons are likely to exhibit a higher proportion of male children, whereas those with later-born sons may display a lower proportion of sons. Consequently, larger families tend to have a lower proportion of sons, while smaller families have a notably higher number of male children. Furthermore, Shelley's second hypothesis suggests that when family size is controlled, the characteristics of women desiring a higher proportion of sons may be similar to those women who actually have a higher proportion of sons. This indicates the importance of accounting for family size in order to accurately comprehend the dynamics of son preference and its implications on child sex composition. By investigating these hypotheses, this study aims to provide a more comprehensive understanding of the nuanced relationship between sex preference, family planning decisions, and the resulting sex composition of children within families.

In we aim to examine the aforementioned two hypotheses in the specific context of Uttar Pradesh. To test these hypotheses, we will employ the ideal and actual sex compositions of children among ever-married women or eligible women. The focal point of our analysis

lies in determining whether the proportion of sons exhibits a decline as family size increases, and whether the characteristics of women/couples desiring a higher proportion of sons may be similar to those women/couples who have more sons, particularly when family size is taken into account. By utilizing this approach, we endeavor to gain valuable insights into the interplay between son preference, family size dynamics, and the actual sex composition of children, offering a comprehensive understanding of these phenomena within the context of Uttar Pradesh.

Data and Methodology

Source of Data

The data utilized for the current study, aimed at testing the two hypotheses, was sourced from the National Family Health Survey i.e. NFHS-IV (2015-16), which stands as the largest demographic survey conducted in India. The NFHS is carried out under the auspices of the Ministry of Health and Family Welfare (MoHFW), Government of India. The International Institute for Population Sciences (IIPS), Mumbai, has been designated by the MoHFW as the nodal agency responsible for overseeing the survey. Covering all 71 districts of Uttar Pradesh, the NFHS-IV survey extensively collected data on a wide array of parameters, encompassing fertility, infant and child mortality, maternal and child health, family planning, contraceptive usage among couples, ideal number of sons and daughters among couples, actual number of sons and daughters among couples, as well as the number of children ever born to women aged 15 to 49, and many other vital indicators. By utilizing this comprehensive dataset, our study aims to glean valuable insights into the interplay between son preference, family size dynamics, and the sex composition of children within the context of Uttar Pradesh. (NFHS IV, 2015-16).

Description of Data

Independent variables

The multivariate model encompasses a diverse set of socio-economic variables that may be associated with the preference for sons. Educational attainment in India, especially among women, has notably increased compared to previous NFHS data, with 52.6% of women in the sample having received some form of education. Additionally, approximately 72.8% of women reside in rural areas. Among the sampled population, the majority (79.4%) identify as Hindu, while 20.2% identify as Muslim, and 0.4% belong to other religious groups (see Table 1).

Dependent variables

The two dependent variables in this study are the actual proportion of sons and the ideal proportion of sons within the family.

Table 1: Selected characteristics of households and eligible women

<i>Independent variables</i>		
1	Mother's age (mean)	28.60
2	Residence (%)	
2.1	Rural	72.8
2.2	Urban	27.2
3	Education (%)	
3.1	No schooling	47.4
3.2	Evered schooling	52.6
4	Caste (%)	
4.1	Other (General)	21.7
4.2	S.C.	22.1
4.3	S.T.	1.1
4.4	O.B.C.	55.1
5	Religion (%)	
5.1	Hindu	79.4
5.2	Muslim	20.2
5.3	Others	0.4
6	Family structure (%)	
6.1	Nuclear family	56.5
6.2	Joint family	43.5
<i>Dependent variables</i>		
1	Actual children (mean)	
1.1	Total child ever born	2.15
1.2	Total sons ever born	1.12
1.3	Total daughters ever born	1.01
1.4	Actual proportions of sons	0.52
2	Ideal children (mean)	
2.1	Total ideal children	2.52
2.2	Total ideal sons	1.39
2.3	Total ideal daughters	1.05
2.4	Total ideal either sons or daughters	0.27
2.5	Ideal proportions of sons	0.55

Methodology

To test the aforementioned two hypotheses, we establish a relationship between family size and the proportion of sons within a family, assuming each family consists of a single mother or woman. The sex of the child is assumed to follow a binomial distribution, represented as a Bernoulli random variate, with a value of 1 denoting a boy and 0 for a girl. Each woman (family) has n_i children, representing the number of trials for i th woman. Among these trials, x_i sons are born to woman i , and "actual α_i " represents the actual probability of having sons for the i th woman, which can be considered as the actual proportion of sons.

To investigate the effect of family size on actual proportion of sons is given by logistic regression model:

$$\text{Logit}(\text{actual } \alpha_i) = \sum_k \delta_k (\text{family size})_i, \dots, \dots (1.1)$$

Where (family size)_i is the number of children ever born i.e. family size of the *i*th woman and δ_k is the logit regression coefficients (Equation 1.1).

This approach allows us to analyze the relationship between family size and the likelihood of having sons, providing valuable insights into the interplay between family dynamics and the proportion of male children within the population under study.

A similar analogy can be applied to determine the characteristics of women who desire to have more sons, represented by "ideal α_i " denoting the ideal probability of having sons or the ideal proportion of sons to the *i*th woman. The model for this scenario is expressed as:

$$\text{Logit}(\text{ideal } \alpha_i) = \sum_j \delta_{ji} (\text{background characteristics})_i, \dots, \dots (1.2)$$

Here, (background characteristics)_i encompasses various socio-economic, cultural, and demographic factors of the *i*th woman, such as age, schooling, residence place, caste, religion, survival status of the last child, and sex of the last child born, while δ_{ji} represents the logit regression coefficients (Equation 1.2).

With the socio-economic, cultural, and demographic characteristics of women exhibiting son preference identified, the hypothesis testing proceeds to assess whether the characteristics of women with more sons are similar to those desiring to have more sons. To model this relationship, we model "actual α_i " as:

$$\text{Logit}(\text{actual } \alpha_i) = \sum_k \delta_k (\text{family size})_i + \sum_j \delta_{ji} (\text{background characteristics})_i, \dots, \dots (1.3)$$

The logit models presented in equations (1.1) through (1.3) serve as crucial tools for testing the two hypotheses described in the previous section, enabling a comprehensive analysis of the interplay between family size dynamics, women's preferences for sons, and the socio-demographic factors influencing these preferences.

Results

Proportion of sons/boys by family size

We commence our investigation by empirically examining the hypothesis that the proportion of sons/boys declines with increasing family size, attributed to the phenomenon where women who achieve their desired number of sons at an early parity opt to discontinue childbearing, while those without sons continue to have more children. The null hypothesis posits that family size has no relation with the proportion of sons. Table 2 presents the actual proportion of boys among all the women, categorized by family size, providing crucial insights into the relationship between family size and the sex composition of children within the

studied population. By scrutinizing this data, we aim to shed light on the intricate dynamics governing the proportion of male children and its potential association with family size.

Table 2 reveals a notable pattern concerning the proportion of sons/boys as family size increases. Initially, the proportion of boys rises until the family reaches a size of two children, after which it begins to decline. Specifically, couples who stop with two or three children exhibit an average of 61% sons, while those with seven or more children have an average of only 53% sons. To assess the above-mentioned null hypothesis in a statistical context, the logit model presented in equation (1.1) is applied, and the logistic regression output is displayed in Table 3. This output includes the values of odds ratio, standard error, and 95% confidence intervals for various family sizes, along with the corresponding probability levels of significance. An odds ratio below 1.00 signifies that women with a particular family size have a lower proportion of sons, while an odds ratio above 1.00 indicates a higher proportion of sons associated with that specific family size.

The analysis of Table 3 indicates noteworthy trends regarding the odds of having sons/boys in relation to family size. Specifically, women with two children exhibit 2.1 times

Table 2: Proportion of sons/boys by family size

Family size	Sex of child		Total	Proportion of sons/boys
	Male	Female		
1	5314	4177	9491	0.559
2	8621	5317	13938	0.618
3	8284	5193	13477	0.614
4	5839	4039	9878	0.591
5	3749	2691	6440	0.582
6	2291	1717	4008	0.571
7	1187	1025	2212	0.536
8+	1132	955	2087	0.542
Total	36417	25114	61531	0.57

Table 3: Effects of family size on the proportion of sons/boys

Variable	Odds Ratio	Standard error	95% confidence interval	
			Lower	Upper
Family Size				
1 child	1.00	-	-	-
2 children	2.171**	0.015	2.106	2.238
3 children	1.219**	0.008	1.202	1.237
4 children	1.085**	0.009	1.067	1.104
5 children	1.042**	0.006	1.029	1.055
6 children	1.013**	0.008	0.998	1.029
7 children	0.937**	0.007	0.925	0.949
8+children	0.934**	0.006	0.923	0.946

**p < 0.001

higher odds of having boys compared to girls, while those with three children have 21% higher odds. A similar pattern emerges for families with four children, with 8% higher odds of having boys. However, as family size increases to seven children, the odds become 7% less, and this decline continues for families with eight or more children. Consequently, the odds ratio experiences an initial rise up to two children, followed by a gradual decline with larger family sizes. Notably, these declines are statistically significant with a $p\text{-value} < 0.001$. Thus, the null hypothesis, positing no association between family size and the proportion of sons, is firmly rejected. The findings lead us to conclude that the proportion of sons among women initially increases up to two children and subsequently starts to decrease with increasing family size. This shows that, in societies with son preference, differential stopping behavior becomes evident, where women who attain their desired number of sons at lower parities tend to cease childbearing, while those unable to achieve their desired sons proceed to higher parities.

Characteristics of women who give importance to the son preference

Conclusive findings from various studies (Arnold and Liu, 1986; Dyson and Moore, 1983; Kwon and Lee, 1976; Murthi, Guio, and Dreeze, 1995; Raju and Bhatt, 1995) suggest that lower socio-economic status and limited education are linked to a strong preference for sons. This observation implies that son preference tends to be concentrated among women exhibiting specific characteristics, rather than being randomly distributed. Building upon these non-random attributes of eligible/ever married women, the second hypothesis of our study is founded. To investigate the characteristics of women who desire to have more sons, we employ the ideal number of children and ideal number of sons expressed by eligible/ever married women. Using the proportion of ideal number of sons in relation to the ideal number of children as the dependent variable, we apply the logit model presented in equation (1.2) to identify the attributes associated with son preference. The analyzed characteristics of women encompass her age, family size, residence, schooling status, caste, religion, family structure, last child survival status, and sex of the last child born. The results of the logit model, presented in Table 4, are expressed in terms of odds ratio, illuminating the characteristics of women desiring a higher proportion of sons.

Table 4 reveals compelling insights into the odds of having sons among women, based on different family sizes. Among women with two children, the odds of having sons are 17% higher, while those with three children exhibit 24% higher odds. Similarly, women with four children have 30% higher odds, but as family size increases to five children and beyond, the odds gradually decline. Thus, the odds ratio demonstrates an initial increase up to four children, followed by a gradual decline with larger family sizes. Moreover, the

Table 4: Logistic regression output of characteristics of women who want a higher proportion of sons/boys.

Variable	Odds Ratio	Standard error	95% confidence interval	
			Lower	Upper
Family size				
1 child	1.00	-	-	-
2 children	1.174**	0.015	1.141	1.209
3 children	1.240**	0.011	1.213	1.267
4 children	1.301**	0.011	1.273	1.330
5 children	1.202**	0.010	1.177	1.226
6 children	1.176**	0.011	1.150	1.201
7 children	1.171**	0.013	1.141	1.202
8+ children	1.184**	0.017	1.144	1.225
Mother's age				
Less than 20	1.00	-	-	-
20–24	0.840**	0.028	0.795	0.888
25–29	1.167**	0.032	1.095	1.244
30–34	1.408**	0.036	1.311	1.512
35–39	1.451**	0.038	1.347	1.563
40–44	1.779**	0.043	1.636	1.934
45–49	1.741**	0.044	1.597	1.898
Residence				
Rural	1.00	-	-	-
Urban	0.652**	0.021	0.625	0.679
Education				
Illiterate	1.00	-	-	-
Literate	0.516**	0.021	0.495	0.537
Caste				
Others (General)	1.00	-	-	-
O.B.C.	1.191**	0.020	1.145	1.239
S.C.	1.268**	0.026	1.206	1.333
S.T.	1.691	0.064	1.493	1.916
Religion				
Hindu	1.00	-	-	-
Muslim	1.048**	0.025	0.997	1.101
Others	0.517**	0.128	0.402	0.665
Family structure				
Nuclear family	1.00	-	-	-
Joint family	1.227**	0.021	1.177	1.278
Last child survival status				
Alive	1.00	-	-	-
Death	1.076**	0.066	0.945	1.226
Sex of last child born				
Female	1.00	-	-	-
Male	0.677**	0.022	0.648	0.706

** $p < 0.001$

analysis of odds ratio, standard error, and 95% confidence intervals establishes a significant relationship between the age of women and their desired ideal number of sons. As the age of women increases, the odds of desiring sons also increase and then start to decline. Older women display a higher preference for sons compared to younger women.

This observation highlights the role of age in shaping son preference among the women. Furthermore, the residence location of women in urban areas of Uttar Pradesh plays a significant role in their preferences, with the odds of desiring sons being 35% lower relative to women residing in rural Uttar Pradesh. Additionally, educational background emerges as a crucial factor, wherein literate women exhibit 48% lower odds of wanting sons compared to illiterate women. Regarding caste affiliations, odds of desiring sons are higher among the other backward class (OBC), scheduled caste (SC), and scheduled tribe (ST) women in comparison to those from the general caste. Among religious groups, Muslim women display 4% higher odds of wanting sons relative to Hindu women. Conversely, in other religious communities, such as Sikh, Christian, Jains, Buddhist, and Parsi communities, the odds of wanting sons decrease by 48% in comparison to Hindu women. The findings underscore the intricate interplay of socio-demographic factors, including age, residence, education, caste, and religion, shaping the preferences for sons among women in Uttar Pradesh.

In analyzing the characteristics of women based on family structure, we observe that in joint families, the odds of desiring sons are 22% higher compared to women in nuclear families. Another significant variable shedding light on the characteristics of women is the survival status of their last child, categorized as either alive or deceased. Here, we find that when the last child is deceased, the odds of wanting sons increase by 7%. Notably, when considering the sex of the last child born, it is not surprising to discover that the odds of desiring sons decrease by 32% for women whose last child is a boy in comparison to those whose last child is a girl. The results of the logit model (Equation 1.2) discussed in the preceding paragraph reveal the heterogeneous nature of son preference, indicative of women with specific background characteristics. Among the socio-economic and demographic factors significantly influencing the desire for sons are the age of women, educational background, caste, and religion. Similar conclusions hold true for the effect of residence background, family structure, and the sex of the last child born. Thus, as presented in Table 4, it is established that son preference is strongest among the women, especially aged women, with lower education level, belong to joint family structures, residing in rural areas of Uttar Pradesh, and identifying as lower caste or Muslim communities and whose last-born child is female. These findings provide valuable insights into the intricate interplay of various socio-demographic factors shaping son preference among women in the region.

Characteristics of women with more sons/boys

The second hypothesis under examination pertains to the comparability of characteristics between women with a higher number of sons and women displaying son preference. Here null hypothesis is that no relationship exists between

proportion of sons and household characteristics. To test this hypothesis, we utilize the actual proportion of sons expressed by women and apply the logit model (Equation 1.3) to ascertain the characteristics associated with having more sons. The focal characteristics subject to analysis encompass the age of women, family size, residence, schooling status, caste, religion, family structure, last child survival status, and

Table 5: Logistic regression output of characteristics of women who have higher proportion of sons/boys

Variable	Odds Ratio	Standard error	95 % Confidence Interval	
			Lower	Upper
Family size				
1 child	1.00	-	-	-
2 children	2.171**	0.015	2.106	2.238
3 children	1.219**	0.008	1.202	1.237
4 children	1.085**	0.009	1.067	1.104
5 children	1.042**	0.006	1.029	1.055
6 children	1.013**	0.008	0.998	1.029
7 children	0.937**	0.007	0.925	0.949
8 children	0.934**	0.006	0.923	0.946
Mother's age				
Less than 20	1.00	-	-	-
20–24	1.341**	0.094	1.116	1.613
25–29	1.696**	0.093	1.413	2.036
30–34	1.721**	0.093	1.433	2.066
35–39	1.712**	0.093	1.426	2.056
40–44	1.697**	0.094	1.412	2.041
45–49	1.640**	0.094	1.363	1.972
Residence				
Rural	1.00	-	-	-
Urban	1.045**	0.019	1.007	1.084
Education				
Illiterate	1.00	-	-	-
Literate	0.93**	0.017	0.900	0.962
Caste				
Others (General)	1.00	-	-	-
O.B.C.	1.010**	0.021	0.978	1.045
S.C.	1.066**	0.024	1.016	1.118
S.T.	0.947**	0.017	0.818	1.096
Religion				
Hindu	1.00	-	-	-
Muslim	1.206**	0.017	1.166	1.246
Others	0.805**	0.104	0.657	0.987
Family structure				
Nuclear family	1.00	-	-	-
Joint family	1.186**	0.016	1.146	1.227
Last child survival status				
Alive	1.00	-	-	-
Death	0.805**	0.038	0.747	0.868
Sex of last child born				
Female	1.00	-	-	-
Male	0.563**	0.017	0.545	0.583

**p < 0.001

sex of the last child born. The outcomes of the logit model are presented in Table 5, elucidating the odds ratio for the characteristics of women who possess a higher proportion of sons. In order to statistically test the aforementioned null hypothesis, the logit model (Equation 1.3) is deployed, and the logistic regression output is displayed in Table 5. This output includes the values of odds ratio, standard error, and 95% confidence intervals, offering valuable insights into the characteristics associated with women who exhibit a higher proportion of sons. Through this analysis, we aim to gain a deeper understanding of the potential commonalities between women with a higher number of sons and those who manifest son preference, thereby contributing to the existing knowledge in this domain.

From the findings presented in Table 5, it becomes evident that women with two children exhibit 2.1 times higher odds of having boys in comparison to girls, while those with three children demonstrate 21% higher odds. A similar trend is observed for women with four children, with 8% higher odds, followed by a gradual decline in odds as family size increases to seven children and beyond. This decline in odds is statistically significant with a p -value < 0.001. Consequently, the odds ratio shows an initial increase up to two children and then starts to decline with increasing family size, signifying a proportional relationship between family size and the likelihood of having boys. These results further affirm that the proportion of boys among women initially increases and then starts to decrease with increasing family size. This shows that the societies with son preference exhibit differential stopping behavior, where women who achieve their desired number of sons at lower parity tend to cease childbearing, while those unable to fulfill their preference for sons proceed to higher parities. Moreover, with the increasing age of women, the odds of desiring sons also rise initially and then start to decline. The above findings contribute valuable insights into the complex dynamics of son preference in the context of family size and the age of women, shedding light on the heterogeneity of preferences within the population.

The analysis reveals that older women exhibit a higher proportion of sons compared to younger women in Uttar Pradesh. Specifically, among women aged 20 to 24 years, the odds of having a son are 34% higher. Similarly, for women aged 25 to 29 years, the odds increase by 69%, and for the age group of 30 to 34 years, the odds surge by 72%. Even beyond 34 years of age up to 49 years, the odds of having sons decline compared to the previous age group; however, they remain over 60% higher than women aged less than 20 years. This robust pattern of son preference in the society underscores the strong influence of age on woman's preference for sons in Uttar Pradesh. In terms of residence, women in urban areas of Uttar Pradesh display 4% higher odds of having sons relative to their rural counterparts.

This difference in preference based on residence highlights regional variations in son preference within the state. Moreover, educational background emerges as a significant factor, with literate women exhibiting 7% lower odds of having sons compared to illiterate women. This suggests that school attendance or literacy serves as a variable that lowers the odds of having sons. Furthermore, among caste affiliations, odds of having sons are higher in other backward class (OBC) and scheduled caste (SC) women, but lower in scheduled tribe (ST) women compared to the general caste. Additionally, Muslim women demonstrate 20% higher odds of having sons relative to Hindu women, whereas in other religious communities such as Sikh, Christian, Jain, Buddhist, Parsi, etc., the odds of having sons are lowered by 20% compared to Hindu women. These findings underscore the multifaceted nature of son preference, which is influenced by age, residence, educational background, and caste and religious affiliations in the societal context of Uttar Pradesh.

Upon examining the characteristics of women from the standpoint of family structure, specifically nuclear versus joint family, we observe that in joint families, the odds of having sons are 18% higher than in nuclear families. The subsequent variable shedding light on women's characteristics pertains to the survival status of their last child, which can either be alive or deceased. Notably, the odds of having sons decrease by 20% when the last child is deceased. Furthermore, when considering the sex of the last child born, it is unsurprising to find that the odds of having sons are diminished by 44% for women whose last child is a boy compared to those whose last child is a girl. These results are derived from the logit models presented in equation (1.3) and equation (1.2) in the preceding paragraph, leading to the rejection of the null hypothesis. This signifies that, with controlling family size, the characteristics of women desiring a high proportion of sons and those who indeed have a high proportion of sons exhibit similar.

Discussion

Our investigation aimed to explore the hypothesis suggesting a decline in the proportion of boys with increasing family size in most populous state of Uttar Pradesh, attributed to women achieving their desired number of sons early on and subsequently discontinuing childbearing, while those without sons continue to expand their families. The empirical evidence presented in Table 2 reveals a discernible pattern. Initially, as family size increases up to two children, the proportion of boys rises, after which it begins to decline. This intriguing trend accentuates the phenomenon of differential stopping behavior observed in societies with strong son preference. Couples who promptly fulfill their desire for sons tend to cease childbearing, while those still aspiring to have sons continue to expand their families.

This finding is consistent with previous studies that have documented the influence of son preference on fertility

behavior and sex ratio by family size. For instance, Kugler and Kumar (2015) found that in India, women's desired fertility is positively associated with their level of son preference and that son preference has a significant impact on the acceptance of contraceptive practices. Similarly, Chauhan (2014) reported that in Rajasthan, India, son preference has a higher dominance on desired family size than other socio-economic and demographic variables. Moreover, Singh *et al.* (2004) showed that in India, son preference declines with ideal family size, but remains strong even among women who want only two children.

To discern the statistical association between family size and the proportion of sons, we employed the logit model (equation 1.1), and the resulting logistic regression output is showcased in Table 3. Our findings substantiated a significant correlation between family size and the odds of having sons. Specifically, couples with two children exhibited higher odds of having sons compared to girls, with a gradual decline in odds as family size increased. The statistical significance of this decline was confirmed with a p -value < 0.001 , firmly rejecting the null hypothesis which posited no relation between family size and the proportion of sons. These results offer compelling support for the influence of son preference on family size decisions. Furthermore, we delved into the characteristics of women manifesting a preference for sons. Using the logit model (equation 1.2) and the analysis presented in Table 4, we identified significant associations between son preference and certain socio-demographic factors. Son preference was notably more pronounced among women, especially elderly women, those with limited education, women from lower socio-economic backgrounds, rural residents, and specific religion like Muslim and caste affiliations like OBC, SC. These findings underscore the non-random distribution of son preference, emphasizing the role of socio-demographic contexts in shaping women's preferences for sons.

For instance, Kugler and Kumar (2017) used nationally representative household surveys to test whether Indian parents make trade-offs between the number of children and investments in education. They found that children from larger families have lower educational attainment and are less likely to be enrolled in school, with larger effects for rural, poorer, and low-caste families as well as for families with illiterate mothers. They also explored the cultural phenomenon of son preference as a natural experiment to examine the causal effect of family size on parental investments in their children. They instrumented family size with the gender of the first child, which is plausibly random, and found that having a first-born girl leads to larger family size and lower educational outcomes for subsequent children. Another paper by Das Gupta *et al.* (2003) analyzed data from two successive rounds of a nationally representative survey to investigate how ideal family size and son preference changed in India between 1992-93 and 1998-99. They found that in

all but one Indian state, ideal family size and son preference declined in tandem between the two surveys: The ideal number of children declined from 2.9 to 2.7, while the overall proportion of women wanting more sons than daughters decreased from 42 to 33%, and the average proportion of sons in the ideal family from 54 to 51%. They also found that in northern India, women's desired fertility is positively associated with their level of son preference; The smaller the reported ideal family size, the lower the likelihood of wanting more sons than daughters and the lower the proportion of sons in the reported ideal family.

Continuing our inquiry, we explored the characteristics of women with a higher proportion of sons. Applying the logit model (equation 1.3) and analyzing the results in Table 5, we discerned a consistent pattern of odds ratios. Women with two children exhibited higher odds of having sons, with a subsequent gradual decline in odds as family size increased. This observed decline reaffirmed the association between family size and the likelihood of having boys. Moreover, we unearthed the influence of age, educational background, residence, caste, religion, family structure, and the sex of the last child on the proportion of sons among women. Older women displayed higher odds of having sons, indicating the significance of age in shaping son preference. Additionally, educational attainment emerged as a notable factor, with literate women exhibiting lower odds of having sons compared to their illiterate counterparts. Caste and religious affiliations also played pivotal roles, contributing to variations in son preference. Overall, our study provides valuable insights into the intricate dynamics of son preference in Uttar Pradesh, shedding light on the interplay of family size decisions, socio-demographic factors, and cultural norms. The results offer significant implications for addressing gender biases and fostering gender equality within the region. By examining the complex landscape of son preference, our research contributes to the broader understanding of reproductive behaviors and socio-cultural influences impacting gender ratios in populations.

Klaus and Tipandjan (2014) applied the value of children-approach to explain the regional gradient of son preference in India, using data from Uttar Pradesh and Puducherry. They found that son preference was more pronounced among north Indian mothers than south Indian mothers, and that sex-specific benefits and costs were associated with son preference. However, they also noted that region-specific socioeconomic and sociocultural factors did not fully mediate the relationship between region and son preference. Halli *et al.* (2019) analyzed fertility and family planning trends in Uttar Pradesh and India, using data from Sample Registration System (SRS) and National Family Health Survey (NFHS). They observed that fertility declined in Uttar Pradesh but remained above the national level, and that traditional methods and condoms were more prevalent than modern contraceptives among women in Uttar

Pradesh. They suggested that inadequate access to modern contraceptives and variations in need and geography were challenges for improving family planning programs and fertility outcomes.

Conclusion

The present study delves into the influence of son preference on the sex composition of children within households in Uttar Pradesh, a region where decisions pertaining to childbearing and cessation of reproduction are made. Previous investigations on son preference employing aggregate methods, such as parity progression ratios, have overlooked the impact at the family level. Son preference drives women to adopt differential stopping behavior, wherein those who achieve desired sons at an early parity stop childbearing at a younger age, while those unsatisfied with their preference continue having children. Analyzing the relationship between family size and the actual proportion of sons aids in comprehending the implications of son preference on the sex composition of the children. Empirical and statistical analyses demonstrate a negative correlation between the proportion of sons and family size. Notably, girls tend to belong to larger households on an average, leading families with a higher number of female children to strive for more male children. This exercise of differential stopping behavior highlights the non-random and heterogeneous nature of sex preferences, challenging previous assumptions that socioeconomic characteristics are unrelated to the sex composition of children within a household. The findings of this study confirm that son preference is associated with various factors, including the age of women, residence background, educational attainment, family structure, religion, last child survival status, and sex of the last child born. Particularly, son preference is most pronounced among women, especially elderly women, with lower education level, residing in joint family structures in rural areas of Uttar Pradesh, belonging to lower caste and Muslim communities, and having a last-born child as female. Moreover, with controlling family size, women/couples desiring a high proportion of sons and those with a high proportion of sons exhibit similar characteristics. Statistically, logit models serve as valuable tools in revealing the intricate relationship between son preference and the sex composition of children at the family level in Uttar Pradesh, the most populous state in India.

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