

P-ISSN: 2338-8617

E-ISSN: 2443-2067

Jurnal Ilmiah

PEURADEUN

Vol. 11, No. 3, September 2023



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Valid Until the January 2026 Edition



SCAD Independent
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JIP
The Indonesian Journal of the Social Sciences
www.journal.scadindependent.org
DOI Prefix Number: 10.26811

**The Impact of Mother's Gender Preference
on Children's Cognitive Ability in Indonesia**

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Article in Jurnal Ilmiah Peuradeun

Available at : <https://journal.scadindependent.org/index.php/jipeuradeun/article/view/1008>
DOI : <https://doi.org/10.26811/peuradeun.v11i3.1008>

How to Cite this Article

APA : Thahira, Z., & Handayani, D. (2023). The Impact of Mother's Gender Preference on Children's Cognitive Ability in Indonesia. *Jurnal Ilmiah Peuradeun*, 11(3), 1027-1052.
<https://doi.org/10.26811/peuradeun.v11i3.1008>

Others Visit : <https://journal.scadindependent.org/index.php/jipeuradeun>

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THE IMPACT OF MOTHER'S GENDER PREFERENCE ON CHILDREN'S COGNITIVE ABILITY IN INDONESIA

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Received: April 05, 2023	Accepted: August 20, 2023	Published: September 30, 2023
Article Url: https://journal.scadindependent.org/index.php/jipeuradeun/article/view/1008		

Abstract

A simple theoretical model predicts that when a mother gives birth to a child of her preferred sex, parents will likely invest more resources in that child, leading to more significant human capital. This bias can result in unequal treatment and opportunities, affecting a child's long-term development. This study investigates how gender preference influences cognitive ability between sons and daughters in Indonesia. This study utilizes longitudinal data from the Indonesian Family Life Survey 1 and 5, analyzed using the Ordinary Least Square method. The results indicate that daughters whose mothers had a son preference had 0.259 points higher cognitive scores. This finding is attributed to the sample distribution, revealing that daughters of mothers who prefer sons were mainly those without male siblings, allowing them to receive equal input from their parents without competing with boys. The heterogeneity analysis further revealed that daughters from disadvantaged backgrounds, such as those living in rural areas and born to less educated mothers, are disproportionately affected by son preference. In conclusion, it appears that children's family background and sibling composition can significantly impact the disparity in cognitive achievement between sons and daughters.

Keywords: Gender Preference; Son Preference; Inequality; Cognitive Score.



A. Introduction

The prevalence of son preference over daughters remains a persistent gender issue across the globe. Son preference broadly refers to the view that sons are more important and valuable than daughters (Clark, 2000). Son preference appears more prevalent in Asian countries than daughter preference due to the population's socioeconomic influence, culture, beliefs, and social norms (Jayachandran, 2015). For instance, in South Asia, a system mandates the bride's family to pay a dowry to the groom's family as a condition of marriage. This practice has led to an assumption that daughters are an economic burden, and as a result, they are undervalued compared to sons (Chowdhury, 2010). In contrast, sons are often seen as more valuable because they are expected to earn a higher average wage or income in the future and can continue the family lineage (Puri et al., 2011). Consequently, the value of sons to their parents concerning daughters is presumed to be high, which leads to a greater desire for a high ratio of sons to daughters (Clark, 2000).

According to preliminary studies, a child's gender determines family structure and future fertility, sex-selective abortion, and sex differences in parental time inputs, as well as access to health care and nutrition (Lin et al., 2021). It is common in households with limited resources, whereby this preference is used as a reference for parents in allocating resources for their children. Children who receive more investment in nutrition, parental time, or educational inputs perform better across a wide range of outcomes during childhood and as adults (Suryadarma et al., 2008). Therefore, the unequal distribution of resources can significantly impact children's development and achievements.

A substantial body of research indicates that unequal distribution of resources often results in discriminatory behavior towards daughters and women (Ariftha & Azhar 2023). Multiple studies have found that parents who favor sons tend to engage in discriminatory practices against their daughters when allocating scarce resources such as breastfeeding, vaccinations, access to sources of vitamins, time allocation, and health care (Aurino, 2017; Jayachandran & Kuziemko, 2011; Inayatillah, 2023). This discrimination can



lead to increased childhood mortality rates among daughters, impacting the sex composition of surviving children (Jayachandran, 2017).

In families where the desired number of sons is not achieved, daughters become increasingly unwanted as birth order rises and the number of remaining birth attempts decreases. To satisfy son preferences, some parents may engage in fertility behavior biased towards having sons, resulting in larger family sizes as they continue to try for a son (Ebert & Vollmer, 2019). According to Jayachandran (2011), mothers with a son preference are more likely to become pregnant again if their firstborn is a girl, resulting in a gender gap in breastfeeding since daughters are weaned at an earlier stage to allow for the birth of another son. Exclusive breastfeeding is one of the most effective ways to fulfill the nutritional adequacy of children for growth and adequate development (Hadi et al., 2021).

Using a panel data set from Indonesia, this paper investigates early cognitive skills as an outcome of son-biased discrimination. Several previous studies showed that cognitive ability is the primary capital investment during early life, which can predict an individual's future success (Nilsson, 2015). Parents are considered to have the most dominant role in determining the life quality of their children, specifically in the formation of their cognitive ability.

Some previous literature stated that when the preferred sex does match the realized sex, parents will allocate more resources toward that child, resulting in more significant human capital (Ebert & Vollmer, 2019; Palloni, 2017). Therefore, this study is related to the literature focusing on various outcomes of children affected by gender. For instance, Silvia (2014) and Aurino (2017) show that Indian parents tend to favor sons in the intra-household allocation of childcare time, breastmilk, and sources of vitamins and proteins. Therefore, they tend to have improved growth in terms of weight and height in comparison to daughters.

Hafeez (2018) similarly validates the prevalence of son preferences regarding the duration of breastfeeding in Pakistan. In addition, the study conducted by Baker and Milligan (2016) reveals that fathers are inclined to



invest more time in their sons. Palloni (2017) stated that children born of their mother's preferred gender show fewer illnesses and tend to weigh more. Le and Nguyen (2022) also reported that daughters born to mothers with son preference have lower height and weight.

However, prior studies have also shown that daughters in India receive the same nutrition and vaccinations as sons despite the country's high son preference rate (Deaton, 2003; Surya & Wijaya, 2023). According to Duflo (2005), no evidence exists that daughters are treated less well than sons in India and other countries with high son preference. In India, parents strongly desire daughters rather than sons under certain favorable conditions (Edlund, 1999; Uthman, 2022). Edlund (1999) explains that son preference will lead to situations that are advantageous to daughters rather than sons.

Prior studies exploring how son preference affects the differences in outcomes between sons and daughters have shown varying findings. Few studies still further determine the influence of parents' gender preference on children's outcomes, specifically cognitive ability as a measure of their quality. Further studies are needed because children's cognitive skills can influence the quality of human resources required to increase the country's economic growth. Therefore, this study aims to fill those gaps by investigating how gender preference affects cognitive ability between sons and daughters in Indonesia.

B. Method

This study aims to determine the impact of mothers' gender preferences on cognitive ability discrepancies between girls and boys. The research used a descriptive approach with a quantitative analysis, relying on secondary data sources. This research utilized data from the Indonesian Family Life Survey (IFLS) 1st wave and 5th wave, from late 1993 to mid-1994 and at the end of 2014 to mid-2015, respectively.

The sample households for this study were those in IFLS 5 with children between 14 and 21 who still resided with their parents. The



biological children of the head of the household were children between the ages of 14 and 21 to restrict the analysis unit employed. The data collection was through observations from 1,705 homes of children born on or after 1993, surveyed in IFLS-1 and IFLS-5. This estimation started from the first IFLS survey in 1993 as the baseline and ended with the 5th to predict outcomes. In 2014, these children were expected to be around 14-21. Due to data limitations in the IFLS, in which cognitive test results were limited to children aged 7-14 years only, those between 0-6 years were not included in the study estimate.

The IFLS provided cognitive assessment data of children aged between 7 to 14 years old. These data were used to assess children's general cognitive intelligence and would be used as the dependent variable of this study. Moreover, the independent variable of this study was the mother's gender preference. The indicator variable of gender preference was constructed from questions asked in the IFLS 1 survey (1993). Participants were asked two questions regarding their desired fertility: "How many (more) children do you wish to have?" and "Among the children that you (still) wish to have, how many sons and daughters do you wish to have?". Based on their responses, mothers were classified as having a son preference if they desire more future sons than future daughters and a daughter preference if the opposite was true. Mothers who preferred no future children or equal numbers of each gender were categorized as not having a preference for a specific gender.

The method used in this study was the Ordinary Least Square (OLS) regression model with cross-sectional data due to the data limitation in IFLS. This method was used to answer the research question regarding the relationship between son preference and children's cognitive ability. Since the source of variation in this model was within and across households, standard errors throughout the paper were clustered at the household level. The statistical analysis throughout the paper was conducted in STATA-16.

This study used Ebert's (2019) model, but a few changes were made to better align with the research objectives. Inferential analysis using



the OLS estimation method provided answers to specific purposes. The empirical model in the form of an equation is written as follows.

$$\text{Cog}_{ijt} = \beta_1 + \beta_1 \text{SonPref}_{ijt} + \beta_2 \text{SonPref}_{ijt} * \text{Female}_{ijt} + \beta_3 \text{Cog}_{ijt}^{7-14} + \beta_4 X_{ijt} + \varepsilon_{ijt}$$

The variable Cog_{ijt} as a proxy for the formation of children's human capital is the cognitive test score for individual/ child i in household j and was born in year t . The variable SonPref_{ijt} (Son Preference) presents the degree of son preference ranging from zero (daughters are strictly preferred) to one (sons are strictly preferred). The variable Female_{ijt} a zero-one indicator takes a value of one if the child is female and zero otherwise. The vector X_{ijt} is a set of control variables that characterize individual and household characteristics. The variables are child's age, BMI, years of schooling, early-school status, birth order, parents' age, parent's education, parent's employment status, and household expenditure, number of household members, urban dummy, and student-teacher ratio. Lastly, ε_{ijt} is the random error component. Since the source of variation in this model is within and across households, standard errors throughout the paper are clustered at the household level.

This study hypothesizes that the mothers who have son preference will have a persistent impact on the process of human capital formation with a lower cognitive ability score of daughters, which is indicated by the parameter β_2 in equation (1.1), whose direction is estimated to be negative.

H₀: Mothers with son preference have no impact on their daughter's lower cognitive score, $\beta_2 \geq 0$

H₁: Mothers with son preference have an impact on their daughter's lower cognitive score, $\beta_2 < 0$

The coefficients β_1 and β_2 capture the impacts of son preference on children's cognition. In particular, the coefficient β_1 presents the estimated impacts of son preference on the cognitive outcomes of sons (i.e., when Female_{ijt} is zero for male children; we have $\beta_1 \text{SonPref}_{ijt} + \beta_1 \text{SonPref}_{ijt} \times 0 = \beta_1$). The sum $\beta_1 + \beta_2$ reflects the estimated impacts of son preference on the



cognitive scores of daughters (i.e., when $Female_{ijt}$ is one for daughters), and the coefficient β_2 shows the disparity in the cognitive scores of sons and daughters due to son preference. In other words, β_2 quantifies the differences between the cognitive outcomes of the daughter and the son due to son preference. In this paper, we are particularly interested in cognitive disparities between sons and daughters due to son preference.

In order to overcome the problem of unobserved variables, this study used the children's cognitive scores in wave four as the baseline for children's outcomes. In addition, because this research focuses on the quality of children, according to Hanushek (2015), using the OLS method alone can cause bias in the model. So, this study includes variables related to the characteristics of children's schools, namely the ratio of students to teachers.

C. Result and Discussion

First, descriptive analysis was performed to describe the variables utilized to estimate the effect of son preference in a child's early childhood on the development of human capital later in life in terms of cognitive performance. One thousand seven hundred-five samples of children were obtained based on the 1st and 5th waves of IFLS. The sample distribution in this study, when viewed by gender, as shown in Table 1, only 40% of the model comprises females, while 60% was composed primarily of males. Most of the samples at the time of scoring had also taken formal education, i.e., the average length of education was about nine years or had attended school up to grade 3 of secondary school.

Table 1. Summary statistic

Variable	Obs	Mean	Std. Dev.	Min	Max
Dependent variable					
Cognitive score	1705	0.344	0.870	-3.100	1.645
Independent variable					
Son preference	1705	0.227	0.419	0	1
Female	1705	0.405	0.491	0	1
Female x son preference	1705	0.143	0.350	0	1



Variable	Obs	Mean	Std. Dev.	Min	Max
Characteristic of children					
Child age	1705	17.39	2.184	14	21
BMI	1705				
Underweight	665	0.390	0.487	0	1
Normal	856	0.502	0.500	0	1
Overweight	130	0.076	0.265	0	1
Obese	54	0.031	0.175	0	1
Year-of-schooling	1705	9.306	2.211	1	16
Preschool	1705	0.534	0.498	0	1
Birth order	1705	2.407	1.363	1	8
Cognitive score sge 7-14	1705	-0.194	1.017	-3.532	1.533
Characteristic of mother					
Mother's sge	1705	23.987	5.879	14	39
Mother's employment status	1705	.386	.487	0	1
Mother's last dducation	1705				
Primary school	856	.502	.5	0	1
Secondary school	380	.223	.416	0	1
High school	469	.275	.447	0	1
Characteristic of father					
Father's age	1705	28.49	6.678	17	52
Father's employment status	1705	.947	.224	0	1
Father's last education	1705				
Primary school	730	.428	.495	0	1
Secondary school	301	.177	.381	0	1
High school	674	.395	.489	0	1
Characteristic of household					
Number of household members	1705	5.002	1.434	3	10
Total expenditure	1705	13.128	.647	11.019	16.08
Region	1705	.614	.487	0	1
Characteristic of school					
Student-teacher ratio	1628	28.780	8.543	6	76

Source: Processed by the author (2022)

Table 1 also showed that, in general, the cognitive scores of children or respondents had an average of 0.344. Based on the sample distribution of cognitive scores in Table 2, using the average as a benchmark, 59.76% of the respondents had a cognitive score above the average. In comparison, 40.24% of the other respondents scored below average. The results of the respondent's cognitive z-score show that the greater the cognitive score, the more questions the respondent can answer correctly.



Table 2. Distribution of cognitive score samples

Cognitive Score	Correct Answer Score	Freq.	Percent	Cum.
-3.100	1	7	0.41	0.41
-2.803	2	1	0.06	0.47
-2.507	3	6	0.35	0.82
-2.210	4	7	0.41	1.23
-1.913	5	31	1.82	3.05
-1.617	6	23	1.35	4.40
-1.320	7	35	2.05	6.45
-1.023	8	74	4.34	10.79
-0.727	9	69	4.05	14.84
-0.430	10	83	4.87	19.71
-0.133	11	127	7.45	27.16
0.162	12	223	13.08	40.23
0.459	13	248	14.55	54.78
0.756	14	296	17.36	72.14
1.052	15	255	14.96	87.10
1.349	16	143	8.39	95.48
1.645	17	77	4.52	100.00
Total		1705	100.00	

Source: Processed by the author (2022)

Table 3. Average Cognitive Score by Gender and Other Independent Variables

Variable	Son & Daughter	Son	Daughter
Characteristic of children			
Child Age			
7-10 years	-0.4123	-0.4176	-0.4044
11-14 years	0.1939	0.1947	0.1928
14-17 years	0.3465	0.3354	0.3633
18-21 years	0.3376	0.3229	0.3580
BMI			
Underweight	0.3166	0.2526	0.4623
Normal	0.3654	0.4061	0.3188
Overweight	0.2631	0.1728	0.3382
Obese	0.5198	0.6489	0.2616
School participation			
0-6 years	-0.2530	-0.2361	-0.2896
7-9 years	0.3052	0.3054	0.3050
10-12 years	0.4854	0.4857	0.4855
>12 years	0.5865	0.5003	0.6386
Preschool			
Yes	0.4831	0.4885	0.4757



Variable	Son & Daughter	Son	Daughter
No Birth order	0.1833	0.1597	0.2203
1	0.3700	0.3973	0.3222
2	0.3726	0.3037	0.4675
3	0.3827	0.3744	0.3934
≥ 4	0.2101	0.2151	0.2032
Characteristic of household			
Number of Household Members			
3	0.3315	0.3214	0.3460
4	0.3539	0.3450	0.3668
≥ 5	0.3413	0.3624	0.3271
Total Expenditure			
Q1 (Poorest)	0.1853	0.2290	0.1188
Q2 (Poor)	0.2911	0.2265	0.3821
Q3 (Intermediate)	0.3828	0.3339	0.4594
Q4 (Rich)	0.3468	0.3620	0.3271
Q5 (Richest)	0.5116	0.5021	0.5263
Region			
Rural	0.2209	0.2090	0.2422
Urban	0.4205	0.4187	0.4229

Based on Table 3, when viewed from the age of the child from 7 to 10 years, daughters had a higher average cognitive score of -0.404 with -0.471 for sons. However, these two age groups had an average cognitive score below the benchmark average for ages 7 to 14, which was -0.194. In the older age group of 11 to 14, the average cognitive scores of daughters and sons were not significantly different. Meanwhile, in the age groups of 14 to 17 years and 18-21 years, daughters had a higher average cognitive score than sons.

Regarding school participation, daughters who finished within 0 to 6 years had a lower average cognitive score than sons. When viewed from the number of household members, daughters living with five or more members appeared to have lower cognitive average scores than sons. However, their cognitive scores tended to be higher when the number was less.

Table 4 shows the results of the influence of son preference on children's cognitive results using OLS estimation. The results indicated that the preference



variable has a significant negative effect from each equation model at $\alpha = 0.05$. Model 5 showed that son preference reduced sons' cognitive scores by 0.214, which means parents who desired to have a son were considered to reduce the cognitive scores of sons. This finding is also in line with Le and Nguyen (2022), which found a significant negative effect of son preference on child health outcomes, where mothers who have a preference for sons reduce the height and weight of sons.

Furthermore, the estimation results also showed a disparity in cognitive scores between sons and daughters. Daughters with mothers with a son preference had higher cognitive scores controlled for the characteristics of children, parents, and regions. Due to son preference, the difference in cognitive scores between daughters was 0.268 points higher than that of sons.

Moreover, in models 2, 3, 4, and 5 in Table 4, several control variables were used, consisting of individual characteristics of the children, mother, father, and socioeconomic and regional. From all input characteristics of children, the variable of age has a significant effect on their cognitive scores. Based on the test results, a one-year increase in age reduces the child's cognitive score by 0.0913 points with a significance of 0.05. This finding contradicts previous theories and studies because as children age, their cognitive performance increases due to the investment absorbed during their growth (Christensen et al., 2014; Liu et al., 2012).

In addition, Piaget's theory of cognitive development explains that the older a child, the more complex the stages of development. The more children grow, the greater the time used in the learning process by observing the environment, thereby increasing the accumulation of cognitive input. In this study, the decline in cognitive scores at older ages was because most of the age group above 15 had scores below the average. According to Zhu (2017), increasing age reduces cognitive scores due to biological factors that affect individuals. An increase in age also changes the brain's structure, affecting an individual's cognitive abilities.



In addition, the estimation results also showed that children's school years significantly positively affect their cognitive development in each model. The test results found that the length of schooling greatly affected children's cognition, where an increase of one year raised the cognitive score by 0.125. It aligns with Reynolds's (2010) and Ceci's (1991) studies, which confirmed that children's school participation is associated with increased cognitive scores. Christian et al. (2001) also found that children who spent ten days longer studying in school had better cognitive outcomes than those who did not. Cahan and Cohen (1989), using a sample of 11,000 students, found that education could improve cognitive abilities.

Early childhood children who participate in early childhood education, such as kindergarten schools, have higher cognitive scores. It is in line with Bakken (2017), which showed early childhood education's importance and stated that under five years is the most critical period in child development. Trawick-Smith (2014) said that children develop language, cognitive, social, emotional, and self-regulation skills that can later function as adults. Previous literature supports this by showing a positive relationship between early childhood education and children's cognitive performance (Bakken et al., 2017; Burger, 2010).

The estimation results using OLS found that characteristics of mothers affected children's cognitive scores, such as age, which had a significant effect of 0.01 for all models. Furthermore, mothers' last education plays a vital role in predicting the child's cognitive score, which can be seen from its significance. All categories of mothers' education are statistically significant and positively affect children's cognitive scores. For instance, those whose last education status is middle and Senior High Schools and college significantly increased children's cognitive scores by 0.105 and 0.120, respectively. It means mothers with higher education generally have better knowledge of more about prenatal care and the golden age of children.

Additionally, children's cognitive abilities can be stimulated when a highly educated mother becomes a teacher or director at home. It boosts



children's cognitive skills, which, in turn, provides higher scores (Hsin, 2007). The length of education also reflects the mother's level of intelligence and ability to promote the child to continue schooling because children's intelligence is inherited genetically (Rowe et al., 1999; Zvoch, 1999). Mothers' education is also related to various characteristics, including income, family background, and genetics (Hidayati et al., 2022).

Moreover, models 4 and 5 showed that a father's education was associated with children's cognitive development in a positive and significant direction. It means that the longer the fathers' education year, the more likely it is to increase the children's cognitive ability because their educational level is related to employment status in the labor market. Parents are role models to their children; therefore, when they complete higher education, they will encourage their children to follow suit (Rowe et al., 1999). However, the father's age negatively affects children's cognitive ability. As people age, a person's productivity decreases, meaning the father will leave the labor market in old age. Therefore, it will indirectly affect the family's financial ability and impact the investment received by children.

The number of household members negatively influences children's cognitive development. It means that children with more household members have the potential to limit the resources received; hence, the inputs that are useful for optimizing cognitive development become relatively more minor.

Finally, the test results showed that the region had a positive and insignificant effect on children's cognitive scores, with those in urban areas having higher rates than the rural ones. It is undoubtedly because urban areas have better public facilities such as education and health. Therefore, it eases access for children living in urban areas to obtain inputs that enhance their cognitive development (Christensen et al., 2014).

Table 4. Estimation results on children's cognitive score

Cognitive Score	Model 1	Model 2	Model 3	Model 4	Model 5
Son preference	-0.239*** (0.0898)	-0.213** (0.0867)	-0.216** (0.0863)	-0.215** (0.0864)	-0.214** (0.0864)



Cognitive Score	Model 1	Model 2	Model 3	Model 4	Model 5
Son preference	0.312***	0.259**	0.263**	0.270**	0.268**
* Female	(0.120)	(0.116)	(0.116)	(0.116)	(0.116)
Age of children		-0.0920***	-0.0919***	-0.0891***	-0.0913***
		(0.0137)	(0.0143)	(0.0146)	(0.0148)
Body mass index					
1. Normal		0.0197	0.0215	0.0192	0.0208
		(0.0516)	(0.0513)	(0.0514)	(0.0514)
2. Overweight		-0.0847	-0.107	-0.108	-0.107
		(0.0934)	(0.0929)	(0.0930)	(0.0931)
3. Obese		0.190	0.187	0.188	0.182
		(0.138)	(0.137)	(0.137)	(0.137)
Children's school participation		0.145***	0.129***	0.125***	0.125***
		(0.0143)	(0.0147)	(0.0149)	(0.0150)
Preschool		0.123***	0.0900***	0.0866***	0.0847***
		(0.0243)	(0.0252)	(0.0253)	(0.0257)
Birth order		0.00599	-0.0294	-0.0291	-0.0340
		(0.0177)	(0.0219)	(0.0238)	(0.0248)
Mother's age			0.0169***	0.0172***	0.0172***
			(0.00506)	(0.00585)	(0.00589)
Mother's employment status			0.0735	0.0696	0.0778
			(0.0489)	(0.0492)	(0.0497)
Mother's last education					
1. Middle school			0.107*	0.107*	0.105*
			(0.0615)	(0.0635)	(0.0635)
2: High school			0.198***	0.126*	0.120*
			(0.0609)	(0.0714)	(0.0725)
Father's age				-0.0129**	-0.0122**
				(0.00556)	(0.00556)
Father's job status				0.0165	0.0160
				(0.104)	(0.104)
Father's last education					
1. Middle school				0.0493	0.0404
				(0.0687)	(0.0693)
2. High school				0.125*	0.112*
				(0.0649)	(0.0668)
Number of					-0.0160



Cognitive Score	Model 1	Model 2	Model 3	Model 4	Model 5
household members					(0.0171)
Total expenditure					0.00966
Region					(0.0410) 0.0481
Student-teacher ratio					0.0160 -0.0317***
Observations	1,705	1,705	1,705	1,705	(0.00285) 1,705
R-squared	0.001	0.182	0.196	0.199	0.202

Standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Source: processed by the author (2022)

According to the estimation results in Table 5, on average, mothers with son preference reduced their son's cognitive score by 0.196 points from 7 to 14 years old. Economically, the estimation results showed a significant influence compared to the overall cognitive score average of 0.344, which was 56.98%. Furthermore, the test results found that daughters living with mothers with a son's preference were considered to influence their cognitive score positively.

That is, due to son preference, the cognitive achievement of daughters was 0.259 points higher than that of sons. These findings contradict Le and Nguyen (2022), which found that the disparity of health outcomes for daughters is lower than for sons due to son preference. In addition, these findings are also contrary to the hypothesis developed in this study, where the authors suspect that son preference will reduce the cognitive scores of daughters and daughters' cognitive scores will be lower than sons' cognitive scores. The initial suspicion that the reason for the high achievement of cognitive scores for girls compared to boys was alleged because girls included in this study's observation were girls who had cognitive scores that had an average that tended to be high.



Table 5. Estimation results of children’s cognitive score

Children’s Cognitive	Model 1	Model 2	Model 3
Son Preference	-0.197** (0.0853)	-0.197** (0.0850)	-0.196** (0.0849)
Son Preference * Female	0.246** (0.115)	0.258** (0.115)	0.259** (0.115)
Cognitive score on 7-14 Years old	0.163*** (0.0254)	0.147*** (0.0256)	0.146*** (0.0256)
Children Characteristics	V	v	v
Parent Characteristics	x	v	v
	x	x	v
Observations	1,705	1705	1705
R-squared	0.396	0.474	0.489

Standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Source: processed by the author (2022)

The composition of mothers who preferred sons depending on their most recent educational status appeared to have a relatively comparable composition if you look at the percentage of mothers with the last education included in the observation of this study, as shown in Figure 1. It is assumed that the mother’s past background does not influence the emergence of preference for sons because the group division of son preference is symmetrical.

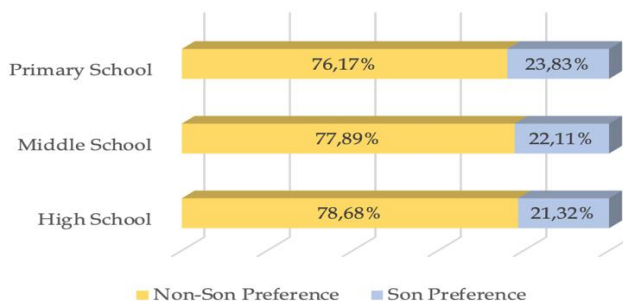


Figure 1. Distribution of mother’s last education based on mother’s gender preference

Furthermore, the authors suspect that the estimation results from this study, which were found to be more favorable to women, were caused by the distribution of girls, with the mother’s preference in this study being dominated by the first or eldest child, where the distribution

can be seen in Table 6. In Table 4, we can see that even though birth order had no significant effect on a child's cognitive score achievement, the impact of this birth order variable showed a negative direction. Children born in the first sequence have more outstanding cognitive scores than children born later. The results of a study by Heiland (2009) found that children with first birth order have better cognitive outcomes than children born later or middle children.

Furthermore, the distribution results in Table 6 and Table 7 also showed that the daughters of mothers with a son preference were dominated by daughters who did not have male siblings, either older or younger male siblings. As much as 76.22% of daughters who lived with mothers with son preferences in this study did not have older brothers, and 67% of daughters who had mothers with son preferences did not have younger siblings. That is, girls could get input from their parents equally without competing with boys. Therefore, it is understandable why girls with mothers' preferences in this study had higher cognitive scores than boys.

Table 6. Distribution of birth order of girls in the household
Based on the number of older brothers

Birth Order	Number of Older Brothers				Total
	0 Person	1 Person	2 Persons	3 Persons	
1 st Child	89	0	0	0	89
2 nd Child	51	9	0	0	60
3 rd Child	40	19	3	0	62
4 th Child	6	10	5	2	23
5 th Child	0	1	2	0	3
6 th Child	0	3	0	3	6
7 th Child	0	0	1	0	1
Total	186	42	11	5	244

Source: Data processed (2022)

Table 7. Distribution of birth order of girls in the household
Based on the number of younger brothers

Birth Order	Number of Younger Brothers			Total
	0 Person	1 Person	2 Persons	
1 st Child	48	30	11	89
2 nd Child	43	15	2	60
3 rd Child	43	15	4	62



Birth Order	Number of Younger Brothers			Total
	0 Person	1 Person	2 Persons	
4 th Child	20	1	2	23
5 th Child	3	0	0	3
6 th Child	6	0	0	6
7 th Child	0	1	0	1
Total	163	62	19	244

Source: Data processed (2022)

The heterogeneity analysis results in terms of age groups showed differences in the effect of son preference on children's cognitive scores. The preference significantly negatively affected the cognitive score in the 14 to 15 years old age group. Meanwhile, despite the negative direction on the cognitive scores, no significant effect was found for the age group of 16 to 18 and 19 to 21 years old. Due to the son preference, daughters in the age group of 14-15 years old had a higher cognitive score of 0.643 points.

Furthermore, when viewed from the residential area, there was no influence between the son preference and cognitive scores of those living in rural areas. On the other hand, the preference significantly reduced their cognitive score in urban areas by 0.334 points. This test also found a significant effect on the sons and daughters' cognitive score achievement disparity on the daughter with a mother with a preference for a son. The findings of this analysis indicate that, due to son preference, daughters have an average lower cognitive score of 0.3 points.

When viewed from mothers' last educational level, it can be seen that son preference hurt their cognitive scores, both from mothers with high and low education. However, for those with higher education, son preference only affected cognitive scores in models 1 and 2, namely before and after being controlled by the children's characteristics. For the disparity between daughters who had mothers with son preference, it was found that the effect was insignificant at all levels. However, this variable showed a negative direction when the mother whose last education status is low school graduates. It means that, due to son preference, the difference in cognitive scores of daughters was 0.456 points lower than those of mothers with low education.



Table 8. Heterogeneity analysis based on age group, Residential area and mothers' last education

Heterogeneity Analysis Based on Age Group				
Aged 14-15 years old	(1)	(2)	(3)	(4)
Son preference	-0.554*** (0.145)	-0.617*** (0.142)	-0.673*** (0.139)	-0.690*** (0.140)
Son preference * female	0.545*** (0.205)	0.590*** (0.202)	0.614*** (0.200)	0.643*** (0.201)
Aged 16-18 years old				
Son preference	-0.107 (0.160)	-0.123 (0.152)	-0.0969 (0.154)	-0.0843 (0.155)
Son preference * female	0.0919 (0.208)	0.0661 (0.197)	0.0441 (0.199)	0.0202 (0.199)
Aged 19-21 years old				
Son preference	-0.138 (0.174)	-0.129 (0.173)	-0.0932 (0.175)	-0.0965 (0.174)
Son preference * female	0.356 (0.235)	0.350 (0.235)	0.303 (0.238)	0.297 (0.237)
Children characteristics	x	v	v	v
Parent characteristics	x	v	v	v
Household characteristics	x	x	x	v
Heterogeneity Analysis Based on Residential Area				
Urban Area	(1)	(2)	(3)	(4)
Son Preference	-0.302** (0.139)	-0.340** (0.136)	-0.336** (0.136)	-0.334** (0.136)
Son Preference * Female	0.230 (0.195)	0.241 (0.191)	0.211 (0.192)	0.204 (0.192)
Rural Area	(1)	(2)	(3)	(4)
Son Preference	-0.181 (0.113)	-0.115 (0.110)	-0.125 (0.111)	-0.124 (0.111)
Son Preference * Female	-0.357** (0.147)	-0.269* (0.144)	-0.302** (0.145)	-0.299** (0.145)
Children Characteristics	x	v	v	v
Parent Characteristics	x	x	v	v
Household Characteristics	x	x	x	v
Heterogeneity Analysis Based on Mother's Last Education				
Low School Graduate	(1)	(2)	(3)	(4)
Son Preference	-1.183*** (0.294)	-1.190*** (0.304)	-1.067*** (0.278)	-0.994*** (0.279)
Son Preference * Female	-0.0433 (0.510)	-0.174 (0.541)	-0.286 (0.498)	-0.456 (0.500)



Heterogeneity Analysis Based on Age Group				
Aged 14-15 years old	(1)	(2)	(3)	(4)
High School Graduate	(1)	(2)	(3)	(4)
Son Preference	-0.531* (0.271)	-0.585** (0.295)	-0.413 (0.284)	-0.487 (0.294)
Son Preference * Female	0.684 (0.357)	0.680 (0.384)	0.207 (0.381)	0.260 (0.403)
Children Characteristics	x	v	v	v
Parent Characteristics	x	x	v	v
Household Characteristics	x	x	x	v

*Standard errors in parentheses *** p<0.01, **p<0.05, * p<0.1*

Source: Processed by the author (2022)

The heterogeneity analysis showed that daughters suffered from son preference only when they come from low-income family backgrounds, such as living in rural areas and having mothers with low education. This is due to the possibility that people living in rural areas tend to work in the agricultural sector, which generates the most insufficient income. Furthermore, mothers with low education and below work in the non-formal sector, which certainly does not support retirement money in old age; parents will depend on their sons as breadwinners in the household. Households with this background are generally poor, so they do not have many resources to train all their children simultaneously. Low-income families are more likely to sacrifice investments for their daughters due to limited resources, while those with affluent backgrounds provide input to their daughters and sons. Therefore, the household background is suspected to cause the disparity in the cognitive scores of both genders.

D. Conclusion

Based on the description of the results and discussion of the previous section, this study leads to conclusions that answer the research objectives. The disparity in cognitive scores between daughter and son can be found in this study, which showed that daughters have a higher cognitive score when controlled by parental and household characteristics. However, the test results showed that when the daughter was from a poor



household background, the difference in the cognitive score was lower due to the son's preference. It indicates that family backgrounds are one of the factors responsible for the disparity between sons and daughters in their cognitive achievement.

The limitation of this study is the partial discussion of the influential inputs without considering the cognitive due to the limited data available in the IFLS survey. Although evidence provided that son preference negatively impacted children's cognition, the available data did not quantitatively analyze the potential mechanisms behind this impact.

The results of this study have important implications in that the impact of son preference at an early age (early life) provides a high cost to the formation of human capital. The results of this study can be used as a basis for evaluating demography planning to improve the quality of human capital. These results also indicate that the government can reduce the negative impact of son preference in quality human capital development efforts by strengthening maternal education levels to reduce the gender gap. This process aims to give mothers more significant opportunities to work in the formal sector, which provides higher wages. Therefore, the policy implication related to improving the quality of human capital is the need to increase women's access to education, considering that maternal education contributes significantly to improving children's cognition. Educated mothers can also promote nutritional adequacy, which substantially affects the high and low quality of the children's human capital.

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