

Amendment of the Hindu Succession Act and Women' s Human Capital in India: Evidence from the National Family Health Survey

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Abstract

Using five-period repeated cross-sectional data from the Indian National Family Health Survey, this study examines the impact of inheritance rights reforms on the human capital of Hindus, Sikhs, Jains, and Buddhists. The results demonstrate that, in the reform states, Hindu, Sikh, Jain, and Buddhist daughters of landholding household heads (the treatment group) improved their human capital indicators of education (years of education) and their health status (underweight and BMI z-score). There is also some indication that their reading habits might have improved compared to the control group. In contrast, the human capital indicators of the placebo group—Muslims and Christians, who share similar characteristics with the treatment group but were not subject to the reform—showed no clear improvements. Estimates based on reform timing show that Karnataka and Maharashtra, which were reformed in 1994, have contributed the most to the main result. The results provide evidence for the human capital-enhancing impact of inheritance reforms for women.

Keywords: education, health, natural experiment, inheritance rights, property, Hindu Succession Act

Introduction

Correcting property rights inequalities is essential for economic development, as implied in the United Nations Sustainable Development Goal No. 5 (United Nations, 2022). However, the equality in inheritance and land ownership practices in South Asian countries is significantly lower than that in developed countries (Agarwal et al., 2021; World Bank, 2012). Previous studies have demonstrated a strong correlation between women's empowerment and economic development (Duflo, 2012). Women's empowerment includes improvements in educational and health/nutrition statuses, which are fundamental topics in the context of gender inequality (World Bank, 2012).

Currently, the Indian government applies various inheritance laws to different religions. India does not have a uniform civil code despite the provision in Article 44 of the Constitution (Ministry of Law and Justice, 2024). Traditional Hindu law and the Hindu Succession Act, 1956 (hereinafter HSA) ruled an equal distribution for sons but did not provide for women's inheritance rights, especially for joint family property. Therefore, researchers have highlighted this inequity and investigated the relationship between property rights and Indian women's empowerment (Agarwal, 1994).

Several economic studies have focused on amendments to the 1956 HSA that concern Hindus, Sikhs, Jains, and Buddhists as natural experiments (e.g., Ajefu et al., 2022; Anderson and Genicot, 2015; Bhalotra et al., 2020; Bose and Das, 2021; Deininger et al., 2013; Deininger et al., 2019; Heath and Tan, 2020; Makino, 2019; Rosenblum, 2015; Roy, 2015). Five Indian states (Kerala, Andhra Pradesh, Tamil Nadu, Karnataka, and Maharashtra) enacted new laws or amended the HSA during the 1970s to 1990s. The state governments extended the inheritance rights of joint family property to widows and daughters under certain conditions, such as being unmarried. In 2005, all states of India,

except Jammu and Kashmir, enacted the Hindu Succession (Amendment) Act (hereinafter HSAA). This reform made it possible for women to inherit joint family property nationwide. Consequently, India's inheritance framework entirely changed, at least from a legal perspective.

Against this background, this study examines the effects of the HSAA on women's educational and health outcomes in India, applying a triple-difference (difference-in-difference-in-difference) approach on repeated cross-sectional data from the Indian National Family Health Survey (hereinafter NFHS). Using data from five NFHS periods, 1992–93, 1998–99, 2005–06, 2015–16, and 2019–21, this study investigates the following research questions:

RQ1 Did the human capital indicators of women who have been granted inheritance rights to joint family properties improve?

RQ2 Which groups contributed the most to the main results based on the timing of the HSAA enactment?

This study has three objectives. First, we investigate whether the education and health status indicators of women in landowning households in the reform states improved. We contribute to the literature by using a more stringent identification strategy and a more extended period of data compared with existing studies (e.g., Bose and Das, 2021; Roy, 2015; Sapkal, 2017), which have treated women's educational status. Studies addressing the effects of HSAA on health outcomes already exist (e.g., Ajefu et al., 2022; Heath and Tan, 2020); however, our analysis differs clearly from these studies in terms of its focus and

identification strategy. Our findings differ from those of Ajefu et al. (2022), who examined the HSAA's effects on children's health status.

Moreover, our identification strategy and results are more detailed and rigorous than those of Heath and Tan (2020), who addressed a broader range of outcome variables. This study assumes that marginal farmers and those below them have no incentive to change their intergenerational transfer framework through the HSAA. Second, robustness checks are conducted on the results using a placebo regression analysis. As discussed later, the HSA and HSAA are laws that apply only to Hindus, Sikhs, Jains, and Buddhists. This study considers the group of Muslim and Christian women not subject to the act and belonging to landowning households in the reform state as the 'placebo group'. Third, this study considers bias in the fixed effects difference-in-difference (hereinafter FEDID) approach when using multiple treatment timing. This study examines the existence of bias using a timing-based, triple-difference approach. The results are found to be robust in Maharashtra and Karnataka, which enacted the HSAA in 1994.

This study has several limitations. First, our analysis focuses on women who continue to live with their parents beyond the average age of marriage and whose parents were both alive at the time of the survey. While this data restriction allows us to control for the age and years of education of the women's parents, it limits the external validity of our findings. Additionally, in cases where the household head has multiple spouses, it may not be possible to accurately control for information on the biological parents. Second, we use agricultural land recorded in the dataset as a proxy variable for joint family property. Due to limitations in the data, we cannot identify cases where agricultural land is private property, nor can we examine any other joint family properties owned by the household aside from agricultural land. Third, we assume that the state of residence at the time of the survey was the same as at the time of the reform. However, interstate migration of women in India is rare, and most

migration due to marriage occurs within the same state (Ajefu et al., 2022; Heath and Tan, 2020; Roy, 2015). Fourth, our focus is on the effects of state-level reforms, and we have not examined the effects of the country-level reform of 2005. Finally, while this study suggests improvements in the human capital indicators of women affected by the reforms, some studies have reported a deterioration in conditions for women before adulthood (Bhalotra et al., 2020; Rosenblum, 2015). Therefore, there is a possibility that our results may be affected by survivorship bias.

This paper is structured as follows. The ‘Background’ section presents the HSA and its state- and country-level amendments, reviews the related literature, and details the problems concerning Indian women’s educational and health/nutrition statuses. The ‘Identification strategy’ section describes the data and empirical analysis strategy. The ‘Results’ section provides the outcomes of the triple-difference approach and robustness checks. The final section discusses the results and presents the conclusions.

Background

This section summarises the inheritance rights, previous studies, and human capital indicators in India. This study focuses on education, health, and nutrition variables as human capital indicators. Inheritance, including the transfer of property rights, is an important means of acquiring assets and bequeathing productive resources to the next generation (Doss et al., 2012). Parental bequests for material wealth and human capital investments are central to intergenerational wealth transfer. These can affect the long-term distribution of resources in the economy, patterns of asset accumulation, and overall development through the impact on individuals’ wealth and earning opportunities (Deininger et al., 2013).

Hindu Succession (Amendment) Act

In India, religious and customary laws govern marriage, divorce, and inheritance matters.

Article 246 of the Constitution of India states that ‘the Legislature of any State has exclusive power to make laws for such State or any part thereof with respect to any of the matters’

(Ministry of Law and Justice, 2024), allowing the state government to act independently. The Hindu Succession Act of 1956 applied to all of India except Jammu and Kashmir and extended to Sikhs, Jains, and Buddhists; in addition to Hindus, the act meant women gained the right to inherit personal property (Ministry of Law and Justice, n.d.). However, rights to joint family property were limited by marriage customs.

Perceived inequality led to legal reforms in the five states between the 1970s and 1990s. The Kerala Joint Hindu Family System (Abolition) Act in 1976 abolished joint family properties for all Hindu families in the state by converting them into personal properties and eliminating gender inheritance inequality. Subsequently, Andhra Pradesh adopted the HSAA in 1986, Tamil Nadu in 1989, and Karnataka and Maharashtra in 1994. In the event of the male household head’s death, the HSAA gave daughters rights to joint family property equal to those of sons. These amendments applied the same rights to daughters as sons if they remained unmarried. Therefore, the state-level amendment could not achieve complete equality in inheritance rights between sons and daughters. In 2005, all states of India, except Jammu and Kashmir, enacted the HSAA, which brought about significant changes. This act stipulates that daughters have equal rights with sons regarding inheritance, and the condition of daughters being unmarried was eliminated.

The HSA reforms have been the subject of policy-oriented research. Although the reforms in Kerala and the other four states differed in that they enacted new laws and

amended existing ones, they can be viewed as homogeneous in expanding women's rights to inherit joint family property, including the right to inherit ancestral land.

This study examines whether the effects of these reforms have had a positive impact on women's empowerment by using variables that represent education and health. Our hypotheses pertain to the mechanisms by which the HSAA affected women's human capital and align with the findings of previous studies (e.g., Roy, 2015; Sapkal, 2017). Men and women might become equal as heirs, so women inheriting family property and families investing in women have increased (equalisation hypothesis). Parents might make other forms of investment in their daughters instead of allowing them to inherit joint family property (compensation hypothesis). These two hypotheses partially coexist because sons and daughters have different needs. Household wealth can be categorised as follows: (a) personal properties, including precious metals, jewellery, and land; (b) ancestral properties; and (c) marriage funds or dowries. Particularly in the case of daughters, marriage funds or dowries are required at the time of marriage. Agarwal et al. (2021) note that the percentage of women landowning or inheritance remains low, and that inheritance rights reform has not overcome traditional social norms. However, from the daughter's perspective, as long as the form of marriage and the practice of leaving the family of birth remains in place, managing her affairs would be challenging if she was only given inheritance rights. Therefore, it is natural that the proportion of female landowners will not increase unless the form of marriage changes significantly. In the reform states, although the HSAA has increased the awareness of treating sons and daughters equally in households with assets, daughters' human capital indicators should increase even if land inheritance to daughters has not increased. In other words, daughters would improve their nutritional status, receive an education, and inherit marriage funds and dowries, whereas sons would inherit ancestral land. The equalisation hypothesis is

not valid if the land is the focus, but it may be valid if the entire intergenerational transfer framework is the focus.

The outcomes focused on in related literature can be divided into two groups. The first group analysed how inheritance reforms have directly changed the inheritance of joint family property from parents to children. The findings on whether the HSAA has directly increased women's inheritance of joint family property are mixed (Deininger et al., 2010, 2013; Roy, 2015). The reason for this difference can be attributed to the fact that Deininger et al. (2010, 2013) use as a factor in the difference-in-differences analysis whether the father had died after the HSAA, whereas Roy (2015) uses whether the grandfather had died. They assumed that if the head of the household (often the father or grandfather) died before the reform, there was no incentive for daughters and sons to be treated equally in a no-will inheritance.

The second group analysed the impact of the inheritance reform on women's empowerment. Women's land ownership correlates with their empowerment (Meinzen-Dick et al., 2019; Nguyen and Le, 2023). Hence, previous studies focused on the relationship between the HSAA and empowerment, such as women's education (Deininger et al., 2010, 2013; Heath and Tan, 2020; Sapkal, 2017; Roy, 2015), labour force participation (Heath and Tan, 2020; Sapkal, 2017; Gupta, 2022), autonomy and decision-making ability (Heath and Tan, 2020), age at marriage (Deininger et al., 2010, 2013; Heath and Tan, 2020), and dowry (Makino, 2019; Roy, 2015). Given that the NFHS does not query the specific amount of personal income or consumption, we do not discuss this. However, several prior studies discuss women's work using the National Sample Survey of India. For example, Gupta (2022), using the Time-Use Survey of 2019, found that women exposed to the reforms increased their hours of employment and decreased their home production. Sapkal (2017), using the Employment and Unemployment Survey of the NSS 55th (1999–2000) round and

61st (2004–05) round, found that working days increased for women exposed to the reforms.

Some studies have suggested that the reform may harm women. Anderson and Genicot (2015) found that the HSAA increased the incidences of suicide among both men and women and the incidence of domestic violence against women. They explained that with the HSAA empowering women by equalising inheritance rights, the intrahousehold conflict between wives and husbands consequently increased. Rosenblum (2015) and Bhalotra et al. (2020) found that the HSAA heightened the relative costs of raising girls and encouraged higher incidences of sex-selective female abortions or girls' higher mortality rates. Survivorship bias may exist as post-growth women's empowerment indicators have improved, but the treatments of pre-growth women have deteriorated. In this regard, the equalisation hypothesis in this study is only concerned with surviving women.

Several previous studies have also analysed the impact of HSAA on multiple generations (Ajefu et al., 2022; Bose and Das, 2021; Deininger et al., 2019). Using NFHS data, Ajefu et al. (2022) revealed that improved women's inheritance rights positively affected their children's health and reduced the probability of nutritional deficiency in children.

Women's education and health status

Education

Primary education was not widespread in Indian society until after Indian independence. Immediately after independence, school enrolment and literacy rates remained low. However, literacy and school enrolment rates by gender for those born between the 1940s and 1990s (the target dataset for our empirical analysis) have improved significantly. Their gaps

gradually narrow with each new generation. According to the Ministry of Human Resource Development (2018), the primary and upper primary school enrolment rate for the 1950–51 school year was 32.1%; specifically, 46.4% for boys and 17.7% for girls, representing the oldest age cohort in the NFHS data used in this study. In 2005–06, when the youngest age cohorts in the data were closest to the start of primary school, the enrolment rate was 94.9%. In 2015–16, the gross elementary education enrolment rate was 96.9% (94.5% for boys and 99.6% for girls) (Ministry of Human Resource Development, 2018). Improvements in educational attainment may lead to higher literacy rates and an increased likelihood of women reading newspapers and magazines (Elvestad and Blekesaune, 2008).

Health

Health investments are intended to shape capabilities and enable people to fulfil their societal potential (World Bank, 2012). The improvement of nutritional status and physical well-being of the Indian population has been noted to be sluggish (Deaton and Drèze, 2009; Deaton, 2013). Indians are in an inferior position to people in developed countries in terms of health, and women are in poorer positions than men. Inevitably, short and undernourished women also give birth to undernourished children, limiting the physical and cognitive development of both men and women in adulthood (Deaton, 2013). In short, improving women's health will benefit the wider population. Investing in the nutritional intake of children and pregnant women provides a significant social payoff (Banerjee and Duflo, 2012). Nutritional status during the foetal stage and childhood affects health status in adulthood (Humphrey, 2009; Pacheco and Wagner, 2023; Victora et al., 2008), including height (Deaton, 2008), weight (Black et al., 2013), and cognitive skills (Aurino and Burchi, 2017). To measure health

investment rigorously, diverse information is required. However, obtaining such data from birth is difficult. Thus, we use health status in adulthood as a proxy for ‘health investment’.

If their dietary and nutritional intake improves, the proportion of underweight women can be reduced. Body mass index (BMI) is commonly used to define an individual’s underweight status (WHO, 2019). The BMI for a person weighing w kilogrammes (kg) and h metres (m) in height is measured as w/h^2 . If a woman’s BMI is less than 16.00, she is considered ‘severe thinness’, and if it is between 16.00 and 16.99, she is considered ‘moderate thinness’ (WHO, 2019).¹

Identification strategy

Using the triple-difference approach, this study demonstrates a causal relationship between the HSAA and educational and health statuses. We use repeated cross-sectional data from the NFHS (For the variables used in this study and their original questions, see Table A1 in the Appendix). The NFHS is a nationally representative survey conducted by the Ministry of Health and Family Welfare, Government of India, as part of the Demographic and Health Survey Program. The NFHS data pertain to five periods: NFHS-1 (1992–1993), NFHS-2 (1998–1999), NFHS-3 (2005–2006), NFHS-4 (2015–2016), and NFHS-5 (2019–2021). The states surveyed in each survey year, and the states used in our study are summarised in Tables A2 and A3.

This study uses the following three factors to identify women exposed to the HSAA. We define women who meet all three of the following factors as the treatment group: (i) *Residence in reform states*.² We treat Kerala (reformed in 1976), Andhra Pradesh (reformed in 1986),³ Tamil Nadu (reformed in 1989), Karnataka (reformed in 1994), and Maharashtra

(reformed in 1994) as reform states. (ii) *Age*.⁴ We consider that a woman was not exposed to the amendment if she was 21 or older during the state-level reform. As previously explained, in the state-level amendment, only unmarried women at the time of the reform could benefit. The average marriage age of women was 18.7 and 19.3 in the 1981 and 1991 censuses, respectively (Vijayanunni, 1999). Therefore, we assume most women over 20 during the reform were unaffected. (iii) *Landholding*. If the household did not own joint family property above a certain level, the household head would have no incentive to change the inheritance framework. In this study, the threshold is set at 1 hectare. Even if a woman partially meets the factors for the treatment group, she will be classified in the control group unless she meets all three factors (See Table A4 for the birth years of women and the composition of the treatment group for each survey year).

The NFHS does not include a person who left their birthplace. Hence, it is impossible to identify details regarding married women's upbringing, such as, for example, their parents' educational level. To overcome this shortcoming, we limit the data: First, we use only the data of women aged 22 to 49 at the time of the survey because their educational stage might be almost complete. Second, we use only the data about the daughter of the household head to control for her upbringing status. When the household head has multiple spouses (in cases of polygamy), identifying the biological/foster daughter's mother (or father) is impossible. Therefore, this study retains only one spouse in the dataset in such cases. If the daughter is older than the household head or their spouse, or the age difference is less than ten years, the daughter's information is excluded as an outlier. Selection bias may be a concern in the estimation because datasets of only women still living with their parents after the average marriage age were used. However, by doing so, we could control for the age and educational year of the women's parents.

Households holding less than 1 hectare of land are ‘Marginal Farmers’ (Ministry of Agriculture and Farmers Welfare, 2019). This study groups marginal farmers with landless households because their property will be the minimum size and may not be able to be further subdivided as a joint family inheritance. Recently, the traditional caste-based land ownership structure has changed. Traditionally, landless social classes began to purchase agricultural land (Bakshi, 2008; Kapur et al., 2010). The purchased land will be considered personal property, not joint family property.

Though joint family properties include other forms, such as ancestral houses, this study uses landholding information as a proxy variable for joint family properties. As in Roy (2015) and Rosenblum (2015), we assume that joint family property refers to agricultural land because it was not possible to strictly determine its type (i.e., individual or joint family property) from the NFHS data. Additionally, the estimation does not distinguish whether the land was irrigated or non-irrigated and whether it was under cultivation or not.

This study focuses on five education and health indicators: years of education, reading habits, underweight, BMI z-score, and short stature.⁹ Years of education are calculated based on the respondents’ educational level and do not reflect extended years of schooling due to retention. The reading habits dummy indicates whether women read newspapers or magazines. This study set a dummy variable as one if the respondent read a newspaper or a magazine at least once a week and zero otherwise. The underweight dummy is a binary variable set to one if BMI is below 17.0 and zero if BMI is 17.0 and above. Additionally, we used the z-score (standard deviation) of BMI as the outcome variable. The short stature dummy is a binary variable set to one if the woman’s height is below 145 centimetres (cm). The cutoff point for height, below which a woman can be identified as nutritionally at risk, is usually considered to be in the range of 140–150 cm. There is a strong negative relationship

between this height measure and education and the standard of living index (IIPS and ORC Macro, 2000).

[Insert Table 1 here]

Table 1 illustrates the descriptive statistics for the study data relating to Hindus, Sikhs, Jains, and Buddhists.⁶

The estimation equation for the triple-difference approach is as follows:

$$Y_{isk} = \alpha_0 + \beta_{1s}D_s + \beta_{2k}D_k + \beta_3AG_i + \beta_{12sk}D_s \times D_k + \beta_{13s}D_s \times AG_i + \beta_{23k}D_k \times AG_i + \delta D_{is,(k \geq k' - 20)} \times AG_i + X_{isk} + \varepsilon_{isk} \quad (1)$$

where Y_{isk} refers to the outcome variable (i.e., years of education, reading habits dummy, underweight dummy, BMI z-score, and short stature dummy) for daughter i born in year k and residing in state s . k' denotes the year of the state-level amendment. α_0 is a constant term. D_s , D_k , and AG_i are the fixed effects of state, year of birth, and landed household, respectively. Similarly, $D_s \times D_k$ denotes the state $\times$ year of birth fixed effect; $D_s \times AG_i$, state $\times$ landed household fixed effect, and $D_k \times AG_i$, year of birth $\times$ landed household fixed effect. X_{isk} denotes a vector of daughter's and household control variables, including urban dummy, number of children aged 5 years and under in the household, Scheduled Castes (SCs) dummy, Scheduled Tribes (STs) dummy,⁷ household asset ownership dummies (TV, radio, clock, and motorcycle), the parents' age at the time of the survey, parents' years of education, and NFHS round dummies. ε_{isk} is an error term.

To be included in the treatment group, $D_{is,(k \geq k' - 20)} \times AG_i$, all of the following criteria must be met: (1) she resides in a reform state, (2) she belongs to a household with more than 1 hectare of land, and (3) she is aged 20 years or below at the time of the reform (including prenatal generations). In this equation, the coefficient of interest to us is δ .

Regardless of whether we assume the equalisation or compensation hypotheses, we expect the coefficients of educational outcomes and BMI z-score to increase, while the coefficients of underweight and short stature are expected to decrease. In this analysis, we expect women residing in urban areas to have better average outcomes. The number of siblings and birth order are important for intrahousehold resource allocation or its disparity (Fors and Lindskog, 2021). However, the NFHS can only identify members who live together. Therefore, the number of children aged 5 years and under in the household is used as a proxy variable for control. We expect that a higher number of co-residing children will negatively impact women's resource allocation. SCs and STs are socially and economically vulnerable groups compared to general castes and Other Backward Classes (OBCs), so their average outcomes are expected to be poorer. Household asset ownership dummies are used as proxies for household income because the NFHS does not include information on household income.⁸ The more assets a household owns, the higher its living standards are expected to be, and a positive effect on outcomes is anticipated. The years of education and age of a woman's parents are expected to positively impact her outcomes through the parents' experience and knowledge regarding human capital investment.

Similarly, the estimating equation for the treatment group, divided into three groups based on reform age, is as follows:

$$Y_{isk} = \alpha_0 + \beta_{1s}D_s + \beta_{2k}D_k + \beta_3AG_i + \beta_{12sk}D_s \times D_k + \beta_{13s}D_s \times AG_i + \beta_{23k}D_k \times AG_i$$

$$\begin{aligned}
& +\delta_1 D_{is,(k \geq k' - 10)} \times AG_i + \delta_2 D_{is,(k' - 15 \leq k \leq k' - 11)} \times AG_i + \delta_3 D_{is,(k' - 20 \leq k \leq k' - 16)} \times AG_i \\
& + X_{isk} + \varepsilon_{isk} \quad (2)
\end{aligned}$$

The treatment group is divided into three categories following the age at the HSAA: the first group, $D_{is,(k \geq k' - 10)} \times AG_i$, comprises those aged ten years and below at the time of the amendment (including prenatal generations), corresponding to primary school and below, and before the onset of puberty. The second group, $D_{is,(k' - 15 \leq k \leq k' - 11)} \times AG_i$, comprises those aged 11–15 years, corresponding to middle and junior high schools, and the first stage of puberty. The third group, $D_{is,(k' - 20 \leq k \leq k' - 16)} \times AG_i$, comprises those aged 16–20 years, corresponding to senior high school and the second stage of puberty. Girls show a rapid increase in height and weight until 14–15 years old. This additional height and weight growth during the onset of puberty stops around 18–20 years old (Indian Academy of Paediatrics, n.d.). In this equation, the coefficients of interest to us are δ_1 , δ_2 , and δ_3 .

For the outcome variables of reading habits, underweight, and short stature, we conducted analyses using not only a linear probability model but also a probit regression model.

Results

Main results

[Insert Table 2 here]

[Insert Table 3 here]

Table 2 presents the regression estimates of Eq. (1).⁹ Column (1) shows that the treatment group's years of education increased by 0.659 years on average. Column (2) shows that the treatment group's reading habits increased by 7.4 percentage points on average. Column (3) shows that the treatment group's underweight decreased by 10.4 percentage points on average. Column (4) shows that the treatment group's BMI z-score increased by 0.230 standard deviations on average. The coefficient for the treatment group in Column (5) was insignificant. In our analysis, the impact of the reforms on improving short stature was unclear.¹⁰

Similarly, Table 3 presents the regression estimates of Eq. (2). The results in Table 3 suggest that women being young (including those not yet born) at the time of the reforms may have been important for improvements in outcomes.

[Insert Table 4 here]

Table 4 presents the marginal effects of the probit regression model. When underweight and short stature are used as the dependent variables, results are consistent with those in Tables 2 and 3. On the other hand, when reading habits are used as the dependent variable, the result do not support an improvement in reading frequency among women in the treatment group. Various factors influence individual habits, so these results may not clearly reflect improvements in educational attainment.

Robustness checks

Placebo regression

For the first robustness check, we conduct a placebo regression analysis using only the data of Muslim and Christian women called the ‘placebo groups’ in this study. They have the same characteristics as those in the treatment group. However, Muslims and Christians are not covered by the HSA. The Muslim Personal Law (Shariat) Application Act 1937 applies to Muslims. The Indian Succession Act 1925 and its amendments apply to Christians.¹¹ If we obtain similar results in the analysis using the placebo group instead of the treatment group, the results in Tables 2–4 may have picked up another effect.¹²

The regression equations are as follows:

$$Y_{isk} = \alpha_0 + \beta_{1s}D_s + \beta_{2k}D_k + \beta_3AG_i + \beta_{12sk}D_s \times D_k + \beta_{13s}D_s \times AG_i + \beta_{23k}D_k \times AG_i + \gamma P_{is,(k \geq k' - 20)} \times AG_i + X_{isk} + \varepsilon_{isk} \quad (3)$$

where $P_{is,(k \geq k' - 20)} \times AG_i$ is a dummy variable set to one if a woman lived in a household with landholding, lived in a reform state, and was aged 20 years or below (including prenatal generations) at the time of the reform.

$$Y_{isk} = \alpha_0 + \beta_{1s}D_s + \beta_{2k}D_k + \beta_3AG_i + \beta_{12sk}D_s \times D_k + \beta_{13s}D_s \times AG_i + \beta_{23k}D_k \times AG_i + \gamma_1 P_{is,(k \geq k' - 10)} \times AG_i + \gamma_2 P_{is,(k' - 15 \leq k \leq k' - 11)} \times AG_i + \gamma_3 P_{is,(k' - 20 \leq k \leq k' - 16)} \times AG_i + X_{isk} + \varepsilon_{isk} \quad (4)$$

Similarly, this placebo group can also be divided into three categories following the age at the time: $P_{is,(k \geq k' - 10)} \times AG_i$ refers to those aged 10 years and below at the time of the reform (including prenatal generations). $P_{is,(k' - 15 \leq k \leq k' - 11)} \times AG_i$ refers to those aged 11–15 years, and $P_{is,(k' - 20 \leq k \leq k' - 16)} \times AG_i$, to those aged 16–20 years.

[Insert Table 5 here]

Tables 5, A14, and A15 present the regression estimates of Eqs. (3) and (4). Women in the placebo group showed at least a comparable magnitude of effects in educational indicators, underweight, and BMI z-scores compared to those in the treatment group; however, these improvements were not statistically significant.

Reform-timing regression

Here, we conduct a ‘reform-timing regression’ analysis for the second robustness check with only one type of treatment group. We divide the treatment group into four groups based on the time of enactment of the HSAA: 1976 (Kerala), 1986 (Andhra Pradesh), 1989 (Tamil Nadu), and 1994 (Karnataka and Maharashtra). This analysis maintains only one timing group in the dataset and drops the other timing groups. This analysis avoids the bias that occurs when using the conventional fixed effects difference-in-difference approach and examines the impact of treatments at different reform years for the HSAA. Recently, researchers have discussed the staggered Difference-in-Difference (Callaway and Sant’Anna, 2021; Goodman-Bacon, 2021; Sant’Anna and Zhao, 2020). As previously discussed, a causal interpretation of two-way FEDID estimates requires a parallel trend assumption and constant treatment effects over time. The ‘negative weights’ problem in FEDID occurs when the DID has more than two periods and variations in treatment timing and when the average treatment effects vary over time (Goodman-Bacon, 2021). These arguments can be applied to the HSAA. Most previous studies have more than two time-period datasets and timing groups. Nevertheless, they do not provide a series of econometric treatments in the context of a

staggered DID. This study does not directly use the newly proposed methods.¹³ Instead, the problem is avoided as much as possible by having reform-timing groups.¹⁴

[Insert Table 6 here]

Table 6 shows the results with only Karnataka and Maharashtra, which implemented reforms in 1994, remaining in the treatment group. This robustness check indicates that, at least in Karnataka and Maharashtra, the human capital of women who may have benefited from the HSAA improved on average. On the other hand, when only the other reform-timing group was retained in the treatment group, there were no clear improvements in human capital indicators within the treatment group (For other results, see Tables A16–A19). The analysis results using the probit regression model are consistent with those obtained using the linear probability model. Additionally, in this timing group, the treatment group’s reading habits increased by 8.4 percentage points on average when using the probit regression model (see Table A20).

Conclusion

This study examined the impact of improving women’s property inheritance rights on their outcomes in India using state-level enactments of the Hindu Succession (Amendment) Act or the Kerala Joint Hindu Family System (Abolition) Act. Employing a triple-difference approach, we analysed the outcomes of the household head’s daughters, who were Hindus, Sikhs, Jains, and Buddhists. We set the treatment group as individuals under 20 years old at the time of the reform, who lived in a reform state and belonged to a household with more

than 1 hectare of agricultural land. The treatment group had improved education and health indicators. Specifically, the number of years of education increased among these women. The results for the habit of reading newspapers and magazines differed between the linear probability model and the probit regression model. Although there is some indication that their reading habits might have improved compared to the control group, the improvements were not as clear as the increase in educational attainment. The incidence of underweight decreased, and BMI z-scores increased among these women. The impact of improvements in short stature was unclear. The results of this study suggest that making the rules more equitable in joint family property inheritance can affect the entire inheritance framework and improve the human capital of women exposed to the HSAA.

As robustness checks, this study conducted a placebo regression and reform-timing regression. We performed a placebo regression analysis using data on Muslim and Christian daughters. The coefficients of education and health indicators for the placebo group were insignificant. Thus, these results lend credence to our main results. This study also conducted additional robustness checks that reflect as many recent discussions in econometrics as possible. We used only each reform-timing group as the treatment group in the reform-timing regression. Our results showed that Maharashtra and Karnataka (the last reform-timing group) had the most significant impact on the main results.

Previous studies have indicated that the HSAA may not necessarily increase women's joint family property inheritance. Despite emphasising gender equality in the inheritance rules for joint family property, some ignore or circumvent the law in various ways. Social norms favouring boys persist, and the reforms may have had a negative impact because they increased the cost of having a girl child. Therefore, the results of this study showed improved human capital indicators for women who benefited from the HSAA, which may be subject to survivorship bias. However, our results suggest that implementing the HSAA has at least

increased the indirect inheritance of daughters living with their parents. Further examination of this phenomenon could reveal inequalities in Indian society that exist in various forms, such as those concerning gender and religion, and fuel discussions regarding institutional reforms.

Notes

1 Although a BMI of less than 18.50 is considered ‘underweight’, this study used only the categories of ‘severe thinness’ and ‘moderate thinness’ to represent malnutrition.

2 Data is used for all states except Jammu and Kashmir, which was governed by a different legal framework under the Jammu and Kashmir Hindu Succession Act 1956. The region became a union territory under The Jammu and Kashmir Reorganisation Act 2019.

3 Andhra Pradesh includes Telangana, which became a separate state in 2014.

4 Respondents’ ages may not be accurate and may have been rounded. This is because people do not always have accurate information about their ages. In the data, ages that were multiples of five were somewhat prevalent, although not outliers, so these factors were used in the current analysis.

5 We also conducted analyses using other health outcomes (diabetes, asthma, and thyroid disease) as dependent variables (see Tables A5 and A21–A26). Although malnutrition is among the causes of these outcomes, the theoretical pathways linking them to the HSAA are ambiguous, and the results were either statistically insignificant (for diabetes and thyroid disease) or lacked robustness (for asthma). For instance, in the case of diabetes, lifestyle and dietary habits in adulthood are significant contributors (Pradeepa and Mohan, 2021). Additionally, autoimmune thyroid disease is more common than iodine deficiency and is a cause of goitres in iodine-sufficient regions (Unnikrishnan and Menon, 2011). Asthma decreased in both the treatment and placebo groups, but its onset is likely influenced by air pollution resulting from economic activity and inexpensive yet harmful kitchen fuels used in impoverished households (Yokoo et al., 2023).

6 Table A6 shows the means and standard deviations for reform and non-reform states. Table A7 shows the pre-reform balance test between reform and non-reform states to examine whether there is any prior bias for Hindus, Sikhs, Jains, and Buddhists.

7 Nothing contained in the HSA shall apply to any STs unless the Central Government, by notification in the Official Gazette, is otherwise directed (Ministry of Law and Justice, n.d.). Although this study follows many previous studies' controls for STs using dummy variables, similar results can be obtained if STs are excluded from the data (see Table A8).

8 This control follows that of Roy (2015). The NFHS include information on the wealth index. However, making comparisons across survey years is difficult.

9 Tables A9 and A10 present the regression estimates of Eqs. (1) and (2) excluding Kerala. The results of this estimation are nearly identical to those listed in Tables 2 and 3.

10 We also analysed women's height measurements as the dependent variable (see Tables A5, A21, and A22). In this analysis as well, the effect of the reforms on height was statistically insignificant.

11 This act also applies to Parsis, Jewish people, and those in civil marriages. However, their sample is not used because they are a very small portion of the NFHS.

12 Table A11 shows the descriptive statistics for the study data relating to Muslims and Christians. Table A12 shows the means and standard deviations for reform and non-reform states. Table A13 shows the descriptive statistics for the control, treatment, and placebo groups.

13 Goodman-Bacon's (2021) decomposition is not possible with the repeated cross-sectional data of NFHS; panel data such as macro data must be used. Similarly, Callaway and Sant'Anna's (2021) staggered DID method is not possible due to gaps between the HSAA period (the 1970s–1990s) and the study data period (the 1990s–2020s).

14 The timing-group observations are as follows: 51 in Kerala, 678 in Andhra Pradesh, 346 in Tamil Nadu, 965 in Karnataka, and 807 in Maharashtra.

Conflict of interests

On behalf of all authors, the corresponding author states that there is no conflict of interest.

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