Estimated effect of age of marriage on utilisation of India's Integrated Child Development Service programme

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► Additional supplemental material is published online only. To view, please visit the journal online (http://dx.doi.org/10.1136/jech-2023-221325).

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This research paper was presented at the 15th International Health Economics Association (IHEA) World Congress held in Cape Town, South Africa, 8–12 July 2023.

Received 24 August 2023
Accepted 1 December 2023

To cite: Rai RK, Bromage S. *J Epidemiol Community Health* Epub ahead of print: [*please include* Day Month Year]. doi:10.1136/jech-2023-221325

ABSTRACT

Background Age of marriage among women is considered an important indicator of their readiness for familial integration and parenting. This study estimated the effect of age of marriage of young mothers (aged 15–24 years) on utilisation of various services for their children, provided under the Integrated Child Development Service (ICDS) programme in India.

Methods Data from the nationally representative 2019–2021 National Family Health Survey of India were analysed. Mothers' age of menarche was used as an instrumental variable to isolate the effect of age of marriage on whether their children received (1) food, (2) health check-up, (3) immunisation, (4) early childhood care or preschooling or (5) weight measurement services from ICDS.

Results Nationally, 67.9% (95% CI 67.6%, 68.3%) of children received food (sample: 60 578), 61.8% (95% CI 61.4%, 62.1%) received a health check-up (sample: 60 316), 60.0% (95% CI 59.6%, 60.4%) received immunisation services (sample: 60 537), 52.0% (95% CI 51.6%, 52.4%) received early childhood care or preschooling (sample: 60 458) and 62.9% (95% CI 62.5%, 63.3%) received weight measurement services (sample: 60 278). Findings from instrumental variable analysis suggest that a 1-year increase in age of marriage could yield a 9 percentage point increase (95% CI 4%–13%; p<0.001) in utilisation of immunisation services. Although postponement of marriage positively affected utilisation of each of the other four ICDS components, these effects were not statistically significant.

Conclusion Postponing age of marriage among young women is an effective intervention for promoting uptake of child immunisation services. Our findings support the Government of India's 2021 Bill to raise legal age of marriage of women.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Age of marriage among women is considered an important indicator of their social well-being, autonomy and degree of opportunity, and is a crucial factor in their readiness for familial integration and parenting; however, little is known on how age of marriage among young mothers affects utilisation of various health and welfare services for their children.

WHAT THIS STUDY ADDS

⇒ This quasiexperimental study, based on a nationally representative survey, revealed that postponing marriage by 1 year could yield a 9 percentage point increase in utilisation of child immunisation services.
⇒ We explored potential mechanisms and found that postponing marriage could empower young mothers to seek appropriate health and welfare services for their children.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Postponing marriage among young women is an effective intervention for promoting uptake of immunisation services for their children.
⇒ The Government of India's 2021 Bill to raise legal age of marriage of women could be helpful in increasing utilisation of child immunisation services.

INTRODUCTION

Age of marriage among women is an important indicator of their social well-being, autonomy and degree of opportunity, and is a crucial factor in their readiness for familial integration and parenting.[1] Marriage before 18 years (child marriage)[2] is a violation of Article 16(2) of the Universal Declaration of Human Rights.[3] One goal of the Programme of Action, a landmark international consensus adopted at the 1994 International Conference on Population and Development, was to eliminate child marriage.[3] However, nearly 21% of women aged 20–24 years globally had married as children in 2018.[4] South Asia has the largest regional population of child brides,[5] the majority of whom live in India (nearly 223 million). The state of Uttar Pradesh alone has nearly 36 million child brides.[5] According to the 2019–2021 National Family Health Survey (NFHS), 26.8% of Indian women aged 20–24 were married before 18 years, a 3.5 percentage point reduction from NFHS 2015-2016 (23.3%).[6]

The patterning and causes of child marriage are context specific and multifactorial. Among 34 Indian states, the proportion of women aged 20–24 who married in childhood is highest in West Bengal, Bihar, Tripura, Jharkhand, Assam and Andhra Pradesh,[7] which collectively account for one-third of the country's child brides. These states also rank among the bottom third in terms of Human Development Index[8] (a composite measure of health, income and education) and account for one-third of the country's rural population. Reports[5 6] have

found that child brides in India are more likely to come from rural areas and poorer households and have less education, all findings of which are supported by multivariable analysis of NFHS.[9] Multidimensional poverty and entrenched gender inequality are identified as primary factors conditioning child marriage in India, where the practice is further driven by manifestations of poverty within households, inadequate or inaccessible public services and entitlements, norms around gender roles and marital age, and other social and cultural factors.[10]

The impacts of child marriage are multifarious, severe and long lasting. Girls who marry before 18 are often deprived of opportunities for higher education and more likely to conceive soon after marriage,[4] even if they are neither physically nor mentally ready.[4 5] Early conception and unintended pregnancies among child brides can result in adverse maternal and offspring health outcomes[11] which compound added financial burdens of supporting additional family members, contribute to increased immediate out-of-pocket expenses for girls and households and have long-term effects on household earnings and productivity. Among diverse outcomes manifesting from child marriage, potential adverse effects on mothers' utilisation of healthcare services for children are insufficiently documented.[12 13] Such effects are plausible given that service utilisation is influenced by many factors that may be compromised by child marriage,[14 15] including mothers' power and preferences in making informed investments negotiating intrahousehold decisions.

Efforts to prevent child marriage by the Government of India date to the Child Marriage Restraint Act, 1929. The Act was later replaced by the Prohibition of Child Marriage Act, 2006, which prescribed 18 years as the minimum age of marriage for women.[16] The Bill on Prohibition of Child Marriage (Amendment), 2021, introduced in Parliament by the Ministry of Women and Child Development and currently under examination, would further raise the legal age of marriage to 21 years.[16] Aside from constitutional amendments, state and central governments run conditional cash transfer and social protection programmes aimed in part at preventing child marriage.[17] Critics have argued that these programmes inadequately address causes and drivers of child marriage, including adolescent girls' lack of agency in their marriage decisions and sexual rights within marriage, and prevailing social norms.[18]

In this study, we explored the effects of age of marriage among young women (15–24 years) on utilisation of services for their children provided under the Integrated Child Development Service (ICDS) programme in India. Launched in 1975, ICDS is the world's largest community-based outreach programme, providing nutritious meals, preschool education, primary healthcare, immunisation, and health check-up and referral services to children under 6 years and their mothers through a vast network of *anganwadi* centres (AWC).[19]

METHODS

Study population

We analysed data from the nationally representative cross-sectional 2019–2021 Demographic and Health Survey (DHS), known as the fifth round of the National Family Health Survey (NFHS-5) in India.[20] Conducted under stewardship of the Ministry of Health and Family Welfare, NFHS-5 covered 707 districts (defined as of 31 March 2017) across 28 states and nine union territories and is widely used to inform national health programmes and policies. Using the sample frame of the 2011 Census, NFHS-5 adopted a two-stage uniform sampling design representative at national, state/union territory and district levels. Each district is stratified by urban and rural areas. Primary sampling units (PSUs) were villages in rural areas and Census Enumeration Blocks in urban areas, and 30 456 PSUs in total were selected across the country. Overall household response rate was 97.5% and rates for women (15–49 years) and men (15–54 years) were 96.9% and 91.6%, respectively. Further details on sampling are published in the survey report.[20]

NFHS-5 recorded age of menarche (in complete years) of currently married young women 15–24 years by asking, 'How old were you when you had your first monthly period?'. Restricting this question to young women limited the possibility of recall error. Data from 71 229 children born to mothers 15–24 years were obtained from the NFHS-5 'Children's Recode' file. Women's age at marriage was computed as the difference between year of marriage and year of birth. The denominator for each outcome of interest is provided in 'Outcome events: utilisation of ICDS/AWC services' below. Figure 1 presents mean age of marriage by age of menarche to illustrate mean duration

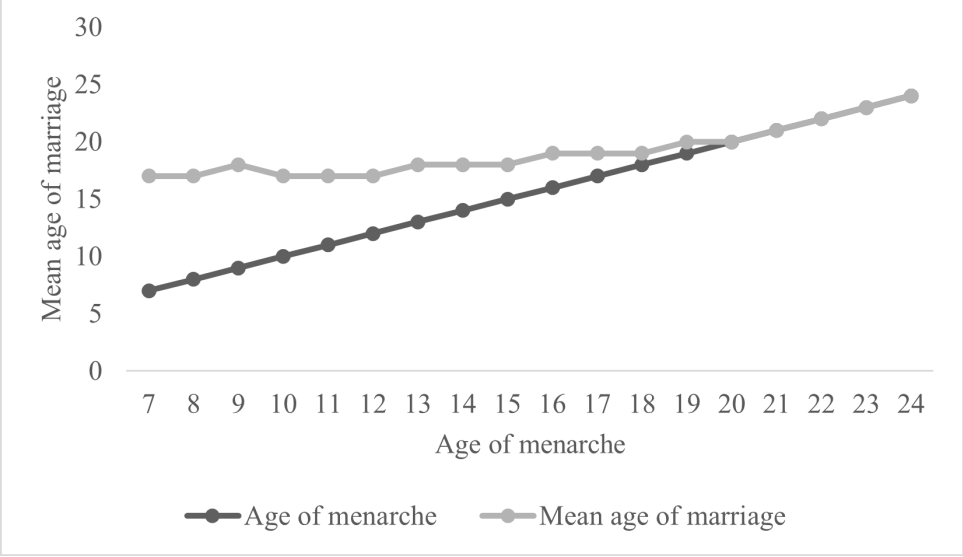

Figure 1 Mean age of marriage by age of menarche.

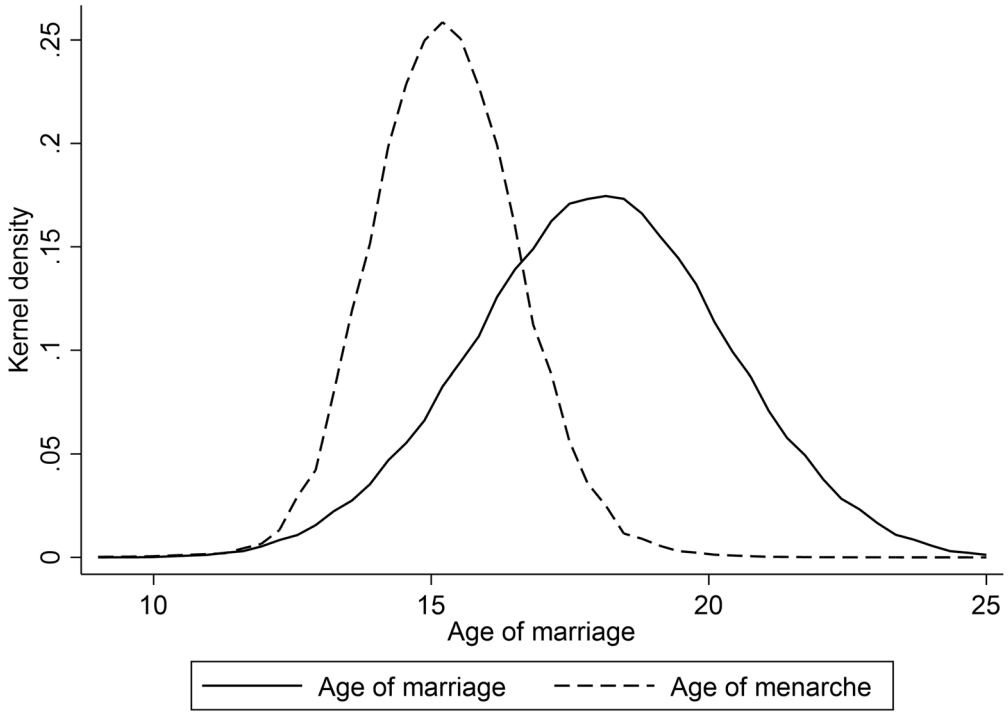

Figure 2 Kernel density (Epanechnikov kernel, bandwidth=1) of age of menarche and age of marriage.

between menarche and subsequent marriage. Figure 2 shows the distribution of age of marriage and age of menarche, indicating the symmetric shift in timing of marriage.

Outcome events: utilisation of ICDS/AWC services

In NFHS-5, mothers of all living children born in or after 2013 were asked, 'During the last 12 months, has (name of the child) received any benefits from the *anganwadi* or ICDS centre?' (n=60 683). In case of an affirmative response, five follow-up questions were asked (for each question, the number of available data points is provided):

'In the last 12 months, how often has (name of child)…

1. …received food from the *anganwadi*/ICDS centre?' (Responses: not at all, almost daily, at least once a week, at least once a month, less often, don't know) n=60 578.
2. …had a health check-up from the *anganwadi*/ICDS centre?' (Responses: not at all, at least once a month, less often, don't know) n=60 316.
3. …received any immunizations through the *anganwadi*/ICDS centre?' (Responses: yes, no, don't know) n=60 537.
4. …go to the *anganwadi*/ICDS centre for early childhood care or for preschool: regularly, occasionally, or not at all?' (Responses: regularly, occasionally, not at all, don't know) n=60 458.
5. …weight been measured by the *anganwadi*/ICDS centre?' (Responses: not at all, at least once a month, at least once in 3 months, less often, don't know) n=60 278.

For each indicator, a binary variable was derived for use in regression (non-utilisation of services was coded as 0; any utilisation was coded as 1). The sample with a response of 'don't know' to any of the six questions (less than 0.5% of the total sample) was dropped from analysis to prevent misclassification bias. Descriptive statistics for the study population were generated using sample weights provided in the NFHS-5 dataset.

Causal identification: age of menarche as an instrumental variable

We used a quasiexperimental study design employing the instrumental variable (IV) approach,[21] which allows for estimation of causal effects when there exist one or more exogenous factors (ie, instruments) that have sufficiently strong association(s) with the explanatory variable.[22] In this case, age at menarche was used as an IV for age of marriage (a method first employed in Bangladesh[23]) in a two-stage least squares (2SLS) strategy to estimate the effect of age of marriage on ICDS/AWC service utilisation. The 2SLS models were specified as follows, where parameters pertain to children i born to women j; $Controls_{ij}$ include child, mother and household-level control variables; and robust SEs are clustered at the district level:

First stage: $$Age\ of\ Marriage_j = \alpha_0 + \alpha 1\ Age\ of\ Menarche_j + \alpha_2 Controls_{ij} + \eta 1$$

Second stage: $$Y_{ij} = \delta_0 + \delta_1 Age\ of\ Marriage_j + \delta_2 Controls_{ij} + \eta 2$$

Using the IV approach, the instrument must meet three assumptions or conditions to serve as a consistent estimator of the effect of the endogenous explanatory variable on the outcome.[22] The condition of relevance states that the instrument must explain sufficient variation in the endogenous explanatory variable. As empirically demonstrated in earlier studies,[24 25] age of menarche is strongly correlated with age of marriage in India (girls are often married off after reaching puberty, in part to avoid unwanted pregnancies[26]). In this study, we tested the relevance condition by observing the Kleibergen-Paap rk Wald F-statistic[27] associated with the instrument in the first 2SLS stage ranged from 212 to 216, well above the proposed critical value of 10, indicating age of menarche is a sufficiently strong instrument.

The exclusion restriction assumption requires that the instrument causally affects the outcome solely through its effect on the endogenous explanatory variable.[21] While this assumption

is challenging to test empirically, it may be informed by subject matter knowledge of causal pathways. As argued in various studies conducted in India[24 25] and elsewhere,[23 28] age of menarche is plausibly exogenous in that it is largely biologically determined[29] and thus affects later life outcomes exclusively through its impact on age of marriage.

For instruments and endogenous explanatory variables expressed continuously, the third assumption of monotonicity requires that a change in the instrument imparts a change in the explanatory variable in the same direction (ie, there is an absence of 'defiers').[21] This study included women married on or after their year of menarche, minimising the likelihood of defiers.

Stata V.17[30] was used for analyses.

Control variables

Because the instrument is uncorrelated with the error term in IV regression, the IV approach can estimate the causal effect of an explanatory variable on an outcome without controlling for unobserved factors related to either variable.[21] However, adjustment for control variables can increase precision of effect estimates while minimising violations of IV assumptions.[22]

Control variables used in this analysis were: mother's year of birth and height (in metres); children's age, sex and birth order; and household size, wealth quintile, religion (Hinduism, Islam, Christianity and Others), social group (Scheduled Castes (SCs), Scheduled Tribes (STs), Other Backward Classes (OBCs) and Others), district, locality (urban and rural) and altitude of survey cluster. Control variables were guided by a recent study[28] estimating impacts of age of marriage on women's education and reproductive and maternal healthcare decisions using age of menarche as an IV. In NFHS-5, women's year of birth was self-reported, height was measured using SECA 213 stadiometers and wealth index was derived through principal component analysis of household assets and durables.[31] Social groups were defined as per the Constitution of India. While the 'Others' group has historically been relatively privileged, SCs, STs and OBCs have been socially and economically disadvantaged. According to the 2011 Census, SCs and STs comprise approximately 16.6% and 8.6% of India's population, respectively, while the 2004–2005 National Sample Survey estimated OBCs comprise 41%.[32] Guided by the Constitution, SCs, STs and OBCs are offered welfare services for their educational and

	Received any benefit from the ICDS/ AWC	Received food from the ICDS/AWC	Received health check-up from the ICDS/AWC	Received immunization from the ICDS/AWC	Went to ICDS/AWC for early childhood care or preschooling	Weight was measured at the ICDS/ AWC
Andaman & Nicobar Islands	63.9	63.6	54.6	22.5	54.4	60.4
Andhra Pradesh	86.6	84.9	81.4	72.8	58.0	81.1
Arunachal Pradesh	35.6	34.2	23.1	16.3	26.5	24.1
Assam	71.1	69.4	58.4	37.0	46.5	52.3
Bihar	58.6	43.8	36.1	51.1	41.6	36.2
Chandigarh	57.8	57.8	49.0	40.6	43.9	50.8
Chhattisgarh	87.1	85.6	80.3	76.0	62.2	83.2
Ddadra & Nagar Haveli	76.4	70.7	74.0	65.5	67.8	73.6
Delhi	62.6	52.0	47.6	43.6	38.6	52.0
Goa	77.4	77.4	59.3	61.4	56.2	73.8
Gujarat	77.4	74.6	74.2	69.8	68.4	75.1
Haryana	76.1	70.6	67.7	64.3	45.8	68.4
Himachal Pradesh	82.9	81.4	70.9	34.8	40.7	72.8
Jammu & Kashmir	48.4	47.5	35.7	25.1	37.8	37.7
Jharkhand	73.1	66.4	58.8	63.7	56.6	59.3
Karnataka	86.1	81.4	78.9	76.3	55.9	79.4
Kerala	66.2	62.7	52.5	29.1	32.1	55.1
Ladakh	67.2	62.0	47.6	32.4	42.5	43.0
Lakshadweep	59.3	59.3	37.0	18.5	28.2	37.0
Madhya Pradesh	86.3	81.9	78.6	76.0	63.4	81.6
Maharashtra	65.7	63.0	57.7	52.4	49.8	61.3
Manipur	39.3	38.8	8.4	13.6	12.9	7.4
Meghalaya	58.6	56.9	43.9	26.3	29.6	49.6
Mizoram	68.1	67.2	51.1	28.2	59.2	63.5
Nagaland	60.1	59.3	18.7	17.1	16.6	31.3
Odisha	94.4	92.8	88.1	83.7	62.7	89.9
Puducherry	76.7	76.2	68.7	44.9	48.8	67.5
Punjab	57.4	53.5	41.4	40.8	38.7	42.5
Rajasthan	65.7	55.1	51.8	56.2	39.8	52.3
Sikkim	78.1	74.8	63.7	59.7	66.0	70.7
Tamil Nadu	84.0	82.4	77.3	66.6	57.2	76.6
Telangana	82.1	79.8	74.2	66.8	54.9	76.5
Tripura	76.3	73.3	54.0	44.6	61.3	60.5
Uttar Pradesh	72.8	66.5	61.2	63.8	49.3	59.8
Uttarakhand	84.0	82.5	71.3	64.7	38.9	74.5
West Bengal	85.0	83.4	69.7	44.8	67.4	75.5
India	74.0	67.9	61.8	60.0	52.0	62.9

Figure 3 Heat map showing prevalence (%) of availing various services from Integrated Child Development Service (ICDS)/*anganwadi* centres (AWC) by states and union territories of India.

Table 1 Proportion of children who availed various services from ICDS/*anganwadi* centres, by select background characteristics

	Any benefit	Food	Health check-up	Immunisation	Early childhood care or preschooling	Weight measurement
	n; % (95% CI)	n; % (95% CI)	n; % (95% CI)	n; % (95% CI)	n; % (95% CI)	n; % (95% CI)
Mother's age of marriage						
≤14	2601; 70.9 (69.3, 72.5)	2594; 64.5 (62.8, 66.2)	2576; 55.9 (54.1, 57.7)	2594; 55.9 (54.2, 57.7)	2590; 52.2 (50.4, 54.0)	2573; 58.1 (56.3, 59.8)
15–16	10 544; 71.9 (71.1, 72.7)	10 516; 65.7 (64.8, 66.5)	10 468; 59.0 (58.1, 59.9)	10 507; 56.2 (55.4, 57.1)	10 505; 53.2 (52.3, 54.1)	10 459; 60.1 (59.2, 61.0)
17–18	22 509; 74.0 (73.5, 74.6)	22 468; 68.1 (67.5, 68.7)	22 360; 61.9 (61.3, 62.5)	22 449; 60.1 (59.5, 60.8)	22 420; 53.0 (52.3, 53.6)	22 359; 63.0 (62.4, 63.6)
19–20	17 971; 75.3 (74.7, 76.0)	17 946; 69.6 (68.9, 70.2)	17 894; 63.9 (63.2, 64.6)	17 943; 62.2 (61.5, 62.9)	17 911; 51.9 (51.2, 52.7)	17 872; 65.0 (64.3, 65.7)
21–24	7058; 74.9 (73.8, 75.9)	7054; 68.6 (67.5, 69.7)	7018; 62.9 (61.7, 64.0)	7044; 61.7 (60.5, 62.8)	7032; 46.4 (45.2, 47.5)	7015; 63.8 (62.7, 65.0)
Age of child (years)						
0	18 389; 73.2 (72.6, 73.8)	18 358; 65.7 (65.0, 66.4)	18 303; 59.3 (58.6, 60.0)	18 369; 59.9 (59.2, 60.6)	18 307; 44.1 (43.4, 44.8)	18 298; 58.6 (57.9, 59.3)
1	14 971; 80.4 (79.8, 81.0)	14 944; 74.3 (73.6, 75.0)	14 883; 67.9 (67.2, 68.6)	14 940; 69.4 (68.7, 70.2)	14 916; 53.3 (52.5, 54.0)	14 874; 69.4 (68.7, 70.1)
2	11 830; 75.7 (74.9, 76.4)	11 808; 70.7 (69.9, 71.5)	11 739; 63.6 (62.8, 64.5)	11 795; 61.3 (60.4, 62.1)	11 783; 56.1 (55.2, 57.0)	11 735; 65.9 (65.1, 66.8)
3	8946; 69.5 (68.6, 70.4)	8931; 64.2 (63.3, 65.2)	8887; 58.8 (57.9, 59.8)	8909; 53.1 (52.1, 54.1)	8922; 57.6 (56.6, 58.6)	8874; 60.9 (60.0, 61.9)
4	6547; 64.6 (63.4, 65.7)	6537; 60.1 (58.9, 61.2)	6504; 55.5 (54.3, 56.6)	6524; 46.0 (44.9, 47.2)	6530; 55.2 (54.1, 56.4)	6497; 57.2 (56.0, 58.4)
Sex of child						
Male	31 194; 73.5 (73.0, 74.0)	31 142; 67.5 (67.0, 68.0)	30 994; 61.2 (60.7, 61.7)	31 121; 59.7 (59.1, 60.2)	31 085; 51.2 (50.6, 51.7)	30 992; 62.4 (61.9, 62.9)
Female	29 489; 74.4 (73.9, 74.9)	29 436; 68.4 (67.9, 68.9)	29 322; 62.4 (61.8, 62.9)	29 416; 60.3 (59.7, 60.8)	29 373; 52.8 (52.3, 53.4)	29 286; 63.4 (62.8, 63.9)
Birth order						
1	39 513; 73.6 (73.2, 74.0)	39 448; 67.8 (67.3, 68.2)	39 286; 61.8 (61.3, 62.3)	39 425; 59.1 (58.6, 59.6)	39 365; 51.9 (51.4, 52.4)	39 234; 63.1 (62.6, 63.6)
2	17 275; 75.3 (74.7, 76.0)	17 246; 69.2 (68.5, 69.9)	17 164; 62.6 (61.9, 63.3)	17 226; 62.0 (61.3, 62.7)	17 217; 53.0 (52.3, 53.7)	17 171; 63.7 (63.0, 64.4)
≥3	3895; 71.3 (69.9, 72.6)	3884; 63.9 (62.5, 65.3)	3866; 57.5 (56.0, 59.0)	3886; 59.8 (58.3, 61.2)	3876; 48.5 (47.0, 50.0)	3873; 57.2 (55.8, 58.7)
Religion of household						
Hinduism	49 170; 75.0 (74.6, 75.4)	49 087; 68.8 (68.4, 69.2)	48 871; 63.0 (62.6, 63.4)	49 064; 61.7 (61.3, 62.1)	48 994; 52.8 (52.4, 53.2)	48 834; 63.9 (63.4, 64.3)
Islam	6379; 67.8 (66.8, 68.8)	6367; 62.0 (61.0, 63.1)	6347; 54.3 (53.2, 55.4)	6360; 50.4 (49.4, 51.5)	6361; 47.6 (46.5, 48.7)	6345; 56.7 (55.6, 57.8)
Christian	3323; 77.3 (74.7, 79.7)	3319; 75.8 (73.1, 78.3)	3302; 66.1 (63.2, 68.9)	3310; 55.6 (52.5, 58.5)	3303; 49.6 (46.6, 52.7)	3306; 68.7 (65.8, 71.4)
Others	1811; 66.2 (63.4, 68.9)	1805; 62.8 (59.9, 65.6)	1796; 54.1 (51.2, 57.0)	1803; 51.4 (48.5, 54.4)	1800; 46.1 (43.2, 49.1)	1793; 56.2 (53.3, 59.1)
Social group of household						
Others	8717; 70.0 (69.1, 70.8)	8699; 64.3 (63.4, 65.2)	8652; 57.3 (56.4, 58.3)	8695; 52.5 (51.5, 53.4)	8687; 49.2 (48.2, 50.1)	8655; 59.8 (58.9, 60.7)
OBC	26 126; 72.9 (72.4, 73.4)	26 080; 65.7 (65.2, 66.3)	25 980; 60.6 (60.0, 61.1)	26 080; 60.9 (60.4, 61.5)	26 040; 50.1 (49.5, 50.6)	25 951; 61.2 (60.6, 61.7)
ST	11 671; 80.3 (79.3, 81.2)	11 652; 77.1 (76.1, 78.0)	11 600; 70.9 (69.8, 71.9)	11 635; 66.4 (65.3, 67.5)	11 622; 59.1 (58.0, 60.3)	11 602; 71.9 (70.9, 72.9)
SC	14 169; 75.7 (75.0, 76.3)	14 147; 70.2 (69.5, 70.8)	14 084; 62.8 (62.0, 63.5)	14 127; 60.2 (59.5, 61.0)	14 109; 54.0 (53.2, 54.8)	14 070; 63.9 (63.2, 64.7)
Locality of residence						
Urban	9779; 64.1 (63.3, 64.9)	9769; 58.4 (57.6, 59.3)	9723; 53.1 (52.3, 54.0)	9756; 50.1 (49.2, 50.9)	9743; 44.8 (43.9, 45.6)	9723; 55.4 (54.6, 56.3)
Rural	50 904; 76.6 (76.2, 77.0)	50 809; 70.5 (70.1, 70.9)	50 593; 64.1 (63.7, 64.5)	50 781; 62.7 (62.2, 63.1)	50 715; 53.9 (53.5, 54.4)	50 555; 64.9 (64.5, 65.3)
Household wealth index						
Poorest	16 549; 74.4 (73.8, 75.1)	16 508; 67.7 (67.0, 68.4)	16 431; 59.8 (59.0, 60.5)	16 508; 60.2 (59.4, 61.0)	16 494; 54.7 (53.9, 55.4)	16 426; 60.5 (59.7, 61.2)
Poorer	15 806; 75.2 (74.6, 75.9)	15 778; 69.0 (68.2, 69.7)	15 710; 62.2 (61.4, 63.0)	15 758; 60.8 (60.0, 61.6)	15 748; 54.0 (53.2, 54.8)	15 701; 63.5 (62.7, 64.2)
Middle	13 131; 77.8 (77.1, 78.5)	13 114; 72.2 (71.5, 72.9)	13 055; 67.0 (66.2, 67.7)	13 103; 63.4 (62.6, 64.2)	13 076; 54.2 (53.4, 55.0)	13 061; 68.1 (67.3, 68.9)
Richer	9940; 72.5 (71.7, 73.3)	9926; 67.5 (66.6, 68.3)	9890; 62.4 (61.6, 63.3)	9922; 58.9 (58.0, 59.8)	9898; 49.1 (48.2, 50.0)	9860; 63.2 (62.3, 64.1)
Richest	5257; 63.6 (62.4, 64.8)	5252; 57.3 (56.0, 58.5)	5230; 52.8 (51.6, 54.1)	5246; 51.4 (50.2, 52.6)	5242; 40.4 (39.2, 41.6)	5230; 55.2 (54.0, 56.4)
Household size						
<4	6402; 74.4 (73.3, 75.4)	6389; 68.2 (67.1, 69.3)	6357; 61.3 (60.1, 62.5)	6394; 59.7 (58.5, 60.9)	6377; 53.4 (52.2, 54.6)	6350; 63.0 (61.8, 64.2)
4–5	21 331; 75.2 (74.6, 75.7)	21 287; 69.8 (69.2, 70.4)	21 204; 62.9 (62.3, 63.5)	21 275; 60.1 (59.4, 60.7)	21 254; 53.3 (52.7, 54.0)	21 192; 64.3 (63.7, 64.9)
≥6	32 950; 73.1 (72.7, 73.6)	32 902; 66.7 (66.2, 67.2)	32 755; 61.2 (60.6, 61.7)	32 868; 60.0 (59.4, 60.5)	32 827; 50.9 (50.3, 51.4)	32 736; 62.0 (61.4, 62.5)
Total	60 683; 74.0 (73.6, 74.3)	60 578; 67.9 (67.6, 68.3)	60 316; 61.8 (61.4, 62.1)	60 537; 60.0 (59.6, 60.4)	60 458; 52.0 (51.6, 52.4)	60 278; 62.9 (62.5, 63.3)

All sample counts (n) are unweighted.
ICDS, Integrated Child Development Service; OBC, Other Backward Class; SC, Scheduled Caste; ST, Scheduled Tribe.

economic upliftment and afforded special protections against injustice and exploitation.

Collectively, these variables account for exogenous variation in age of menarche in India that may be attributable to women's socioeconomic and nutritional status. Women's height is partly a proxy for childhood nutrition status[28] as children with smaller stature are also shorter in adulthood[33] which may delay age of menarche. Online supplemental figure S1 presents the relationship between women's height and age of menarche obtained from linear regression modelling. Mother's year of birth controls for period effects incurred in infancy,[28] and non-biological factors such as altitude and district of residence account for effects of geographical conditions (eg, temperature, rainfall, neighbourhood socioeconomic status) on age of menarche.[34] Online supplemental figure S2 shows the linear relationship between age of menarche and altitude and online supplemental figure S3 is a scatter plot between mother's age of menarche and year of birth.

Table 2 Effect of women's age of marriage on availing various services from ICDS/*anganwadi* centres for their children

	2SLS results	
	First stage β (95% CI) P value (F-statistic)	Second stage β (95% CI) P value
Any benefit	0.11 (0.10, 0.13) <0.001 (214)	0.02 (−0.02, 0.06) 0.260
Food	0.11 (0.10, 0.13) <0.001 (214)	0.004 (−0.038, 0.045) 0.869
Health check-up	0.11 (0.10, 0.13) <0.001 (216)	0.02 (−0.03, 0.06) 0.491
Immunisation	0.11 (0.10, 0.12) <0.001 (214)	0.09 (0.04, 0.13) <0.001
Early childhood care or preschooling	0.11 (0.10, 0.13) <0.001 (214)	0.03 (−0.01, 0.08) 0.168
Weight measurement	0.11 (0.09, 0.12) <0.001 (212)	0.04 (−0.01, 0.08) 0.111

Control variables: child age, sex, birth order; mother's height; household size, wealth index, religion, social group, district, urban versus rural locality; and altitude of survey cluster.
All specifications also include mother's year of birth. F-statistic is adjusted for district cluster.
P indicates level of significance; β denotes coefficient.
ICDS, Integrated Child Development Service; 2SLS, two-stage least squares method.

RESULTS

Descriptive statistics

The proportion of children receiving different ICDS/AWC services is presented by state and union territories in figure 3 and by strata of population characteristics in table 1. Nationally, 74.0% (95% CI 73.6%, 74.3%) of children received any benefits, 67.9% (95% CI 67.6%, 68.3%) received food, 61.8% (95% CI 61.4%, 62.1%) received a health check-up, 60.0% (95% CI 59.6%, 60.4%) received immunisation services, 52.0% (95% CI 51.6%, 52.4%) received early childhood care or preschooling and 62.9% (95% CI 62.5%, 63.3%) received weight measurement services (figure 3, table 1). Receipt of every service was lower among children whose mothers married before 15 years than among those whose mothers married at or after 17 years. There was less than a 2 percentage point difference in receipt of every service between male and female children.

Effect of age of marriage on ICDS/AWC service utilisation

Table 2 shows the effect of age of marriage on ICDS/AWC service utilisation. Findings indicate that a 1-year increase in age of marriage of young mothers could yield a 9 percentage point increase (β: 0.09; 95% CI 0.04, 0.13; p<0.001; ie, 9%; 95% CI 4%, 13%; p<0.001) in availing child immunisation services. Although postponing marriage positively affected utilisation of each of the other ICDS/AWC components (food, health check-up, early childhood care or preschooling and weight measurement services) or any of the five services, effects were not statistically significant (p>0.10). A similar finding was observed when analysing the effect of age of marriage on availing any of the five services from ICDS/AWC.

Using a comparable IV approach, we explored potential mechanisms through which age of marriage may affect ICDS/AWC service utilisation through its influence on women's autonomy, and found that postponing marriage by 1 year could result in wives being 1.58 years older than their husbands (online supplemental material). We also subjected study findings to three robustness checks (restricting to women with age of menarche between 11 and 16 years, treating early age of marriage as a dichotomous variable defined according to three alternate cut-offs and correcting for multiple hypothesis testing) which produced no material changes in the results (online supplemental material).

DISCUSSION

Using the nationally representative 2019–2021 NFHS, we conducted a quasiexperimental study using age of menarche as an IV and a 2SLS estimation approach to assess the causal effect of age of marriage among young women (15–24 years) in India on availing ICDS/AWC services for their children's health and welfare. To the best of our knowledge, this is the first study to estimate the effect of age of marriage among Indian women on utilisation of ICDS/AWC services for their children.

The positive effect of mother's age of marriage on use of child immunisation services is consistent with IV analysis of DHS data from 39 sub-Saharan African and Southwest Asian countries which concluded that the probability of children receiving basic vaccinations would double if their mothers married between the ages of 15 and 17 instead of 10–14.[35] Our observation that postponing marriage by 1 year could expand the spousal age gap is relevant to the findings of this study because empirical data suggest children born to younger wives are less likely to receive recommended immunisations,[36] whereas older wives are more autonomous in household decision-making[37] and may thus be more empowered to avail child immunisation services. Older wives may also be more inclined to use such services due to increased awareness that non-uptake could be life threatening for their children.

Confidence in the findings of this study is strengthened by important robustness checks, but findings should nonetheless be interpreted considering possible limitations. First, most of the information collected in NFHS-5 was based on respondent recall, which may be affected by memory and/or social desirability bias. Second, because this study analysed the effect of age of marriage among young Indian mothers 15–24 years, findings are immediately generalisable to this age group only and the extent to which they may apply to older women of reproductive age (25–49 years) is unclear. Third, 2SLS estimation relies on linear structural equation models that involve important statistical assumptions, and results should be carefully interpreted in the context of the statistical approach.

India has made much progress in curbing child marriage over the past 50 years, largely attributable to improved educational attainment and reduced poverty and fertility.[7] Nonetheless, child marriage remains an unfortunate reality for hundreds of millions of women across the country and has devastating intragenerational and intergenerational consequences that continue to impede national development. Findings of this study—that postponed marriage could render young mothers more autonomous and increase uptake of child immunisation services—support the Government of India's 2021 Bill to raise the minimum age of marriage for women to 21, which was heavily motivated by imperatives to empower women and reduce infant mortality.[16]

Whether these policy objectives will be effectively met through legislative mechanisms is questionable: the current legal age of 18 is limitedly enforced, child marriages are rarely registered and deep-rooted social, infrastructural and systemic barriers and inequalities that condition and drive child marriage persist.[18 38] Wholistically addressing these drivers calls for a stronger policy implementation framework and large-scale, community-based interventions aptly tailored to the Indian context, within which peer-based education, adolescent empowerment and transformation of social norms must play a central role.[39] Findings of this study should inform the design of applied and implementation research to evaluate and improve such interventions by emphasising sequential links between postponed marriage, increased autonomy, child immunisation and improved health and welfare when communicating to adolescents.

Acknowledgements The authors are indebted to the IHEA Congress participants for their feedback.

Contributors RKR conceived the study design, performed statistical analysis and drafted the manuscript. SB critically revised the manuscript. RKR and SB directly accessed and verified the underlying data reported in the manuscript. All authors confirm that they have full access to all data in the study and accept responsibility to submit for publication. RKR is the guarantor for the study.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient consent for publication Not applicable.

Ethics approval This study involves human participants but prior to conducting the 2019–2021 National Family Health Survey, ethical approval was obtained by the International Institute for Population Sciences from an independent ethics review committee constituted by the Ministry of Health and Family Welfare, Government of India. This research complies with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008. Thus, no separate ethical approval was required for this study. Participants gave informed consent to participate in the study before taking part.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data may be obtained from a third party and are not publicly available. The 2019–2021 National Family Health Survey dataset used for this study could be accessed from the official website of DHS Program: https://dhsprogram.com/

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