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Beyond the first hour: institutional childbirth and delayed initiation of breastfeeding in Ethiopia a cross-sectional analysis of the 2024-25 Ethiopia Demographic and Health Survey

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Abstract

Background

Breastfeeding within the first hour of life is among the most cost-effective newborn survival interventions. Between the 2016 and 2024–25 Ethiopia Demographic and Health Surveys (EDHS), skilled birth attendance rose from 37% to 64% and institutional delivery from 37% to 61%, yet early breastfeeding initiation moved only from 70% to 73%. We examined what now predicts delay.

Methods

We analyzed the 2024–25 EDHS, a two-stage stratified cluster survey of 805 enumeration areas and 21,395 women aged 15–49 years. The sample was each woman's most recent live birth in the 2 years before the survey with a valid time to first breastfeed. Delayed initiation was first breastfeeding more than 1 hr after birth. Estimates incorporated weights, primary sampling units and strata; determinants were identified by design-based logistic regression.

Results

Three health-system factors dominated. Birth outside a health facility carried higher odds of delay (AOR = 6.87, 95% CI [3.22, 14.69]), as did cesarean birth (AOR = 2.27, 95% CI [1.43, 3.57]), both $p < .001$. Among antenatal care attenders, one to three visits carried higher odds than eight or more (AOR = 1.70, 95% CI [1.14, 2.53]). Every socioeconomic gradient significant bivariately became null on adjustment.

Conclusions

Where most births now occur in facilities, the residual burden of delayed initiation is generated at the point of care, not by maternal social background. Embedding the Baby-Friendly Hospital Initiative Ten Steps in intrapartum care, with cesarean-specific skin-to-skin protocols and auditable antenatal counseling, should yield greater gains than socioeconomic targeting alone.

Background

Breast milk is the reference standard for infant nutrition, and the moment at which breastfeeding begins is itself a determinant of survival rather than merely a marker of good practice. The World Health Organization (WHO) and UNICEF recommend that every newborn be placed in skin-to-skin contact with the mother immediately after birth and put to the breast within the first hour of life, with exclusive breastfeeding for 6 months and continued breastfeeding thereafter [1, 2, 3]. Suckling in the first hour stimulates oxytocin release, delivers colostrum and establishes the neuroendocrine feedback loop on which sustained lactation depends [1].

The consequences of failing to achieve this are well quantified. In a community-based cohort in rural Ghana, delaying the first feed beyond the first hour was associated with a graded increase in neonatal death, and initiation after the first day carried more than twice the risk [4]. A meta-analysis pooling five studies and 136,047 breastfed infants confirmed that newborns first breastfed between 2 and 23 hr after birth had a 33% higher risk of neonatal death than those breastfed within the first hour, with risk more than doubling when initiation was delayed beyond 24 hr [5]. Pooled analyses of three randomized neonatal vitamin A trials reached concordant conclusions [6], and systematic reviews of optimal breastfeeding practices identify timing of initiation as an independent contributor to infant and child survival [7]. Critically, these associations hold among infants who were all eventually breastfed, so the exposure of interest is the delay itself rather than the absence of breastfeeding. In Ethiopia, where the neonatal mortality rate remains 25 deaths per 1,000 live births [8], the population-level implications are substantial.

Globally, progress has been slow. World Health Organization and UNICEF [9] estimate that approximately 78 million newborns (three in every five) are not breastfed within the first hour of life, the overwhelming majority in low- and middle-income countries (LMICs), where the prevalence of delayed initiation has been estimated at 53.8%, ranging from 15.0% in Burundi to 83.4% in Guinea [10].

A recurring and undertheorized feature of this stagnation is that it has coincided with a rapid global shift toward facility-based childbirth. Across 58 countries between 2005 and 2017, institutional delivery coverage grew by 18 percentage points while early initiation improved by only six [9]. The mechanisms are increasingly well characterized: routine postpartum separation of mother and infant, administration of prelacteal fluids and infant formula in maternity wards, and above all the rising volume of cesarean births, after which mothers are frequently unable or unsupported to feed in the first hour [10, 11]. Secondary analysis of the WHO Global Survey across 24 countries identified cesarean section as the single strongest determinant of delayed initiation [12], and cesarean rates continue to rise worldwide [13]. Institutionalizing childbirth is therefore necessary but not sufficient, and can actively displace the first hour unless breastfeeding support is deliberately engineered into intrapartum services [11, 9].

Ethiopia now offers an unusually clean test of this proposition, because the transition has occurred there at exceptional speed and is captured within a single national survey series. Between the 2016 EDHS and the 2024–25 EDHS, the proportion of live births attended by a skilled provider rose from 37% to 64%, and the proportion delivered in a health facility rose from 37% to 61%. Over the same interval, the proportion of children put to the breast within 1 hr of birth moved from 69.6% to 72.5%, a gain of fewer than 3 percentage points against gains of 24 to 27 percentage points in delivery care [8, 14]. Ethiopia has, in other words, brought the majority of births into facilities without materially changing what happens in the first hour after those births.

The Ethiopian determinants literature was largely established before this transition. Systematic reviews have produced pooled early initiation estimates of 61.4% [15] and 67.4% [16], and have repeatedly identified place of birth, cesarean section, antenatal and postnatal care, urban residence and maternal

education as correlates [17, 18]. Cesarean section has an unusually strong effect in this literature: A meta-analysis of 17 studies and 29,919 participants estimated that cesarean birth was associated with 79% lower odds of timely initiation, OR = 0.21, 95% CI [0.16, 0.28] [19]. Prelacteal feeding, which mechanically displaces the first feed, remains common [20], and analyses of the 2016 and 2019 rounds have documented marked geographical clustering of delayed initiation [21, 22, 23]. What has not been established is whether these determinants retain independent explanatory power once facility birth has become the norm, or whether the residual burden has migrated into the health system itself.

We therefore analyzed the 2024–25 EDHS to (a) estimate the national prevalence of delayed initiation of breastfeeding; (b) identify the maternal, child, household-socioeconomic and health-system factors independently associated with it, using design-based regression that fully respects the survey's complex sampling structure; and (c) quantify the model-implied probability of delay across the configurations of birth that Ethiopian women now actually experience.

Methods

Study design and setting

We conducted a cross-sectional secondary analysis of nationally representative survey data, reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement for cross-sectional studies [24].

Ethiopia is divided into 12 regions and 2 city administrations [8]. Maternal and newborn services are delivered through a three-tier public system of primary, secondary and tertiary facilities, supported by the Health Extension Programme, which provides community-based preventive services including infant and young child feeding counseling. Health extension workers are classified as skilled providers in Ethiopian national reporting. The National Infant and Young Child Feeding Guideline, revised in 2016, endorses initiation of breastfeeding within 1 hr of birth as a national target.

Nationally, 72.5% of children born in the 2 years before the survey were put to the breast within 1 hr of birth and 57.3% of infants under 6 months were exclusively breastfed [8].

Data source and sampling

Data were drawn from the 2024–25 Ethiopia Demographic and Health Survey, the fifth full EDHS, implemented by the Ethiopian Statistical Service with the Ministry of Health and the Ethiopian Public Health Institute, with technical assistance from ICF through The DHS Program. Data collection ran from 1 August 2024 to 14 April 2025 [8].

The sampling frame was the cartographic frame of 147,602 enumeration areas (EAs) developed for the 2019 Population and Housing Census. A stratified two-stage sample was drawn, with each region

separated into urban and rural areas to yield 27 strata (Addis Ababa having no rural areas). In the first stage, 805 EAs (281 urban, 524 rural) were selected with probability proportional to size within each stratum; after a complete household listing, 28 households per EA were selected by equal-probability systematic sampling, with no replacement of nonrespondents.

Of 22,291 households selected, 21,241 were interviewed (98.8%), and 21,395 of 22,231 eligible women aged 15–49 were interviewed (96.2%). Data were captured on tablets with built-in range, skip and consistency checks; secondary editing was completed on 5 June 2025 [8].

The Children's Recode (KR) file served as the analytic base because breastfeeding initiation is recorded at the level of the individual child; maternal and household characteristics were merged from the Individual and Household Recode files, linked on cluster, household and respondent line number. Variable construction followed the Guide to DHS Statistics [25].

Study population and eligibility

The DHS maternal and newborn health module, including the question on time to first breastfeed, is administered in respect of live births in the 2 years preceding the survey, and the standard early-initiation indicator is accordingly defined on that window [25, 8, 3]. Our eligible population was therefore children born in the 2 years preceding the survey whose mothers were interviewed.

Because including multiple children of the same mother would violate the model's independence assumption, we restricted the analysis to each woman's most recent live birth (birth index BIDX = 1). Children with no valid time to first breastfeed, principally those never breastfed, for whom the question is not applicable, were excluded because delayed initiation is undefined in their case.

Children were also required to link to complete maternal and household records. The selection sequence is shown in Fig. 1.

Note

Flow diagram showing selection from the Children's Recode file of the 2024–25 Ethiopia Demographic and Health Survey to the final analytic sample. DIB = delayed initiation of breastfeeding.

Outcome variable

The outcome was delayed initiation of breastfeeding, derived from the DHS question asking mothers how long after delivery the child was first put to the breast. This item is recorded as a composite code in which the leading digit denotes the unit of time and the remaining digits the quantity, and must therefore be decoded by unit before classification rather than treated as a continuous number [25].

Consistent with WHO and UNICEF guidance and with the prevailing operational definition in the DHS literature [10, 9, 3], breastfeeding begun within 1 hr of birth, including immediately, was classified as early initiation and initiation reported beyond 1 hr as delayed initiation. The variable was coded 0 = early initiation (≤ 1 hr) and 1 = delayed initiation (> 1 hr), with delayed initiation modeled as the event of interest so that odds ratios above unity denote increased risk of the adverse outcome.

All derived health-system variables were validated against the corresponding published national estimates before modeling [8].

Explanatory variables and conceptual framework

Candidate covariates were specified a priori from the determinants literature [15, 19, 18, 16, 10, 12] and organized into four hierarchical domains reflecting an adapted proximate-determinants framework in which distal socioeconomic position acts largely through intermediate access to, and proximate experience of, intrapartum care.

The distal socioeconomic domain comprised household wealth (poor, middle, rich, collapsed from the DHS asset quintiles), maternal and partner's education (none, primary, secondary or higher), maternal employment, mass-media exposure and decision-making autonomy (each low, medium, high), residence, household size, improved sanitation, improved drinking water, cooking fuel, household electricity and sex of household head.

The maternal and reproductive domain comprised maternal age (15–24, 25–34, ≥ 35 years) and parity (primiparous; multiparous, two to four; high parity, five or more).

The child domain comprised child sex, perceived size at birth and age at interview.

The health-system domain comprised number of ANC visits (0, 1–3, 4–7, ≥ 8, reflecting the WHO recommendation of at least eight contacts), place of delivery (health facility vs. home or other), mode of delivery (cesarean vs. noncesarean), skilled birth attendance (following the Ethiopian national definition) and receipt of a postnatal check within 2 days of birth.

Reference categories were the most advantaged or most service-intensive level of each variable so that the direction of association could be read consistently across domains; where this yields an unconventional contrast, results are also reported in the conventional direction in the text.

Statistical analysis

Data were prepared and analyzed in IBM SPSS Statistics (Version 27.0). Every derived variable was cross-tabulated against its source variable to confirm that recoding performed as intended, and weighted distributions were benchmarked against published national estimates before any model was

fitted [8]. Full variable derivation, including the DHS source variable and coding rule for every analytic variable, is provided in Additional file 1: Table S2.

Records missing the outcome were excluded by definition and complete-case analysis was used for covariates; characteristics of children retained in and excluded from the model were compared to assess a missing-at-random assumption (Additional file 1: Table S1). Item-level missingness among retained covariates was low, so multiple imputation was not undertaken.

All analyses accounted for the complex survey design. A design plan was specified in SPSS Complex Samples using the women's sampling weight (v005 divided by 1,000,000), the primary sampling unit (v001) and the sampling stratum (v023, corresponding to the 27 region-by-residence strata).

We computed weighted percentages to describe the sample and unweighted counts to make observed denominators transparent. Bivariate associations were tested using the Pearson chi-square statistic with the second-order Rao–Scott correction for the survey design [26].

Independent determinants were identified using design-based binary logistic regression. Variables associated with the outcome at $p < .10$ bivariately, together with variables judged conceptually essential, were entered into the initial model. Variables were retained if significant at $p < .05$, if their removal changed any other coefficient by 10% or more, or if required on conceptual grounds. Multicollinearity was assessed using variance inflation factors from an auxiliary linear model; all values were below 10 with no tolerance below 0.1 (Additional file 1: Table S3). Two-way interactions, including Place of Delivery × Mode of Delivery, were tested and did not improve fit.

We report crude and adjusted odds ratios (OR, AOR) with 95% confidence intervals and two-tailed p values. Model significance was assessed with the design-based Wald F statistic, explained variation with the Cox and Snell, Nagelkerke and McFadden pseudo-R^2 statistics. Because the sparsest exposure category contained few events, the place-of-delivery estimate was re-estimated using Firth penalized likelihood as a sensitivity analysis (Additional file 1: Table S4). Model-based predicted probabilities were computed to express findings on an absolute scale. Statistical significance was defined as $p < .05$.

Results

Characteristics of the study population

The selection sequence is shown in Fig. 1 and sample characteristics in Table 1. Just over half of mothers were aged 25–34 years (52.6% weighted), with 24.0% aged 15–24 and 23.4% aged 35 or older. Educational attainment was low: 36.9% had no formal education and 39.2% only primary schooling, leaving 24.0% with secondary or higher education, closely matching the national distribution among women with a recent live birth [8]. Weighted household wealth was 39.2% poor, 18.8% middle and 42.0% rich; 69.3% of mothers were not in paid employment and 70.1% lived in rural areas, again consistent with national figures. Half were multiparous (50.0%), 28.9% of high parity and 21.1% primiparous; 54.5% had

attended four or more antenatal care (ANC) visits, against a national estimate of 53.0%. Cesarean birth was reported for 6.5% of children and male children constituted 52.3% of the sample.

Table 1
Characteristics of mothers, children and households in the analytic sample

Variable	Category	Unweighted *n*	Unweighted %	Weighted %
Maternal age	15–24 years	1,402	25.5	24.0
	25–34 years	2,853	52.0	52.6
	≥ 35 years	1,234	22.5	23.4
Maternal education	No education	2,147	39.1	36.9
	Primary	2,044	37.2	39.2
	Secondary or higher	1,298	23.6	24.0
Household wealth	Poor	2,892	52.7	39.2
	Middle	806	14.7	18.8
	Rich	1,791	32.6	42.0
Employment status	Not working	3,978	72.5	69.3
	Working	1,511	27.5	30.7
Parity	Primiparous (1 birth)	1,148	20.9	21.1
	Multiparous (2–4 births)	2,672	48.7	50.0
	High parity (≥ 5 births)	1,669	30.4	28.9
ANC adequacy	< 4 ANC visits	2,799	51.0	45.5
	≥ 4 ANC visits	2,690	49.0	54.5
Place of delivery	Home or other	48	0.9	0.9
	Health facility	5,441	99.1	99.1
Cesarean delivery	No	5,096	92.8	93.5
	Yes	393	7.2	6.5
Postnatal care	No	5,163	95.1	94.1
	Yes	264	4.9	4.7
Child sex	Female	2,670	48.6	47.7

Note. Percentages are column percentages within each variable. Weighted estimates incorporate the DHS sampling weight, primary sampling units, and strata. ANC = antenatal care. Denominators vary across variables owing to item-level missingness.

Variable	Category	Unweighted *n*	Unweighted %	Weighted %
	Male	2,819	51.4	52.3
Residence	Rural	3,898	71.0	70.1
	Urban	1,591	29.0	29.9
Skilled birth attendance	No	4,315	78.6	76.8
	Yes	1,174	21.4	23.2
Mass-media exposure	Low	3,537	64.4	58.2
	Medium	1,283	23.4	27.4
	High	669	12.2	14.4
Household electricity	No electricity	2,165	42.0	35.1
	Has electricity	2,991	58.0	64.9
Initiation of breastfeeding	Early (≤ 1 hr)	4,839	86.8	86.8
	Delayed (> 1 hr)	736	13.2	13.2

Note. Percentages are column percentages within each variable. Weighted estimates incorporate the DHS sampling weight, primary sampling units, and strata. ANC = antenatal care. Denominators vary across variables owing to item-level missingness.

Prevalence and bivariate associations

Delayed initiation was reported for 736 of 5,575 children, a prevalence of 13.2%; conversely, 86.8% were breastfed within the recommended window.

Bivariate associations are presented in Table 2. Delayed initiation varied significantly (all $p \le .016$) by maternal and partner's education, household wealth, parity, place of delivery, cesarean delivery, postnatal care, residence, number of ANC visits, skilled birth attendance, maternal autonomy, mass-media exposure, household size, improved sanitation and cooking fuel; the strongest associations were for number of ANC visits, $\chi^2(19) = 89.14$, cesarean delivery, $\chi^2(1) = 55.27$, and place of delivery, $\chi^2(1) = 53.33$, all $p < .001$.

Maternal age, maternal employment, religion, child sex, sex of household head, improved drinking water and household electricity were not significant. Notably, ANC adequacy dichotomized at four visits was null ($p = .127$) whereas the full visit-count variable was strongly associated, an early indication that the relationship with antenatal contact is not monotonic.

Table 2
Survey-adjusted bivariate associations with delayed breastfeeding initiation

Variable	Category	Early *n*	Delayed *n*	χ^2 (*df*)	*p*
Maternal age	15–24 years	1,158	180	0.38 (2)	.827
	25–34 years	2,554	379		
	≥ 35 years	1,127	176		
Maternal education	No education	1,832	223	21.37 (2)	< .001
	Primary	1,890	294		
	Secondary or higher	1,118	218		
Household wealth	Poor	1,936	251	12.80 (2)	.002
	Middle	915	133		
	Rich	1,989	352		
Employment status	Not working	3,333	532	3.71 (1)	.054
	Working	1,507	203		
Parity	Primiparous (1 birth)	988	190	14.00 (2)	.001
	Multiparous (2–4)	2,460	328		
	High parity (≥ 5)	1,391	218		
Religion	All categories	4,839	737	10.80 (5)	.056
ANC adequacy	< 4 ANC visits	2,182	354	2.33 (1)	.127
	≥ 4 ANC visits	2,657	382		
Number of ANC visits	All categories	4,839	734	89.14 (19)	< .001
Place of delivery	Home or other	26	24	53.33 (1)	< .001
	Health facility	4,814	712		
Cesarean delivery	No	4,572	641	55.27 (1)	< .001
	Yes	268	94		
Postnatal care	No	4,570	679	7.24 (1)	.007
	Yes	213	49		
Skilled birth attendance	No	3,758	522	16.17 (1)	< .001

Note. Pearson chi-square statistics with second-order Rao–Scott correction for the complex survey design. Test statistics are reported once per variable, on the first row. ANC = antenatal care.

Variable	Category	Early *n*	Delayed *n*	χ^2 (*df*)	*p*
	Yes	1,082	214		
Child sex	Female	2,286	374	3.29 (1)	.070
	Male	2,554	362		
Child age (months)	All categories	4,749	713	2.91 (2)	.234
Place of residence	Rural	3,437	472	14.50 (1)	< .001
	Urban	1,402	264		
Maternal autonomy	Low	3,274	460	8.33 (2)	.016
	Medium	738	128		
	High	554	104		
Partner's education	No education	1,411	185	18.71 (2)	< .001
	Primary	1,817	250		
	Secondary or higher	1,318	256		
Mass-media exposure	Low	2,856	391	9.39 (2)	.009
	Medium	1,294	231		
	High	690	113		
Household size	Small (≤ 4)	1,617	273	12.71 (2)	.002
	Medium (5–8)	2,639	354		
	Large (> 8)	364	74		
Sex of household head	Male-headed	3,879	577	1.19 (1)	.275
	Female-headed	742	124		
Improved drinking water	Unimproved	2,533	361	2.72 (1)	.099
	Improved	2,087	340		
Improved sanitation	Unimproved	2,605	346	12.17 (1)	< .001
	Improved	2,015	355		
Cooking fuel	Polluting	4,152	601	10.92 (1)	.001
	Clean	468	100		

Note. Pearson chi-square statistics with second-order Rao–Scott correction for the complex survey design. Test statistics are reported once per variable, on the first row. ANC = antenatal care.

Variable	Category	Early *n*	Delayed *n*	χ^2 (*df*)	*p*
Household electricity	No electricity	1,642	225	3.17 (1)	.075
	Has electricity	2,978	476		

Note. Pearson chi-square statistics with second-order Rao–Scott correction for the complex survey design. Test statistics are reported once per variable, on the first row. ANC = antenatal care.

Factors independently associated with delayed initiation

The fully adjusted model is presented in Table 3. It was significant overall, Wald F(22, 738) = 5.72, p < .001, design df = 738, and explained a modest share of variation, Cox and Snell R^2 = .031, Nagelkerke R^2 = .057, McFadden R^2 = .040, as expected for a behavioral outcome of this prevalence and consistent with much of the remaining variation operating at facility and provider level.

Table 3
Crude and adjusted associations with delayed breastfeeding initiation

Variable	Comparison	OR [95% CI]	*p*	AOR [95% CI]	*p*
Maternal education	No education vs. secondary or higher	0.63 [0.45, 0.86]	.005	0.66 [0.42, 1.06]	.086
	Primary vs. secondary or higher	0.80 [0.58, 1.09]	.153	0.88 [0.59, 1.33]	.544
Household wealth	Poor vs. rich	0.73 [0.54, 1.00]	.047	1.02 [0.64, 1.63]	.931
	Middle vs. rich	0.82 [0.58, 1.16]	.266	1.09 [0.72, 1.65]	.697
Parity	Primiparous vs. high parity	1.23 [0.86, 1.76]	.269	0.98 [0.56, 1.69]	.930
	Multiparous vs. high parity	0.85 [0.65, 1.12]	.250	0.70 [0.49, 1.00]	.050
Place of delivery	Home or other vs. health facility	6.29 [3.13, 12.64]	< .001	6.87 [3.22, 14.69]	< .001
Cesarean delivery	No vs. yes	0.40 [0.27, 0.58]	< .001	0.44 [0.28, 0.70]	< .001
Postnatal care	No vs. yes	0.64 [0.41, 1.01]	.057	0.95 [0.54, 1.65]	.842
Residence	Rural vs. urban	0.73 [0.52, 1.01]	.060	0.87 [0.53, 1.45]	.600
ANC visits	0 vs. ≥ 8 visits	0.80 [0.52, 1.21]	.289	1.30 [0.81, 2.06]	.275
	1–3 vs. ≥ 8 visits	1.17 [0.82, 1.67]	.395	1.70 [1.14, 2.53]	.010
	4–7 vs. ≥ 8 visits	0.82 [0.58, 1.17]	.271	0.99 [0.67, 1.48]	.973
Skilled birth attendance	No vs. yes	0.70 [0.52, 0.96]	.027	0.88 [0.60, 1.30]	.528
Partner's education	No education vs. secondary or higher	0.67 [0.50, 0.91]	.011	0.85 [0.55, 1.32]	.476

Note. N = 4,844. OR = odds ratio; AOR = adjusted odds ratio; CI = confidence interval; ANC = antenatal care. The outcome is delayed initiation of breastfeeding (> 1 hr after birth); early initiation within 1 hr is the reference outcome. Reference categories are secondary or higher education, rich household, high parity (≥ 5 births), health-facility delivery, cesarean delivery, receipt of postnatal care, urban residence, ≥ 8 ANC visits, skilled birth attendance, partner's secondary or higher education, high media exposure, large household (> 8 members), improved sanitation, and clean cooking fuel. Model fit: Wald $F(22, 738) = 5.72$, $p < .001$; Cox and Snell $R^2 = .031$; Nagelkerke $R^2 = .057$; McFadden $R^2 = .040$.

Variable	Comparison	OR [95% CI]	*p*	AOR [95% CI]	*p*
	Primary vs. secondary or higher	0.71 [0.52, 0.97]	.032	0.75 [0.50, 1.11]	.149
Mass-media exposure	Low vs. high	0.83 [0.55, 1.27]	.402	0.93 [0.59, 1.47]	.761
	Medium vs. high	1.09 [0.69, 1.73]	.718	1.03 [0.64, 1.65]	.914
Household size	Small vs. large	0.83 [0.56, 1.24]	.367	0.82 [0.46, 1.47]	.512
	Medium vs. large	0.66 [0.45, 0.96]	.032	0.70 [0.44, 1.10]	.124
Sanitation facility	Unimproved vs. improved	0.75 [0.59, 0.96]	.024	0.91 [0.67, 1.25]	.568
Cooking fuel	Polluting vs. clean	0.68 [0.47, 0.97]	.034	1.01 [0.62, 1.64]	.972

Note. N = 4,844. OR = odds ratio; AOR = adjusted odds ratio; CI = confidence interval; ANC = antenatal care. The outcome is delayed initiation of breastfeeding (> 1 hr after birth); early initiation within 1 hr is the reference outcome. Reference categories are secondary or higher education, rich household, high parity (≥ 5 births), health-facility delivery, cesarean delivery, receipt of postnatal care, urban residence, ≥ 8 ANC visits, skilled birth attendance, partner's secondary or higher education, high media exposure, large household (> 8 members), improved sanitation, and clean cooking fuel. Model fit: Wald $F(22, 738) = 5.72$, $p < .001$; Cox and Snell $R^2 = .031$; Nagelkerke $R^2 = .057$; McFadden $R^2 = .040$.

Place of delivery was the strongest independent determinant: Children born outside a health facility had nearly 7 times the adjusted odds of delayed initiation compared with children born in a facility, AOR = 6.87, 95% CI [3.22, 14.69], $p < .001$, an association that strengthened rather than attenuated on adjustment, OR = 6.29, 95% CI [3.13, 12.64].

Mode of delivery was the second strongest: Noncesarean birth was associated with less than half the odds of delay relative to cesarean birth, AOR = 0.44, 95% CI [0.28, 0.70], $p < .001$; expressed conventionally, cesarean birth carried 2.27 times the adjusted odds of delayed initiation, 95% CI [1.43, 3.57].

The antenatal care gradient was nonmonotonic. Relative to women attending eight or more visits, those attending one to three had significantly higher adjusted odds of delay, AOR = 1.70, 95% CI [1.14, 2.53], $p = .010$, whereas those attending four to seven were indistinguishable from the reference group, AOR = 0.99, 95% CI [0.67, 1.48], $p = .973$, and those attending none did not differ significantly, AOR = 1.30, 95% CI [0.81, 2.06], $p = .275$.

Parity retained a borderline association: Multiparous women had lower adjusted odds of delay than women of high parity, AOR = 0.70, 95% CI [0.49, 1.00], $p = .050$, whereas primiparous women did not

differ, AOR = 0.98, 95% CI [0.56, 1.69], p = .930.

By contrast, every socioeconomic and household variable significant in bivariate analysis lost significance after adjustment. Maternal education, household wealth, partner's education, skilled birth attendance, household size, improved sanitation, cooking fuel, residence, postnatal care and mass-media exposure were all attenuated to the null; crude and adjusted estimates for each are reported in Table 3. Figure 3 displays the estimates that retained significance.

Note

Forest plot of adjusted odds ratios with 95% confidence intervals. The vertical reference line denotes an odds ratio of 1.0; the horizontal axis is plotted on a logarithmic scale.

Model-based predicted probabilities

Predicted probabilities were computed from the fitted model (Figs. 2 and 4). Holding all other covariates at the reference configuration, the predicted probability of delay rose from 42.9% for a facility birth to 83.8% for a birth outside a facility. Removing cesarean birth from the same configuration reduced it to 24.9%, and reducing antenatal contact from eight or more visits to one to three raised it to 56.1%. Because the reference configuration combines the least favorable level of several covariates, these probabilities exceed the observed national prevalence and should be read as contrasts rather than population estimates.

Note

Predicted probabilities by place of delivery, mode of delivery, and antenatal care intensity, estimated from the design-based logistic regression at a fixed reference covariate profile. Because the reference profile combines the least favorable level of several covariates, absolute probabilities exceed the national prevalence and should be read as contrasts rather than population estimates.

Note

Probabilities are model-based contrasts at the reference covariate profile, not representative estimates of the national population. Values are reproduced from the Results section (42.9%, 24.9% and 83.8%).

Discussion

Principal findings

The most striking feature of the adjusted model is not which variables were significant but which were not. Maternal education, household wealth, partner's education, residence, sanitation, cooking fuel, household size and skilled birth attendance were all associated with delayed initiation bivariately, and all lost significance once the circumstances of birth were included. What survived were three health-system

variables, namely where the birth took place, how it took place and how much antenatal contact preceded it, together with a borderline parity effect.

This pattern is consistent with the proximate-determinants logic specified a priori. Distal socioeconomic position shapes whether and where a woman gives birth; the birth itself then determines whether the first hour is protected. In a country where institutional delivery rose from 37% to 61% within a single intersurvey interval [8], socioeconomic disadvantage no longer acts on breastfeeding initiation principally through exclusion from care but through the kind of care received. This reframes the policy problem from one of reaching disadvantaged women to one of what happens to all women once they arrive.

The institutionalization paradox, quantified

The central contribution of this analysis is to locate Ethiopia precisely within a pattern previously documented only across countries. World Health Organization and UNICEF [9] reported that across 58 countries, facility delivery coverage grew three times faster than early initiation coverage. Ethiopia now shows the same divergence within a single intersurvey interval: Skilled birth attendance rose 27 percentage points and institutional delivery 24, while early initiation rose fewer than 3 [8, 14].

This divergence is not a paradox if the causal role of facility birth is understood correctly. Facility birth removes some barriers and introduces others: routine mother–infant separation, prelacteal supplementation and obstetric intervention. Analyses from Indonesia and Cambodia have found that its protective effect is contingent on household circumstances and on the quality of the facility rather than being uniform [27, 28]. Our finding that birth outside a facility carries nearly 7 times the adjusted odds of delay should therefore be read alongside the observation that delayed initiation is far from eliminated among facility births. Coverage of the place of birth has been solved in Ethiopia; the content of care at that place has not.

Two cautions apply to the place-of-delivery estimate. Because non-facility births are now a minority, it rests on few exposed observations, reflected in the width of the confidence interval; the direction of the association is secure but its magnitude is not. Firth penalized estimation returned a substantially smaller but still significant estimate, AOR = 2.31, 95% CI [1.14, 4.46], p = .022 (Additional file 1: Table S4), indicating that the primary estimate is inflated by sparse-data bias and that the penalized value should be read as the more conservative bound. The contrast is also between a shrinking, increasingly selected group of home births and a growing majority of facility births, so the population impact is smaller than the odds ratio suggests, which is relevant when setting priorities.

Cesarean birth as a growing and preventable cause

Cesarean birth more than doubled the adjusted odds of delayed initiation, aligning with an unusually consistent body of evidence: the WHO Global Survey across 24 countries [12], the 58-country analysis, which found the association in almost every country examined [10], the Ghana Multiple Indicator Cluster

Survey, reporting 74% lower odds of timely initiation after cesarean birth [29], and the Ethiopian meta-analysis of 17 studies, estimating 79% lower odds [19].

The mechanisms are procedural rather than physiological: Anesthesia, recovery protocols that separate mother and infant, delayed maternal mobility and theater routines that do not accommodate skin-to-skin contact all displace the first feed. None of these is inevitable. Skin-to-skin contact in theater and recovery is feasible under regional anesthesia, and the revised Baby-Friendly Hospital Initiative explicitly requires that mothers be supported to initiate breastfeeding as soon as possible after birth irrespective of mode of delivery [9]. Because cesarean rates are projected to keep rising globally [13] and Ethiopia's facility-birth expansion will mechanically increase their absolute number, the absence of cesarean-specific protocols is a growing and entirely preventable source of delayed initiation, and in our view the single most tractable target identified here.

Antenatal contact: Counting visits versus auditing content

The antenatal care finding is the most theoretically interesting result in the model and is easy to misread. Women attending one to three visits had significantly higher adjusted odds of delay than women attending eight or more, yet women attending four to seven visits did not differ from the reference group, and women attending no visits at all were not significantly different either. A simple dose–response interpretation is untenable, and the dichotomous ANC adequacy indicator was correspondingly null in bivariate analysis.

Two explanations merit consideration. First, visit count is a poor proxy for counseling content. Ethiopian meta-analytic evidence identifies regular antenatal care as a contributor to early initiation [18, 16], but what plausibly protects the first hour is whether breastfeeding was discussed, demonstrated and planned for, not how often the woman attended. Nationally, 78.1% of women received antenatal care from a skilled provider but only 53.0% completed four or more visits [8]; this large group entering care without completing it may be less likely to have received structured infant-feeding counseling. Second, women with no visits differ from attenders in ways adjustment cannot fully capture, and the estimate for this small group is imprecise.

The practical implication is actionable: Increasing antenatal contacts without standardizing their infant-feeding content should not improve early initiation. Breastfeeding counseling must be a defined, auditable element of every contact, with attention to women whose attendance is partial.

Why the socioeconomic gradients disappear

Multiparous women had lower adjusted odds of delay than women of high parity, with primiparous women intermediate. Prior maternal experience plausibly facilitates positioning and attachment in the first hour, whereas very high parity may co-occur with shorter birth intervals and heavier domestic workload; the association was of borderline significance and should be regarded as hypothesis generating.

The disappearance of every socioeconomic association after adjustment deserves emphasis because it is frequently obscured when crude and adjusted estimates are reported without comment. Studies reporting only bivariate or partially adjusted models may reasonably conclude that breastfeeding initiation is primarily a socioeconomic phenomenon [15, 19, 16]. Our findings indicate that in contemporary Ethiopia these gradients are largely mediated: They determine access to, and type of, delivery care, which in turn determines the timing of the first feed. The national data are consistent with this reading, with institutional delivery ranging from 26.7% in the lowest wealth quintile to 94.5% in the highest [8].

Two caveats apply: Mediation was inferred from attenuation of coefficients rather than estimated formally, and attenuation is also compatible with confounding by the adjusted variables. Nevertheless, the consistency of the pattern across eight distinct socioeconomic indicators, all attenuating in the same direction, is difficult to attribute to chance.

Implications for policy and programmes

Three implications follow. First, intrapartum care is the highest-yield intervention point. Full implementation of the revised Baby-Friendly Hospital Initiative Ten Steps in all facilities conducting deliveries, comprising immediate skin-to-skin contact, support for initiation within the first hour, rooming-in and no non-medically-indicated supplementation, addresses the mechanisms most strongly implicated by our model [9]. Ethiopia's facility-birth expansion has created the precondition for this to reach the majority of births for the first time.

Second, cesarean births require a specific protocol rather than an exemption: Theater and recovery procedures should be redesigned so that skin-to-skin contact and the first feed occur as standard practice, with a named staff member accountable.

Third, antenatal care should be audited on infant-feeding counseling content rather than visit volume. Because 78.1% of women enter antenatal care but only 53.0% complete four or more visits [8], the first contact is the one nearly all women receive and should carry a mandatory infant-feeding counseling component.

Community-level provision retains a role for births still occurring outside facilities, where the Health Extension Programme can deliver counseling on immediate initiation and avoidance of prelacteal feeds [20], but the marginal gain now lies inside the health system.

Strengths and limitations

The principal strengths of this study are the use of the most recent nationally representative data for Ethiopia, internationally comparable measurement, restriction to one child per mother to preserve independence of observations, benchmarking of every derived health-system variable against published national estimates before modeling, and consistent design-based inference throughout. Many published analyses apply weights but not the full design specification, which understates standard errors.

Several limitations qualify the findings. The cross-sectional design permits only associational inference, and no causal claim is made. Time to first breastfeed is maternally reported and subject to recall error and social-desirability bias, both of which would bias the prevalence of delayed initiation downward. Restriction to the most recent birth means the sample is not representative of all births in the eligibility window and is weighted toward lower-parity women. The DHS does not capture several variables of established importance, in particular skin-to-skin contact, prelacteal feeding, breastfeeding counseling received, obstetric indication for cesarean and facility accreditation status, so residual confounding cannot be excluded and the mechanisms proposed above are inferred rather than measured. The small number of non-facility births yields an imprecise estimate for the strongest association, which is why a penalized-likelihood sensitivity analysis is reported. The modest pseudo-R^2 values indicate that most variation is attributable to factors not captured here; a multilevel specification quantifying cluster-level variance would be a valuable extension. Finally, children never breastfed were excluded, so findings apply to ever-breastfed children.

Conclusions

Ethiopia has moved the majority of its births into health facilities within a single decade without materially changing what happens in the first hour after those births. After full adjustment, the determinants of delayed breastfeeding initiation were not the mother's education, wealth or residence but the circumstances of her delivery: whether she gave birth in a facility, whether that birth was by cesarean section and how much antenatal contact preceded it. The remaining burden of delayed initiation has migrated into the health system. Protecting the first hour will therefore depend less on further socioeconomic targeting than on what happens in the delivery room and the operating theater: universal implementation of the Baby-Friendly Hospital Initiative Ten Steps, cesarean-specific skin-to-skin and initiation protocols, and antenatal care audited on the infant-feeding counseling it actually delivers.

Abbreviations

ANC, antenatal care; AOR, adjusted odds ratio; CI, confidence interval; DHS, Demographic and Health Surveys; EDHS, Ethiopia Demographic and Health Survey; KR, Children’s Recode; OR, odds ratio; PSU, primary sampling unit; STROBE, Strengthening the Reporting of Observational Studies in Epidemiology; WHO, World Health Organization.

Declarations

Ethics approval and consent to participate

The 2024–25 EDHS protocol was approved by the Institutional Review Boards of the Ethiopian Public Health Institute and ICF, and informed consent was obtained from each respondent, with parental or guardian consent for minors. This study is a secondary analysis of anonymized DHS data, with no direct

personal identifiers. The authors state that no further ethics approval was required. Access permission was obtained through The DHS Program; individual-level data were not redistributed.

Consent for publication

Not applicable. This study reports aggregated results from anonymized survey data and contains no identifiable individual information.

Availability of data and materials

The dataset supporting this study is available through The DHS Program (https://dhsprogram.com/data/) after registration and approval of a data request. The authors do not have permission to redistribute the dataset. Analysis syntax is available from the corresponding author on reasonable request.

Clinical trial number: not applicable.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

Fazle Rabby conceptualized the study, developed the methodology, curated and analyzed the data, interpreted the results, prepared visualizations and drafted the manuscript. Dr. Md. Ripul Kabir supervised the study, provided scientific guidance and project administration, and critically reviewed and edited the manuscript. Nayim Hasan contributed to methodology, validation of the analytical procedures, literature review, interpretation and review and editing. All authors interpreted the findings, critically revised the work, approved the final manuscript and agree to be accountable for the work.

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Figures

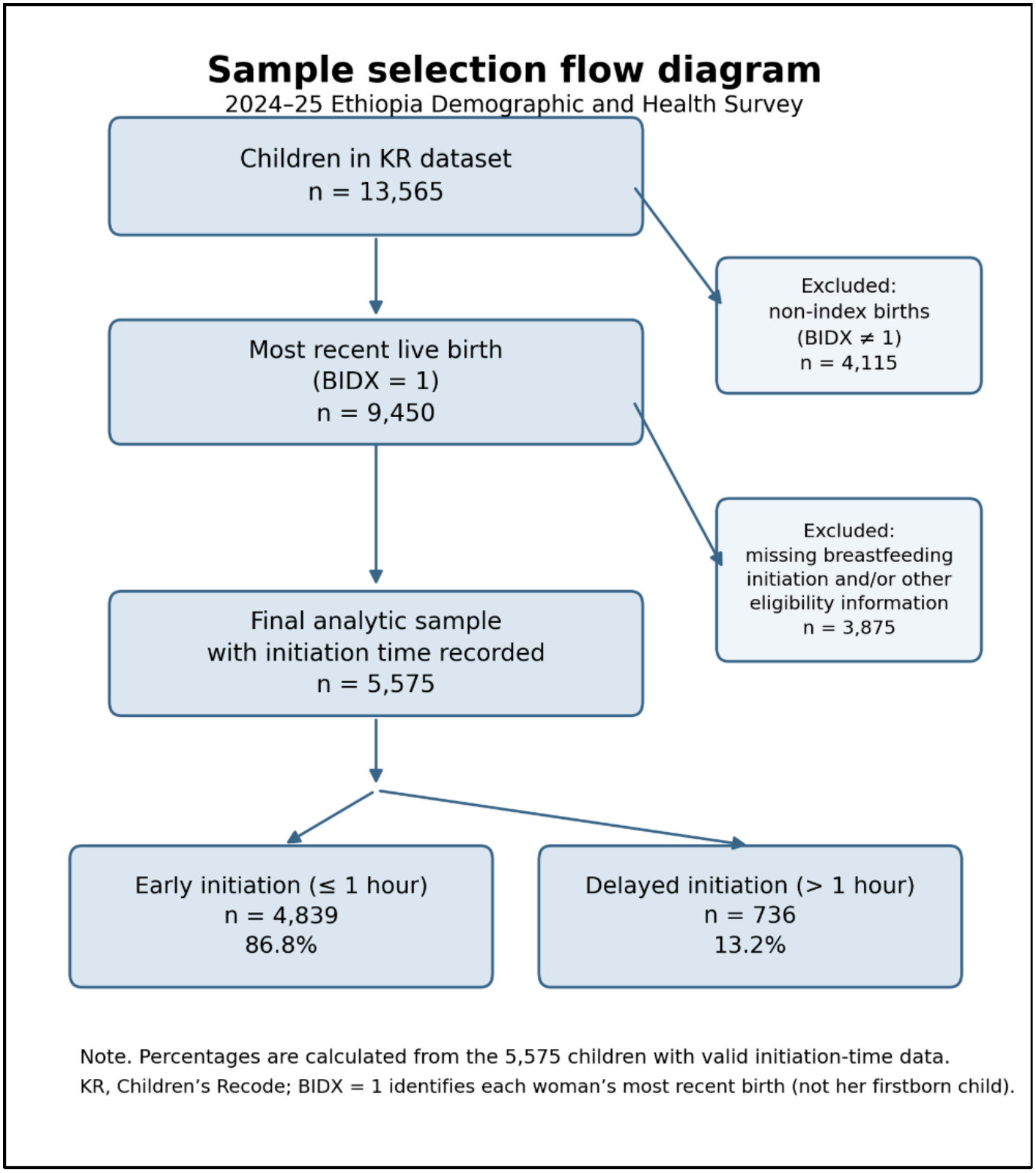


Figure 1

Selection of the analytic sample

Note. Flow diagram showing selection from the Children's Recode file of the 2024–25 Ethiopia Demographic and Health Survey to the final analytic sample. DIB = delayed initiation of breastfeeding.

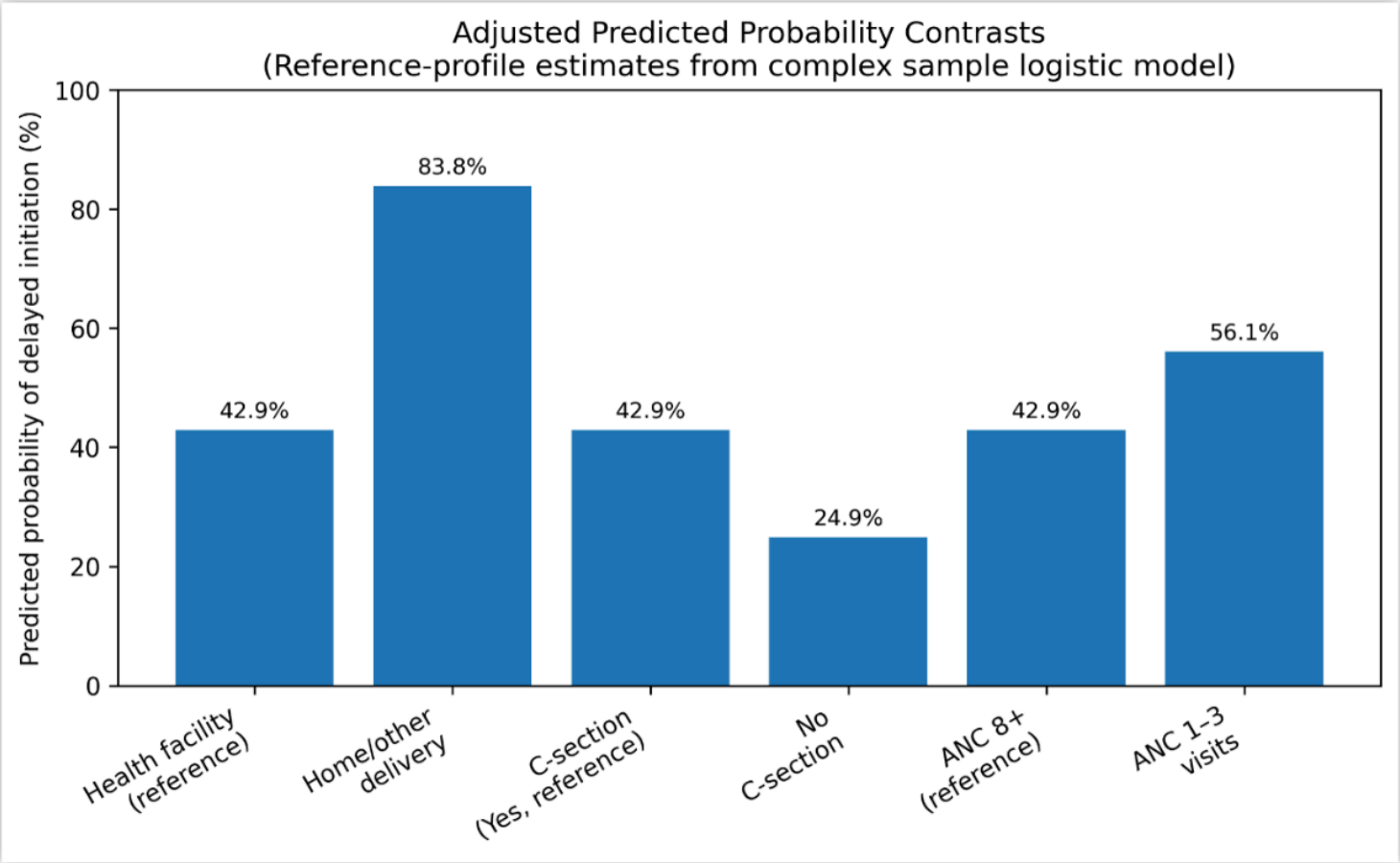


Figure 2

Predicted probabilities of delayed breastfeeding initiation

Note. Predicted probabilities by place of delivery, mode of delivery, and antenatal care intensity, estimated from the design-based logistic regression at a fixed reference covariate profile. Because the reference profile combines the least favorable level of several covariates, absolute probabilities exceed the national prevalence and should be read as contrasts rather than population estimates.

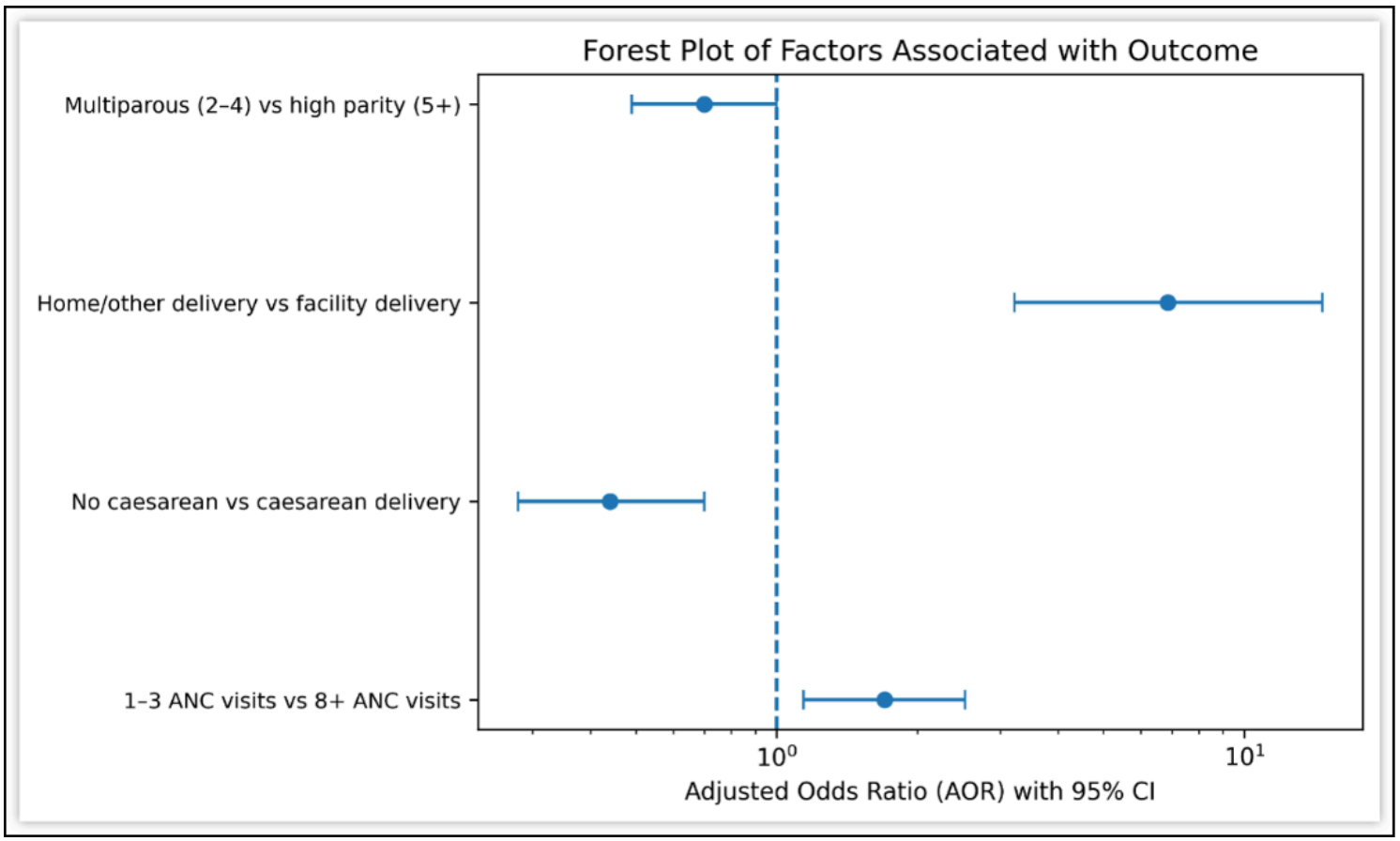


Figure 3

Adjusted odds ratios for statistically significant covariates

Note. Forest plot of adjusted odds ratios with 95% confidence intervals. The vertical reference line denotes an odds ratio of 1.0; the horizontal axis is plotted on a logarithmic scale.

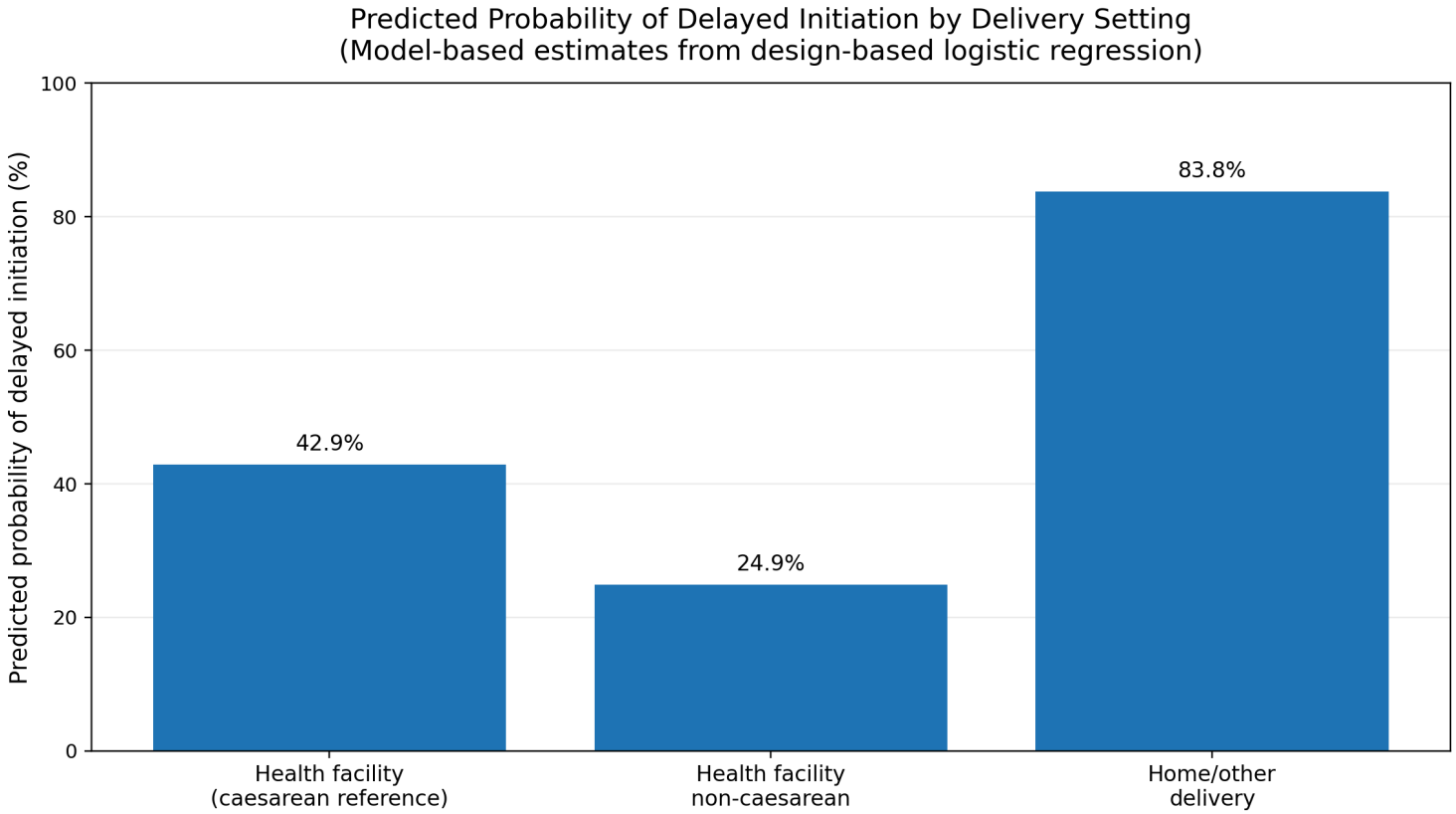


Figure 4

Predicted probability of delayed initiation by delivery setting

Note. Probabilities are model-based contrasts at the reference covariate profile, not representative estimates of the national population. Values are reproduced from the Results section (42.9%, 24.9% and 83.8%).

Supplementary Files

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