

Does extending the duration of legislated paid maternity leave improve breastfeeding practices? Evidence from 38 low-income and middle-income countries

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ABSTRACT

Introduction Among all barriers to breastfeeding, the need to work has been cited as one of the top reasons for not breastfeeding overall and for early weaning among mothers who seek to breastfeed. We aimed to examine whether extending the duration of paid maternity leave available to new mothers affected early initiation of breastfeeding, exclusive breastfeeding under 6 months and breastfeeding duration in low-income and middle-income countries (LMICs).

Methods We merged longitudinal data measuring national maternity leave policies with information on breastfeeding related to 992 419 live births occurring between 1996 and 2014 in 38 LMICs that participated in the Demographic and Health Surveys. We used a difference-in-differences approach to compare changes in the prevalence of early initiation and exclusive breastfeeding, as well as the duration of breastfeeding, among treated countries that lengthened their paid maternity leave policy between 1995 and 2013 versus control countries that did not. Regression models included country and year fixed effects, as well as measured individual-level, household-level and country-level covariates. All models incorporated robust SEs and respondent-level sampling weights.

Results A 1-month increase in the legislated duration of paid maternity leave was associated with a 7.4 percentage point increase (95% CI 3.2 to 11.7) in the prevalence of early initiation of breastfeeding, a 5.9 percentage point increase (95% CI 2.0 to 9.8) in the prevalence of exclusive breastfeeding and a 2.2-month increase (95% CI 1.1 to 3.4) in breastfeeding duration.

Conclusion Extending the duration of legislated paid maternity leave appears to promote breastfeeding practices in LMICs. Our findings suggest a potential mechanism to reduce barriers to breastfeeding for working mothers.

INTRODUCTION

The benefits of breastfeeding on children's survival, health and development are well established in high-income, middle-income and low-income countries.^{1 2} Rates of diarrhoea, respiratory tract infections and other infections are lower among breastfed infants than

Key questions

What is already known?

► Studies have found that more generous paid maternity leave increases the prevalence of exclusive breastfeeding and the duration of breastfeeding in high-income countries. However, whether those findings were generalisable to low-income and middle-income countries (LMICs) remained unclear.

What are the new findings?

► To our knowledge, this is the first study to quantitatively examine the impact of paid maternity leave policy on breastfeeding practices in LMICs.
► Using nationally representative samples from 38 countries, including seven countries that increased the duration of paid maternity leave available, we found evidence suggesting that more generous paid maternity leave policies positively impact early initiation of breastfeeding, exclusive breastfeeding under 6 months and breastfeeding duration.

What do the new findings imply?

► As the proportion of women engaged in the wage and salary labour force in LMICs continues to increase, public policies that support women's ability to work while caring for their family, such as paid maternity leave, have the potential to facilitate health-promoting behaviours such as breastfeeding among working women.

non-breastfed infants, as well as among exclusively breastfed infants than partially breastfed infants during the first 6 months.²⁻⁶ These benefits, provided through stronger immunity, lower exposure to pathogens and better nutrition, make breastfeeding one of the most effective interventions for reducing child mortality. Early initiation of breastfeeding, specifically within 1 hour of birth, reduces risk of neonatal mortality by 50%.^{7 8} A systematic review in 2017 showed that, compared with infants who initiated breastfeeding within 1 hour of birth, infants who initiated breastfeeding 2-23 hours after birth had a 33% greater risk of neonatal

mortality, and infants who initiated breastfeeding 24 hours after birth had a twofold greater risk of neonatal mortality.⁹ Data from 2015 suggest that an estimated 823 000 annual deaths of children under 2 years of age could be prevented in 75 high-mortality low-income and middle-income countries (LMICs) if breastfeeding was scaled up to near-universal levels.¹ Breastfeeding also provides health benefits over the life course,¹⁰ as it is associated with improved neurocognitive development^{11–15} and reduced risk of adulthood obesity and diabetes.^{16–18} In addition, breastfeeding benefits mothers. Women who breastfeed have a reduced risk of breast cancer before menopause, ovarian cancer, osteoporosis, coronary heart disease and diabetes, as well as improved birth spacing.^{19–26}

Given the benefits of breastfeeding, the WHO and Unicef recommend early initiation of breastfeeding within 1 hour of birth, exclusive breastfeeding for the first 6 months and continued breastfeeding up to 2 years of age or beyond with complementary foods.²⁷ However, in LMICs, the prevalence of early initiation of breastfeeding remains low, ranging from 41% in South Asia to 45% in Sub-Saharan Africa,²⁸ and only 37% of children under 6 months (ie, 0–6 months) are exclusively breastfed.¹ The prevalence of breastfeeding at 12 months varies across LMICs, ranging from 31% to 99%.¹ These numbers have been declining as work in the formal economy increases.²⁹

When considering interventions to improve breastfeeding practices, many studies have reported that women who return to work after childbirth are less likely to initiate or maintain breastfeeding.^{30–35} The most often-cited reasons for early weaning among mothers who seek to breastfeed are early return to work and the conditions women experience after returning to work, instead of the quantity and quality of breast milk or interest in breastfeeding.^{36–39} Given the increasing proportion of women in the workforce in the past several decades, the importance of social policies for promoting a healthy balance between work and family roles, in general, and for making exclusive and continued breastfeeding more feasible for new mothers, in particular, has been highlighted.⁴⁰ With respect to paid maternity leave policy, a review of laws in place as of April 2015 showed that only half of all LMICs provided paid maternity leave of at least 14 weeks⁴¹ and 6% of low-income countries and 22% of middle-income countries provided paid maternity leave of at least 26 weeks.⁴¹

The impacts of maternity leave policy on breastfeeding practice have been studied in high-income countries.^{42–47} A new parental leave benefit was introduced in Germany in 2007, which replaced a means-tested child-rearing benefit with a parental leave benefit providing 67%–100% of prebirth net income, increased the number of eligible parents and reduced the maximum benefit period from 2 years to 1 year. According to a longitudinal study, Germany's 2007 parental leave reform increased breastfeeding at 4 months and at 6 months by 9.2 and 7.9 percentage points, respectively.⁴² Another study showed a 10–20 percentage point increase in breastfeeding for at least 6 months and a 3–5 percentage point increase in exclusive breastfeeding

for at least 6 months after California became the first state to offer paid family leave.⁴³ However, the impacts of maternity leave policies on breastfeeding practices in LMICs have not been evaluated, in part due to limited comparative maternity leave policy data. In this study, we provide the first evaluation, to our knowledge, of whether paid maternity leave policy affects the early initiation of breastfeeding, exclusive breastfeeding under 6 months and breastfeeding duration in LMICs.

METHODS

We linked quantitative data on national maternity leave policies developed by McGill University's Policy-Relevant Observational Studies for Population Health Equity and Responsible Development (PROSPERED) project⁴⁸ and University of California Los Angeles' WORLD Policy Analysis Center to breastfeeding information collected through Demographic and Health Surveys (DHS) conducted between 2000 and 2015 for 38 LMICs. We assessed the tenability of the parallel trends assumption and employed a difference-in-differences approach to examine the effects of extending the legislated duration of maternity leave on the prevalence of early initiation of breastfeeding and exclusive breastfeeding under 6 months, as well as the duration of breastfeeding in LMICs.

Data sources

Longitudinal data measuring current maternity leave policies for each selected country were made available by the University of California Los Angeles' WORLD Policy Analysis Center and then collected retrospectively to 1995 by McGill University's PROSPERED project. Further details regarding the collection and coding of global maternity leave policies are available elsewhere.⁴⁹

Information on breastfeeding and other covariates were obtained from the DHS. These surveys use a two-stage cluster sampling design to obtain a range of detailed health-related and demographic information, focusing on maternal and child health. Trained interviewers use structured questionnaires to interview eligible individuals from a nationally representative sample of households in LMICs. Standardised measurement techniques are used to ensure the comparability of surveys across countries and survey waves. Further details regarding the sampling and survey techniques are available elsewhere.^{50 51}

Sample

Our sample comprised 1 000 753 children under 5 years of age at the time of interview from 111 DHS across 38 LMICs. These 38 countries were selected based on the availability of at least two DHS administered between 2000 and 2015, which allowed for the utilisation of the difference-in-differences approach for comparing trends in breastfeeding outcomes within countries. Because paid maternity leave policy information was available from 1995 to 2013 (inclusive), a restriction on children's birth year was applied, leaving 992 419 children born between 1996 and 2014 (inclusive) in the sample (a 1-year lag was used to

respect temporality between exposure and outcome). After further excluding observations with missing and/or inconsistent breastfeeding information flagged by DHS, 401 067 children born in the last 24 months, 86 565 infants 0–5 months of age and 750 118 children younger than five were included in the analyses of early initiation of breastfeeding, exclusive breastfeeding under 6 months and breastfeeding duration, respectively (table 1).

Measures

Outcome variable

We used WHO's definitions for two of our outcome variables²²: early initiation of breastfeeding, defined as the proportion of children born in the past 24 months who were put to the breast within an hour of birth, and exclusive breastfeeding under 6 months, defined as the proportion of infants 0–5 months of age who were fed exclusively with breast milk during the previous day. Our third outcome variable was breastfeeding duration in months. At the time of interview, mothers were asked to provide breastfeeding information for all living children she gave birth to in the last 5 years. If a child was ever breastfed after birth, the interviewer recorded the time the child was first put to the breast, any food the child was given to eat during the previous day and the number of months the child was breastfed for. If the child was still being breastfed at the time of interview, the interval between the child's date of birth and the date of interview was used as the breastfeeding duration.

Exposure variables

The exposure of interest in our study was the legislated length of paid maternity leave, in weeks or full-time equivalence (FTE) weeks, for each sampled country between 1995 and 2013. We first recorded the legislated length of paid leave available to mothers only. We then calculated the FTE weeks of paid leave by multiplying the legislated length of leave by the wage replacement rate. To ensure temporality between exposure and outcome, as well as reduce exposure misclassification, each observation was assigned the legislated length of paid maternity leave 1 year prior to the birth year. We did not distinguish between leave that could be taken before or after birth.

Control variables

Based on the literature review,^{52–55} we identified potential confounders and other determinants of breastfeeding practices in LMICs. Individual-level characteristics included the mother's sociodemographic characteristics (eg, age at childbirth, number of living children, education level, working status in the last 12 months, marital status) and birth order and sex of the child. Household-level characteristics included the number of listed household members, household wealth index and place of residence (eg, urban or rural). We obtained information on these variables from the DHS. In addition, potential country-level confounders, which may influence paid maternity leave policy reforms and be associated with breastfeeding practices, were

extracted from the World Bank's World Development Indicators and Global Development Finance databases.⁵⁶ These variables included gross domestic product per capita based on purchasing power parity, female labour force participation among women aged 15–64, unemployment as a per cent of the female labour force and government health expenditures per capita based on purchasing power parity. Information on workplace support for breastfeeding, specifically the age of the infant (months) until which the mother is guaranteed breastfeeding breaks at work, was obtained from McGill University's PROSPERED project and the University of California Los Angeles' WORLD Policy Analysis Center.

Statistical analysis

Examination of the parallel trends assumption

We examined the parallel trends assumption by comparing the prevalence of early initiation of breastfeeding, the prevalence of exclusive breastfeeding under 6 months and the average duration of breastfeeding among treated and control groups before 2000—the first year any of the treated countries adopted a policy change. First, we plotted each breastfeeding outcome for all treated countries against all control countries among children born between 1996 and 2001. Second, we used a linear regression model with an interaction between treatment status and birth year to assess potential departures from additivity (non-parallel trends on the additive scale) for breastfeeding outcomes among treated and control groups between 1996 and 2001.

Effect of paid maternity leave policy

Our difference-in-differences approach used the following fixed effects regression models to estimate the effect of a 1-month increase in paid maternity leave policy on the average breastfeeding duration in months and the probabilities of early initiation of breastfeeding and exclusive breastfeeding:

$$g(E[Y_{ijt}|M_{jt-1}]) = \beta_0 + \beta_1 * M_{jt-1} + \lambda_j + \delta_t + \varepsilon_{ijt} \quad [1]$$

$$g(E[Y_{ijt}|M_{jt-1}]) = \beta_0 + \beta_1 * M_{jt-1} + \sum \beta_n * Z_{ijt} + \lambda_j + \delta_t + \varepsilon_{ijt} \quad [2]$$

$$g(E[Y_{ijt}|M_{jt-1}]) = \beta_0 + \beta_1 * M_{jt-1} + \sum \beta_n * Z_{ijt} + \sum \beta_k * C_{jt-1} + \lambda_j + \delta_t + \varepsilon_{ijt} \quad [3]$$

Linear regression was used to model breastfeeding duration, and logistic regression was used for the early initiation of breastfeeding and exclusive breastfeeding outcomes. Marginal effects at the means were calculated from logistic regression models to present estimates on the additive scale as prevalence differences.

In all the three models, Y_{ijt} represents the breastfeeding outcome for child i born in country j and in year t , and M_{jt-1} is the calculated months of paid maternity leave in country j 1 year before the child's birth ($t-1$). In the first model, we included fixed effects for country (λ_j) and year (δ_t) to control for, respectively, unobserved time-invariant confounders that vary across countries and any temporal trends in breastfeeding outcomes shared across countries.

Table 1 Sample description by breastfeeding outcome**(a) Early initiation of breastfeeding (within first hour of birth) among children born in the last 24 months (N=401 067)**

Country	DHS survey years	Birth years available (Min, Max)	Sample size	Average proportion of children born in the last 24 months who were put to the breast within 1 hour of birth*
Bangladesh	2004, 2007, 2011, 2014	2002, 2014	11 316	42.59%
Kenya	2003, 2008, 2014	2001, 2014	8540	59.27%
Lesotho	2004, 2009, 2014	2002, 2014	4361	61.10%
Malawi	2000, 2004, 2010	1998, 2010	17 153	77.92%
Uganda	2000, 2006, 2011	1998, 2011	9004	40.96%
Zambia	2001, 2007, 2013	1999, 2014	10 290	59.46%
Zimbabwe	2005, 2010, 2015	2003, 2015	6795	67.54%
All treated countries†			67 459	60.54% (SD=0.07)
Armenia	2000, 2005, 2010	1998, 2010	1776	30.69%
Benin	2001, 2006, 2011	1999, 2012	13 490	54.61%
Bolivia	2003, 2008	2001, 2008	7170	64.27%
Burkina Faso	2003, 2010	2001, 2010	9892	38.24%
Cameroon	2004, 2011	2002, 2011	7741	35.56%
Chad	2004, 2014	2002, 2015	8362	28.35%
Colombia	2000, 2005, 2010	1998, 2010	14 402	61.88%
Congo	2005, 2011	2003, 2012	5698	30.48%
Democratic Republic of Congo	2007, 2013	2005, 2014	10 576	51.56%
Dominican Republic	2002, 2007, 2013	2000, 2013	9616	60.38%
Egypt	2000, 2005, 2008, 2014	1998, 2014	20 509	45.30%
Ethiopia	2000, 2005, 2011	1998, 2011	11 770	57.14%
Gabon	2000, 2012	1998, 2012	4080	53.14%
Ghana‡	2003, 2008, 2014	2001, 2014	5091	52.32%
Guinea	2005, 2012	2003, 2012	5326	27.99%
Haiti	2000, 2005, 2012	1998, 2012	7790	46.97%
Honduras	2005, 2011	2003, 2012	8607	72.52%
Indonesia	2002, 2007, 2012	2000, 2012	20 471	41.58%
Jordan	2002, 2007, 2012	2000, 2012	9754	32.06%
Liberia	2007, 2013	2004, 2013	5093	59.86%
Madagascar	2003, 2008	2001, 2009	6891	64.69%
Mali	2001, 2006, 2012	1999, 2013	14 404	47.60%
Mozambique	2003, 2011	2001, 2011	8511	74.81%
Nepal	2001, 2006, 2011	1999, 2012	6698	35.39%
Niger	2006, 2012	2004, 2012	8475	50.60%
Nigeria	2003, 2008, 2013	2001, 2013	25 078	34.81%
Peru	2000, 2004, 2007, 2009, 2010, 2011, 2012	1998, 2012	34 044	50.19%
Philippines	2003, 2008, 2013	2001, 2013	7551	53.12%
Senegal	2005, 2010, 2012, 2014, 2015	2003, 2015	17 504	35.05%
Sierra Leone	2008, 2013	2006, 2013	6592	54.12%
Tanzania	2004, 2010, 2015	2002, 2016	10 646	48.08%
All control countries§			333 608	48.32% (SD=0.02)

(b) Exclusive breastfeeding up to 6 months among infants 0–5 months of age (N=86 565)

Country	DHS survey years	Birth years available (Min, Max)	Sample Size	Average proportion of infants 0–5 months of age who are fed exclusively with breast milk during the previous day*
Bangladesh	2004, 2007, 2011, 2014	2003, 2014	2618	82.21%
Kenya	2003, 2008, 2014	2002, 2014	2035	67.01%

Continued

Table 1 Continued

(b) Exclusive breastfeeding up to 6 months among infants 0–5 months of age (N=86 565)

Country	DHS survey years	Birth years available (Min, Max)	Sample Size	Average proportion of infants 0–5 months of age who are fed exclusively with breast milk during the previous day*
Lesotho	2004, 2009, 2014	2004, 2014	1156	89.72%
Malawi	2000, 2004, 2010	2000, 2010	3995	78.88%
Uganda	2000, 2006, 2011	2000, 2011	2199	81.74%
Zambia	2001, 2007, 2013	2001, 2014	2442	73.43%
Zimbabwe	2005, 2010, 2015	2005, 2015	1705	66.38%
All Treated countries†			16 150	76.65% (SD=0.029)
Armenia	2000, 2010	2000, 2010	306	83.73%
Benin	2001, 2006, 2011	2001, 2012	3190	83.47%
Bolivia	2003, 2008	2003, 2008	1607	90.03%
Burkina Faso	2003, 2010	2003, 2010	2537	88.75%
Cameroon	2004, 2011	2003, 2011	1902	69.66%
Chad¶	–	–	–	–
Colombia	2000, 2010	1999, 2010	1944	81.29%
Congo¶	–	–	–	–
Democratic Republic of Congo	2007, 2013	2006, 2014	2788	72.03%
Dominican Republic	2002, 2007, 2013	2002, 2013	2216	74.81%
Egypt	2000, 2008, 2014	1999, 2014	3816	76.47%
Ethiopia	2000, 2011	2000, 2011	2151	86.03%
Gabon¶	–	–	–	–
Ghana‡	2003, 2008, 2014	2003, 2014	1259	81.43%
Guinea	2005, 2012	2004, 2012	1427	80.43%
Haiti	2000, 2005, 2012	1999, 2012	1889	55.48%
Honduras¶	–	–	–	–
Indonesia	2002, 2007, 2012	2002, 2012	4768	59.05%
Jordan	2002, 2007, 2012	2002, 2012	2463	77.89%
Liberia	2007, 2013	2006, 2013	1210	88.10%
Madagascar	2003, 2008	2003, 2009	1704	94.65%
Mali	2001, 2006, 2012	2000, 2013	3671	89.51%
Mozambique	2003, 2011	2003, 2011	2055	72.75%
Nepal	2001, 2006, 2011	2001, 2012	1604	92.64%
Niger	2006, 2012	2005, 2012	2227	83.07%
Nigeria	2003, 2008, 2013	2002, 2013	6225	66.91%
Peru	2000, 2004, 2007, 2009, 2010, 2011, 2012	2000, 2012	7485	94.74%
Philippines	2003, 2008	2003, 2008	1197	82.56%
Senegal	2005, 2010, 2012, 2014, 2015	2004, 2015	4516	86.17%
Sierra Leone	2008, 2013	2007, 2013	1674	62.41%
Tanzania	2004, 2010, 2015	2004, 2016	2584	80.12%
All control countries§			70 415	81.34% (SD=0.025)

(c) Breastfeeding duration among children under 5 years of age (N=750 118)

Country	DHS survey years	Birth years available (Min, Max)	Sample size	Average breastfeeding duration (months) among children younger than five*
Bangladesh	2004, 2007, 2011, 2014	1999, 2014	23 499	20.35
Kenya	2003, 2008, 2014	1998, 2014	20 281	15.23
Lesotho	2004, 2009, 2014	1999, 2014	7651	18.33
Malawi	2000, 2004, 2010	1996, 2010	37 405	17.55

Continued

Table 1 Continued

(c) Breastfeeding duration among children under 5 years of age (N=750 118)

Country	DHS survey years	Birth years available (Min, Max)	Sample size	Average breastfeeding duration (months) among children younger than five*
Uganda	2000, 2006, 2009, 2011	1996, 2011	19 749	14.68
Zambia	2001, 2007, 2013	1996, 2014	23 886	15.88
Zimbabwe	2005, 2010, 2015	2000, 2014	7544	18.63
All treated countries†			140 015	16.68 (SD=0.75)
Armenia	2000, 2005, 2010	1996, 2010	3157	12.45
Benin	2001, 2006, 2011	1996, 2012	22 975	20.16
Bolivia	2003, 2008	1998, 2008	17 683	13.65
Burkina Faso	2003, 2010	1998, 2010	15 180	25.11
Cameroon	2004, 2011	1999, 2011	17 175	13.25
Chad	2004, 2014	1999, 2014	10 418	22.61
Colombia	2000, 2005, 2010	1996, 2010	31 918	11.68
Congo	2005, 2011	2000, 2012	7047	18.20
Democratic Republic of Congo	2007, 2013	2002, 2014	14 403	19.75
Dominican Republic	2002, 2007, 2013	1997, 2013	23 345	8.43
Egypt	2000, 2005, 2008, 2014	1996, 2014	36 875	18.34
Ethiopia	2000, 2005, 2011	1996, 2011	22 360	22.28
Gabon	2000, 2012	1996, 2012	5077	18.28
Ghana‡	2003, 2008, 2014	1998, 2014	8319	19.72
Guinea	2005, 2012	2000, 2012	8166	23.68
Haiti	2000, 2005, 2012	1996, 2012	12 951	17.27
Honduras	2005, 2011	2000, 2012	13 836	18.49
Indonesia	2002, 2007, 2012	1997, 2012	37 970	19.20
Jordan	2002, 2007, 2012	1997, 2012	17 263	15.73
Liberia	2007, 2013	2002, 2013	7517	20.22
Madagascar	2003, 2008	1998, 2009	16 514	15.21
Mali	2001, 2006, 2012	1996, 2013	26 099	19.20
Mozambique	2003, 2011	1998, 2011	12 722	21.37
Nepal	2001, 2006, 2011	1996, 2012	14 727	21.32
Niger	2006, 2012	2001, 2012	12 326	21.46
Nigeria	2003, 2008, 2013	1998, 2013	38 792	17.16
Peru	2000, 2004, 2007, 2009, 2010, 2011, 2012	1996, 2012	82 897	14.51
Philippines	2003, 2008, 2013	1998, 2013	13 808	15.89
Senegal	2005, 2010, 2012, 2014, 2015	2000, 2014	21 030	18.38
Sierra Leone	2008, 2013	2003, 2013	8286	19.24
Tanzania	2004, 2007, 2010, 2011, 2015	1999, 2014	29 267	16.63
All control countries§			610 103	14.37 (SD=0.43)

In the second model, we adjusted for individual-level and household-level characteristics, represented by the vector Z_{ijt} . In the third model, we additionally controlled for time-varying country-level confounders measured 1 year before birth ($t-1$), represented by the vector C_{it-1} .

All models incorporated robust SEs to account for clustering at the country-level and respondent-level sampling weights to account for individual survey sampling designs. Per DHS guidelines, we applied the de-normalisation of the standard weight approach described in the DHS Sampling and Household Listing Manual using information on the

number of women aged 15–49 in each survey year from the Population Division of the United Nations.^{57 58} Statistical analyses were performed using SAS software V.9.4 and Stata software V.15.

Sensitivity analyses

For each breastfeeding outcome, sensitivity analyses using exposures with different lead times were conducted to examine the robustness of our main estimates. The examination of lead effects, specifically the length of paid maternity leave in weeks or in FTE weeks during

the birth year (t), and 1, 2 and 3 years after birth ($t+1$, $t+2$, $t+3$), was used to test whether policy effects could be detected before the actual year of implementation, which would be inconsistent with the inference that paid maternity leave had a causal effect on the breastfeeding outcomes.

RESULTS

Descriptive statistics

Between 1995 and 2013, the average weeks and FTE weeks of paid maternity leave in the control group were 12.8 and 12.2, respectively (online supplementary appendix figure 1). Among the seven countries (ie, Bangladesh, Kenya, Lesotho, Malawi, Uganda, Zambia and Zimbabwe) that changed the duration of leave available, paid maternity leave increased, on average, from 7.1 weeks in 1995 to 13.1 weeks in 2013 (figure 1). These seven countries were included in the treated group for the analysis of paid maternity leave in weeks.

Eight countries (ie, Bangladesh, Ghana, Kenya, Lesotho, Malawi, Uganda, Zambia and Zimbabwe) increased paid maternity leave in terms of FTE weeks (figure 2). Ghana did not increase the length of paid maternity leave but raised the wage replacement rate from 50% to 100% in 2004, thereby doubling FTE weeks of paid maternity leave from 6 to 12. Zimbabwe raised the wage replacement rate from 75% to 100% in 2003 and increased the length of paid maternity leave from 12.9 weeks to 14 weeks in 2006, leading to increases in FTE weeks of paid maternity leave in 2003 and 2006. These eight countries were included in the treated group for the analysis of paid maternity leave in FTE weeks.

In the period before 2000, the first year that the treated countries adopted a policy change, the weighted prevalence of early initiation of breastfeeding and exclusive breastfeeding under 6 months were 54.51% (SD=0.11) and 69.50% (SD=0.09) in treated countries compared with 48.35% (SD=0.03) and 86.62% (SD=0.04) in control countries. The weighted average duration of breastfeeding was 18.67 months (SD=1.20) in treated countries and 16.83 months (SD=0.76) in control countries.

Examination of the parallel trends assumption

Prior to paid maternity leave reforms beginning in 2000, the trends in the prevalence of early initiation of breastfeeding, the prevalence of exclusive breastfeeding under 6 months and the duration of breastfeeding among treated and control countries were similar (online supplementary appendix figures 2-4). P values for the interaction terms of treatment status and birth year between 1996 and 2001 ranged from 0.1 to 0.9 for each breastfeeding outcome. Overall, we did not find evidence supporting different trends in breastfeeding outcomes between treated and control countries before the period when these policies began to change.

Effect of weeks of paid maternity leave policy

Table 2 shows the effect of a 1-month increase in the length of paid maternity leave on the prevalence of early initiation of breastfeeding among children born in the last 24 months. In the fully adjusted model (model 3), a 1-month increase in paid maternity leave policy was associated with a 7.40 percentage point increase (95% CI 3.15 to 11.65) in the prevalence of early initiation of breastfeeding.

Table 3 shows the effect of a 1-month increase in the length of paid maternity leave on the prevalence of exclusive breastfeeding under 6 months among infants 0–5 months of age. In the fully adjusted model (model 3), a 1-month increase in paid maternity leave policy was associated with a 5.86 percentage point increase (95% CI 1.95 to 9.77) in the prevalence of exclusive breastfeeding under 6 months.

Table 4 shows the effect of a 1-month increase in the length of paid maternity leave on the average duration of breastfeeding among children under 5 years of age. In the fully adjusted model (model 3), a 1-month increase in paid maternity leave policy was associated with a 2.21-month increase (95% CI 1.05 to 3.38) in average breastfeeding duration.

Effect of FTE weeks of paid maternity leave policy

The online supplementary appendix tables 4-6 show the effect of a 1-month increase in the length of paid maternity leave, in FTE units, on early initiation of breastfeeding among children born in the last 24 months, exclusive breastfeeding under 6 months among infants 0–5 months and breastfeeding duration among children under 5 years of age, respectively. A 1-month increase in paid maternity leave policy, in FTE units, was associated with a 6.85 percentage point increase (95% CI 2.93 to 10.76) in the prevalence of early initiation of breastfeeding, a 5.32 percentage point increase (95% CI 1.65 to 9.00) in the prevalence of exclusive breastfeeding under 6 months and a 2-month increase (95% CI 0.78 to 3.17) in average breastfeeding duration.

Sensitivity analysis

As expected, the results of analyses using a 1-year lead, a 2-year lead and a 3-year lead in paid maternity leave policy, both in weeks and in FTE weeks, did not provide evidence of an association with breastfeeding outcomes (online supplementary appendix tables 1-3). Overall, the results of these sensitivity analyses support the temporality between changes in paid maternity leave policy and each breastfeeding outcome and the robustness of our main estimates.

DISCUSSION

By linking longitudinal data on paid maternity leave duration between 1995 and 2013 to individual-level data on 992 419 children from DHS conducted in 38 LMICs, we evaluated the effect of extending legislated paid maternity leave on breastfeeding practices in these countries.

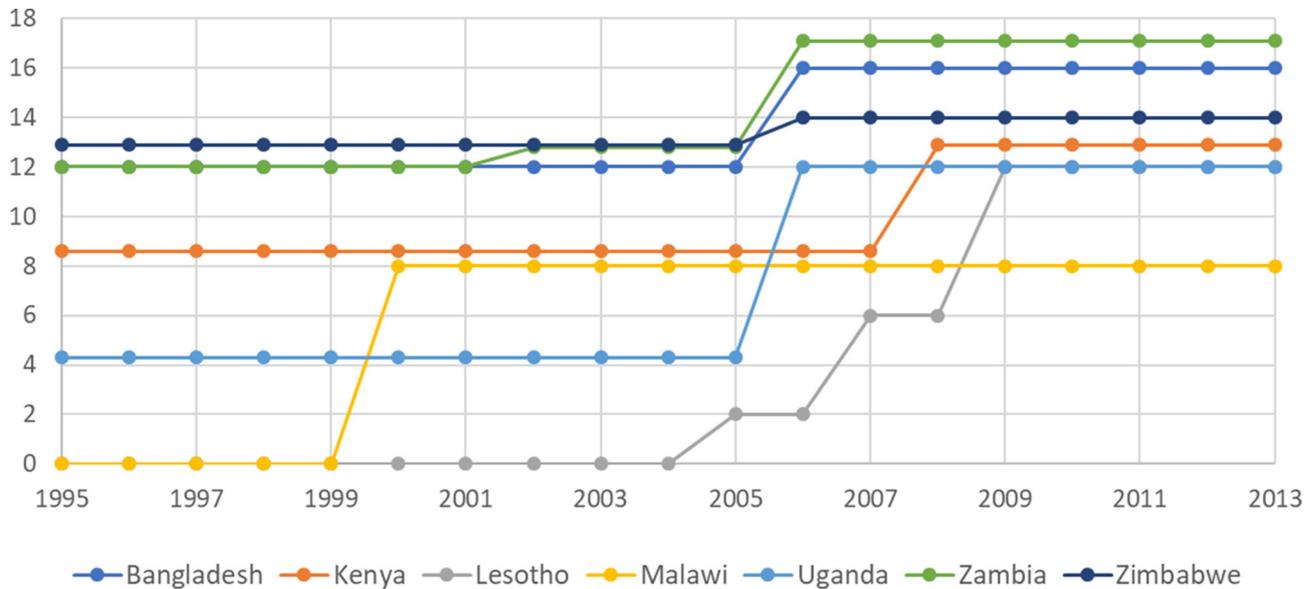


Figure 1 Legislated length of paid maternity leave.

Our difference-in-differences analyses indicated that each additional month of paid maternity leave corresponded to a 7 percentage point increase in the prevalence of early initiation of breastfeeding, a roughly 6 percentage point increase in the prevalence of exclusive breastfeeding under 6 months and a 2-month increase in breastfeeding duration. Sensitivity analyses supported the robustness of our main estimates. As the first analysis to examine this relation in LMICs, our analyses build on previously published studies from higher-income contexts using quasi-experimental methods.

With increasing numbers of women in the workforce, paid maternity leave has become increasingly important. Globally, 185 countries had a maternity leave policy in place in 2015 but only 57% (n=105 countries) met the 14-week standard⁵⁹ set by the International Labour

Organization in convention C183. Among the 80 countries not meeting the standard, 84% (n=67 countries) were LMICs.⁴¹ In addition, the wage replacement rate during maternity leave varies substantially, ranging from 25% to 100%.⁶⁰ Unpaid leave, which grants time off without wage replacement, may end up impoverishing many young families.⁶¹ Take-up of parental leave has generally been low where leave is unpaid or only provides low levels of wage replacement.⁶² Our study showed that extending the duration of paid maternity leave in weeks and FTE weeks promotes breastfeeding practices in LMICs, as the right to take leave and having financial support during that leave are both important.

Prior work has found that providing more generous paid maternity leave policy lowers infant mortality in

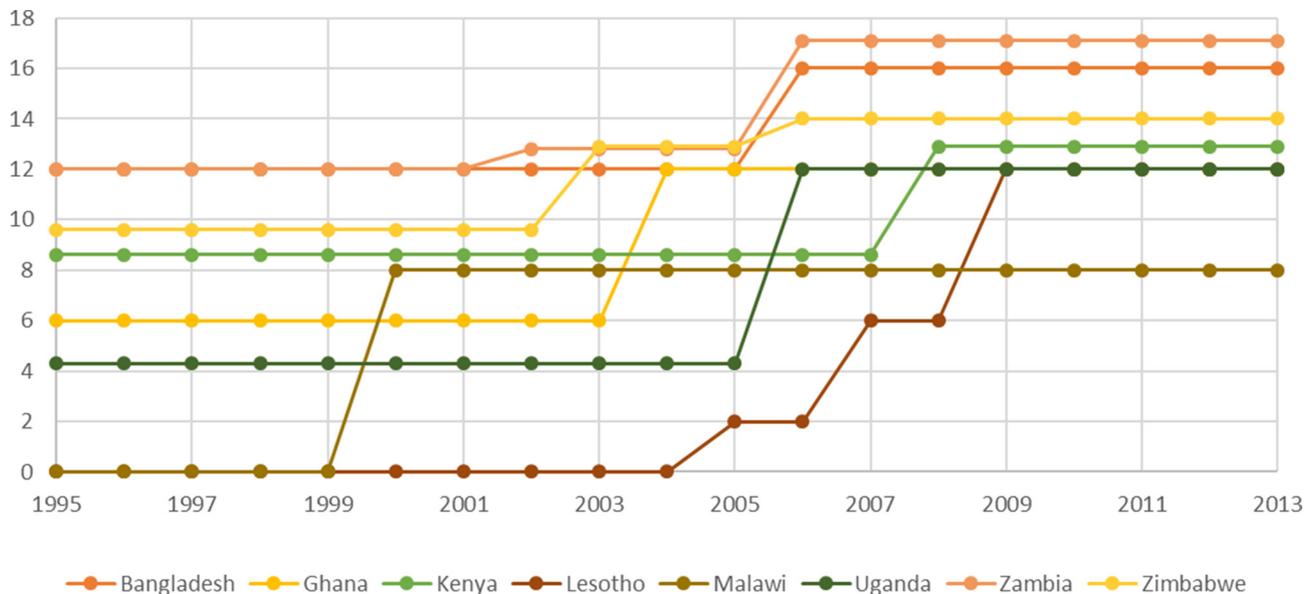


Figure 2 Legislated length of paid maternity leave in weeks in sampled countries that changed policies, 1995–2013.

Table 2 Effect of a 1-month increase in length of paid maternity leave policy on the prevalence of early initiation of breastfeeding among children born in the last 24 months

	Model 1 (n=397 406)	Model 2 (n=387 288)	Model 3 (n=387 288)
Exposure			
One-month increase in length of paid maternity leave policy	8.87 (4.94 to 12.80)	8.09 (4.49 to 11.68)	7.40 (3.15 to 11.65)
Household-level and individual-level covariates			
Number of listed household members		-0.05 (-0.27 to 0.17)	-0.06 (-0.27 to 0.16)
Household wealth			
Poorest		Ref	Ref
Poorer		0.40 (-0.79 to 1.59)	0.42 (-0.78 to 1.62)
Middle		0.49 (-1.36 to 2.34)	0.50 (-1.35 to 2.35)
Richer		1.52 (-0.87 to 3.92)	1.52 (-0.87 to 3.90)
Richest		1.85 (-0.84 to 4.54)	1.81 (-0.86 to 4.48)
Place of residence			
Urban		Ref	Ref
Rural		0.29 (-1.11 to 1.69)	0.26 (-1.21 to 1.73)
Mother's age at childbirth (years)		-0.08 (-0.26 to 0.10)	-0.08 (-0.26 to 0.10)
Mother's number of living children		2.79 (2.05 to 3.53)	2.74 (1.99 to 3.50)
Maternal education			
No education		Ref	Ref
Incomplete primary		1.21 (-1.30 to 3.73)	1.15 (-1.33 to 3.63)
Complete primary		3.99 (0.91 to 7.06)	4.04 (1.04 to 7.04)
Incomplete secondary		1.59 (-1.47 to 4.64)	1.65 (-1.32 to 4.62)
Complete secondary		-1.49 (-5.59 to 2.62)	-1.38 (-5.36 to 2.59)
Higher		-5.79 (-11.19 to -0.39)	-5.58 (-10.86 to -0.30)
Mother's current marital status			
Never in union		Ref	Ref
Married		2.39 (0.67 to 4.10)	2.49 (0.74 to 4.23)
Living with partner		3.01 (1.33 to 4.68)	3.01 (1.33 to 4.68)
Separated/divorced/widowed		1.84 (0.38 to 3.30)	1.96 (0.50 to 3.42)
Mother worked in the last 12 months			
Did not work		Ref	Ref
Worked in the past year		-3.99 (-6.37 to -1.61)	-4.30 (-6.47 to -2.13)
Currently working		-2.36 (-4.02 to -0.70)	-2.38 (-3.99 to -0.77)
Have a job, but on leave last 7 days		-9.08 (-11.88 to -6.28)	-10.35 (-14.13 to -6.56)
Child's birth order		-1.47 (-2.02 to -0.91)	-1.42 (-1.95 to -0.89)
Child's sex			
Male		Ref	Ref
Female		1.23 (0.69 to 1.76)	1.23 (0.69 to 1.77)
Country-level covariates			
Gross domestic product per capita			1.88 (-0.63 to 4.39)
Health expenditure per capita			-0.62 (-1.48 to 0.23)
Percentage of females aged 15–64 participating in the labour force			0.00 (0.00 to 0.00)
Unemployment female (percentage of female labour force)			0.43 (-0.23 to 1.08)

Reported estimates are marginal effects at the means, which were multiplied by 100 in order to be interpreted as the percentage point difference in prevalence.

The 95% CIs are in parentheses.

Model 1 includes country and year fixed effects.

Model 2 additionally controlled for measured individual and household characteristics.

Model 3 additionally controlled for country-level characteristics.

Table 3 Effect of a 1-month increase in length of paid maternity leave policy on the prevalence of exclusive breastfeeding under 6 months among infants 0–5 months of age

	Model 1 (n=84 593)	Model 2 (n=82 081)	Model 3 (n=82 081)
Exposure			
One-month increase in length of paid maternity leave policy	5.87 (1.94 to 9.80)	6.20 (2.07 to 10.33)	5.86 (1.95 to 9.77)
Household-level and individual-level covariates			
Number of listed household members		0.14 (0.02 to 0.25)	0.14 (0.02 to 0.26)
Household wealth			
Poorest		Ref	Ref
Poorer		-0.33 (-1.12 to 0.45)	-0.35 (-1.14 to 0.43)
Middle		-0.13 (-1.42 to 1.17)	-0.13 (-1.43 to 1.17)
Richer		-0.97 (-2.55 to 0.61)	-0.98 (-2.57 to 0.60)
Richest		-1.95 (-3.83 to -0.08)	-1.94 (-3.77 to -0.10)
Place of residence			
Urban		Ref	Ref
Rural		-0.07 (-1.54 to 1.40)	-0.07 (-1.55 to 1.42)
Mother's age at childbirth (years)		0.04 (-0.06 to 0.14)	0.04 (-0.06 to 0.13)
Mother's number of living children		0.21 (-0.58 to 1.01)	0.24 (-0.53 to 1.00)
Maternal education			
No education		Ref	Ref
Incomplete primary		-1.25 (-3.08 to 0.59)	-1.21 (-3.03 to 0.61)
Complete primary		-0.42 (-2.25 to 1.41)	-0.46 (-2.28 to 1.37)
Incomplete secondary		-0.79 (-2.66 to 1.07)	-0.83 (-2.70 to 1.05)
Complete secondary		1.97 (-0.87 to 4.81)	1.93 (-0.88 to 4.74)
Higher		3.92 (0.40 to 7.43)	3.87 (0.41 to 7.32)
Mother's current marital status			
Never in union		Ref	Ref
Married		2.33 (-0.13 to 4.79)	2.26 (-0.24 to 4.75)
Living with partner		3.06 (1.33 to 4.79)	3.10 (1.33 to 4.88)
Separated/divorced/widowed		-0.27 (-2.63 to 2.10)	-0.32 (-2.67 to 2.04)
Mother worked in the last 12 months			
Did not work		Ref	Ref
Worked in the past year		0.49 (-1.06 to 2.03)	0.62 (-0.91 to 2.15)
Currently working		-2.56 (-3.62 to -1.51)	-2.50 (-3.57 to -1.44)
Have a job, but on leave last 7 days		5.17 (3.54 to 6.80)	5.57 (3.74 to 7.39)
Child's birth order		-0.38 (-1.09 to 0.32)	-0.41 (-1.08 to 0.27)
Child's sex			
Male		Ref	Ref
Female		0.40 (-0.15 to 0.95)	0.40 (-0.15 to 0.96)
Country-level covariates			
Gross domestic product per capita			-0.35 (-1.79 to 1.09)
Health expenditure per capita			-0.05 (-1.03 to 0.93)
Percentage of females aged 15–64 participating in the labour force			0.00 (0.00 to 0.00)
Unemployment female (percentage of female labour force)			-0.42 (-1.21 to 0.37)

Reported estimates are marginal effects at the means, which were multiplied by 100 in order to be interpreted as the percentage point difference in prevalence.

The 95% CIs are in parentheses.

Model 1 includes country and year fixed effects.

Model 2 additionally controlled for measured individual and household characteristics.

Model 3 additionally controlled for country-level characteristics.

LMICs.⁶³ As breastfeeding is one of the most effective interventions for reducing child mortality,¹ our findings implicate breastfeeding as one of the mechanisms for this reduced mortality. To protect and promote newborns' health and survival, many determinants

of breastfeeding practice, including a wide range of cultural, socioeconomic and workplace factors, are amenable to interventions. Meta-analyses of the effects of interventions in health systems and services, family and community and workplace and employment

Table 4 Effect of a 1-month increase in length of paid maternity leave policy on breastfeeding duration (months) among children under 5 years of age

	Model 1 (n=750 107)	Model 2 (n=728 541)	Model 3 (n=727 236)
Exposure			
One-month increase in length of paid maternity leave policy	1.58 (0.33 to 2.82)	1.64 (0.48 to 2.81)	2.21 (1.05 to 3.38)
Household-level and individual-level covariates			
Number of listed household members		-0.10 (-0.15 to -0.05)	-0.10 (-0.15 to -0.05)
Household wealth			
Poorest		0.00 (ref)	0.00 (ref)
Poorer		-0.02 (-0.21 to 0.18)	-0.01 (-0.20 to 0.18)
Middle		-0.16 (-0.41 to 0.09)	-0.16 (-0.41 to 0.09)
Richer		-0.38 (-0.69 to -0.07)	-0.37 (-0.68 to -0.06)
Richest		-0.96 (-1.44 to -0.48)	-0.93 (-1.41 to -0.45)
Place of residence			
Urban		0.00 (ref)	0.00 (ref)
Rural		0.23 (0.03 to 0.43)	0.24 (0.05 to 0.44)
Mother's age at childbirth (years)		0.02 (0.00 to 0.05)	0.02 (0.00 to 0.05)
Mother's number of living children		0.30 (0.12 to 0.48)	0.27 (0.07 to 0.47)
Maternal education			
No education		0.00 (ref)	0.00 (ref)
Incomplete primary		-0.22 (-0.52 to 0.08)	-0.18 (-0.48 to 0.12)
Complete primary		-0.29 (-0.70 to 0.12)	-0.26 (-0.67 to 0.15)
Incomplete secondary		-0.59 (-1.03 to -0.15)	-0.56 (-1.01 to -0.12)
Complete secondary		-0.89 (-1.40 to -0.37)	-0.91 (-1.41 to -0.40)
Higher		-1.82 (-2.33 to -1.31)	-1.86 (-2.34 to -1.38)
Mother's current marital status			
Never in union		0.00 (ref)	0.00 (ref)
Married		0.43 (0.15 to 0.70)	0.41 (0.11 to 0.70)
Living with partner		0.41 (0.14 to 0.69)	0.35 (0.07 to 0.63)
Widowed		2.09 (1.63 to 2.55)	2.04 (1.57 to 2.50)
Divorced		1.45 (0.87 to 2.03)	1.39 (0.81 to 1.98)
No longer living together/separated		0.92 (0.59 to 1.25)	0.86 (0.52 to 1.21)
Mother worked in the last 12 months			
Did not work		0.00 (ref)	0.00 (ref)
Worked in the past year		0.21 (-0.22 to 0.63)	0.27 (-0.22 to 0.75)
Currently working		1.13 (0.87 to 1.39)	1.12 (0.86 to 1.39)
Have a job, but on leave last 7 days		-1.42 (-2.05 to -0.78)	-1.30 (-2.26 to -0.34)
Child's birth order		-0.08 (-0.20 to 0.05)	-0.06 (-0.19 to 0.08)
Child's sex			
Male		0.00 (ref)	0.00 (ref)
Female		0.02 (-0.10 to 0.14)	0.02 (-0.10 to 0.14)
Country-level covariates			
Gross domestic product per capita			-0.68 (-1.13 to -0.23)
Health expenditure per capita			-0.05 (-0.31 to 0.21)
Percentage of females aged 15–64 participating in the labour force			0.00 (0.00 to 0.00)
Unemployment female (percentage of female labour force)			-0.01 (-0.20 to 0.17)
Age of infant (months) until which mother is guaranteed breastfeeding breaks at work			0.21 (0.07 to 0.34)

The 95% CIs are in parentheses.

Model 1 includes country and year fixed effects.

Model 2 additionally controlled for measured individual and household characteristics.

Model 3 additionally controlled for country-level characteristics.

showed that interventions delivered in health systems and communities strongly promote breastfeeding practices and the largest effects of interventions can be achieved by delivering combinations of interventions.⁶⁴ Interventions in health systems, such as baby-friendly support and counselling or education, have been found to increase exclusive breastfeeding under 6 months by 49% and 66%, respectively, and continued breastfeeding for 12–23 months by 26% and 15%, respectively.⁶⁴ Combined health systems and community interventions were found to have a major effect on exclusive breastfeeding under 6 months (RR 2.52 (1.39–4.59)) and continued breastfeeding for 12–23 months (RR 10.2 (7.66–13.74)).⁶⁴ The few results available on interventions in the workplace suggest that maternity leave policy increases the chance of exclusive breastfeeding under 6 months (RR 1.52 (1.03–2.23)).⁶⁴ Our results were consistent with the majority of studies that reported positive associations between existing interventions and breastfeeding practices.

Several limitations of this study should be noted. First, the parallel trends assumption is difficult to examine visually in the difference-in-differences approach with several policy changes and multiple treated and control countries. We lacked longitudinal measurements on each breastfeeding outcome from the DHS for all of our sampled countries in the pre-intervention period prior to reforms occurring in treated countries. However, the observations of similar trends in each breastfeeding outcome in the pre-intervention period gave some assurance that this assumption may not be violated (online supplementary appendix figures 2–4). Second, although we included individual-level, household-level and country-level characteristics as covariates, as well as year and country as fixed effects, uncontrolled time-varying confounding is still possible. For example, social and cultural attitudes towards breastfeeding, which are not measured in the DHS, may be uncontrolled confounders if they are associated with paid leave policy reforms and also influence breastfeeding practices. Third, we did not account for the implementation of other interventions, such as breastfeeding promotion programmes, which could coincide with changes in paid maternity leave. Fourth, information related to our outcome variables and several covariates was collected based on maternal recall. Measurements are more prone to recall bias in mothers with older children; however, there is likely less recall bias for breastfeeding than less significant aspects of parenting history. Fifth, although we did not distinguish between paid maternity leave that can be taken before and after birth, or account for other leave (eg, parental leave) that might be available to mothers, exposure misclassification is expected to be minor because the majority of paid maternity leave is taken subsequent to birth in LMICs and paid parental leave is short (eg, less than 4 weeks) among the sampled countries. Sixth, the results might be prone to survivor

bias since breastfeeding information is only available for children who were alive at the time of interview. This could weaken a true positive association between increases in paid maternity leave policy and early initiation and continuation of breastfeeding if the causes of death prevented by paid maternity leave policy also influence the initiation and continuation of breastfeeding, although no evidence for such selection has been established. Seventh, due to the lack of information on policy compliance or enforcement, the intent-to-treat estimate obtained in our study may be downwardly biased. Furthermore, women in informal work sectors are not always protected by paid maternity leave. As a result, an average population effect may underestimate the true effect of paid maternity leave when provided to all women. Finally, the generalisation of our results to all LMICs is limited as the sampling weights only allowed us to draw inference to the target population of the 38 sampled countries.

In conclusion, our study suggested a positive effect of extended paid maternity leave on early initiation of breastfeeding, exclusive breastfeeding under 6 months and breastfeeding duration. From a policy planning perspective, further studies are needed to deepen our understanding of the impact of maternity leave policy on breastfeeding practices. This might include within-country studies with additional information on policy implementation and enforcement. Further studies may also seek to examine whether the increase in breastfeeding duration is longer than the increase in maternity leave duration because of threshold effects. Specifically, future studies could examine whether a certain minimum length of leave is needed to encourage breastfeeding initiation and whether it is easier to continue breastfeeding while working once an infant has reached a certain age. Studies should also explore the impact of other related policies, such as paid parental leave, on breastfeeding practices.^{40 65} This research could help to develop effective early-life interventions to ensure positive health outcomes for mothers and infants in LMICs.

Contributors AN and JH led the development of the policy databases on which this analysis is based. All authors contributed to the conception and design of the study. YC performed the statistical analysis and drafted the manuscript. All authors reviewed the results, edited and approved the final version of the manuscript.

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Data sharing statement Analyses utilised two sources of data, specifically: (1) breastfeeding information collected from respondents surveyed as part of the Demographic and Health Surveys (DHS) (Table 1) and (2) measures of maternity leave policies. The DHS data are publicly available, but users must first register with the DHS program. Registration, which requires a summary of the proposed study and selection of country datasets, can be completed at: <http://www.dhsprogram.com>.

com/data/. Data on current maternity leave policies for each sampled country were made available by the University of California Los Angeles' WORLD Policy Analysis Center and then collected retrospectively to 1995 by McGill University's PROSPERED project. The policy data are freely available through the website, <https://www.prosperedproject.com/>, without any restriction.

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