Breastfeeding 1

Breastfeeding in the 21st century: epidemiology, mechanisms, and lifelong effect

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The importance of breastfeeding in low-income and middle-income countries is well recognised, but less consensus exists about its importance in high-income countries. In low-income and middle-income countries, only 37% of children younger than 6 months of age are exclusively breastfed. With few exceptions, breastfeeding duration is shorter in high-income countries than in those that are resource-poor. Our meta-analyses indicate protection against child infections and malocclusion, increases in intelligence, and probable reductions in overweight and diabetes. We did not find associations with allergic disorders such as asthma or with blood pressure or cholesterol, and we noted an increase in tooth decay with longer periods of breastfeeding. For nursing women, breastfeeding gave protection against breast cancer and it improved birth spacing, and it might also protect against ovarian cancer and type 2 diabetes. The scaling up of breastfeeding to a near universal level could prevent 823 000 annual deaths in children younger than 5 years and 20 000 annual deaths from breast cancer. Recent epidemiological and biological findings from during the past decade expand on the known benefits of breastfeeding for women and children, whether they are rich or poor.

Introduction

"In all mammalian species the reproductive cycle comprises both pregnancy and breast-feeding: in the absence of latter, none of these species, man included, could have survived", wrote paediatrician Bo Vahlquist in 1981.[1] 3 years earlier, Derek and Patrice Jelliffe in their classic book *Breast Milk in the Modern World*[2] stated that "breast-feeding is a matter of concern in both industrialised and developing countries because it has such a wide range of often underappreciated consequences".[3] The Jelliffes anticipated that breastfeeding would be relevant to "present-day interest in the consequences of infant nutrition on subsequent adult health".[3] These statements were challenged by the American Academy of Pediatrics, which in its 1984 report on the scientific evidence for breastfeeding stated that "if there are benefits associated with breast-feeding in populations with good sanitation, nutrition and medical care, the benefits are apparently modest".[4]

In the past three decades, the evidence behind breastfeeding recommendations has evolved markedly (appendix p 3). Results from epidemiological studies and growing knowledge of the roles of epigenetics, stem cells, and the developmental origins of health and disease lend strong support to the ideas proposed by Vahlquist and the Jelliffes. Never before in the history of science has so much been known about the complex importance of breastfeeding for both mothers and children.

Here, in the first of two Series papers, we describe present patterns and past trends in breastfeeding throughout the world, review the short-term and long-term health consequences of breastfeeding for the child and mother, estimate potential lives saved by scaling up breastfeeding, and summarise insights into how breastfeeding might permanently shape individuals' life course. The second paper in the Series[5] covers the determinants of breastfeeding and the effectiveness of promotion interventions. It discusses the role of breastfeeding in HIV transmission and how knowledge about this issue has evolved in the past two decades, and examines the lucrative market of breastmilk substitutes, the environmental role of breastfeeding, and its economic implications. In the context of the post-2015 development agenda, the two articles document how essential breastfeeding is for building a better world for future generations in all countries, rich and poor alike.

Search strategy and selection criteria

We obtained information about the associations between breastfeeding and outcomes in children or mothers from 28 systematic reviews and meta-analyses, of which 22 were commissioned for this review. See appendix pp 23–30 for the databases searched and search terms used. We reviewed the following disorders for young children: child mortality; diarrhoea incidence and admission to hospital; lower respiratory tract infections incidence, prevalence, and admission to hospital; acute otitis media; eczema; food allergies; allergic rhinitis; asthma or wheezing; infant growth (length, weight, body-mass index); dental caries; and malocclusion. For older children, adolescents, and adults, we did systematic reviews for systolic and diastolic blood pressure; overweight and obesity; total cholesterol; type 2 diabetes; and intelligence. For mothers, we did systematic reviews covering the following outcomes: lactational amenorrhoea; breast and ovarian cancer; type 2 diabetes; post-partum weight change; and osteoporosis.

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This is the first in a **Series** of two papers about breastfeeding

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See **Online** for appendix

For the **Demographic and Health Surveys** see http://www.measuredhs.com/aboutsurveys/dhs/start.cfm

For the **Multiple Indicator Cluster Surveys** see http://mics.unicef.org/surveys

Key messages

- Children who are breastfed for longer periods have lower infectious morbidity and mortality, fewer dental malocclusions, and higher intelligence than do those who are breastfed for shorter periods, or not breastfed. This inequality persists until later in life. Growing evidence also suggests that breastfeeding might protect against overweight and diabetes later in life.
- Breastfeeding benefits mothers. It can prevent breast cancer, improve birth spacing, and might reduce a woman's risk of diabetes and ovarian cancer.
- High-income countries have shorter breastfeeding duration than do low-income and middle-income countries. However, even in low-income and middle-income countries, only 37% of infants younger than 6 months are exclusively breastfed.
- The scaling up of breastfeeding can prevent an estimated 823 000 child deaths and 20 000 breast cancer deaths every year.
- Findings from studies done with modern biological techniques suggest novel mechanisms that characterise breastmilk as a personalised medicine for infants.
- Breastfeeding promotion is important in both rich and poor countries alike, and might contribute to achievement of the forthcoming Sustainable Development Goals.

Breastfeeding indicators and data sources for this review

WHO has defined the following indicators for the study of feeding practices of infants and young children:[6] early initiation of breastfeeding (proportion of children born in the past 24 months who were put to the breast within an hour of birth); exclusive breastfeeding under 6 months (proportion of infants aged 0–5 months who are fed exclusively with breastmilk. This indicator is based on the diets of infants younger than 6 months during the 24 h before the survey [to avoid recall bias], not on the proportion who are exclusively breastfed for the full 6-month period); continued breastfeeding at 1 year (proportion of children aged 12–15 months who are fed breastmilk); and continued breastfeeding at 2 years (proportion of children aged 20–23 months who are fed breastmilk).

Because few high-income countries report on the aforementioned indicators, we calculated additional indicators to allow global comparisons: ever breastfed (infants reported to have been breastfed, even if for a short period); breastfed at 6 months (in high-income countries, the proportion of infants who were breastfed from birth to 6 months or older; in low-income and middle-income countries [LMICs] with standardised surveys, the proportion of infants aged 4–7 months [median age of 6 months] who are breastfed); and breastfed at 12 months (in high-income countries, the proportion of children breastfed for 12 months or longer; in LMICs, the proportion of children aged 10–13 months [median age of 12 months] who are breastfed).

For this review, we used the last three, additional indicators for comparisons between high-income countries and LMICs only. Otherwise, we reported on the standard international indicators (appendix p 4).

For LMICs, we reanalysed national surveys done since 1993, including Demographic and Health Surveys, Multiple Indicator Cluster Surveys, and others (appendix pp 5–12). Nearly all surveys had response rates higher than 90% and used standardised questionnaires and indicators.

For all high-income countries with 50 000 or more annual births, we did systematic reviews of published studies and the grey literature and contacted local researchers or public health practitioners when data from a particular country were not available or when there was ambiguity (appendix pp 13–17). Information about breastfeeding from national samples was not available from many countries. Although 27 out of 35 countries had some information about breastfeeding at a national level, response rates were often in the 50–70% range, indicators were rarely standardised, and recall periods tended to be long. We used administrative or other data when surveys were not available. If necessary, we estimated the proportion of infants breastfed at 12 months on the basis of information available for breastfeeding at 6 months and vice versa. We calculated time trends using multilevel linear regression models (hierarchical mixed models) that take into account that two or more surveys were included in the analyses for each country. We explored departures from linearity with fractional polynomial regression models.[7] In all analyses, we weighted country data by their populations of children younger than 2 years of age (see appendix pp 18–22 for statistical methods).

We did systematic searches of the published literature, and, when possible, meta-analyses for outcomes postulated to be associated with breastfeeding (appendix pp 23–30). These systematic reviews and meta-analyses were specially commissioned by WHO to provide background information for this Series.

We used the Lives Saved Tool[8] to predict how many deaths of children younger than 5 years would be prevented if breastfeeding patterns as of 2013 were scaled up in the 75 countries that are part of the Countdown to 2015 effort,[9] which account for more than 95% of all such deaths worldwide. We assumed that 95% of children younger than 1 month and 90% of those younger than 6 months would be exclusively breastfed, and that 90% of those aged 6–23 months would be partly breastfed. We applied the relative risks for the protection against all infectious causes of death obtained from our new meta-analyses[10] to all infectious causes of death in children younger than 2 years, and also to the 15% of deaths caused by complications of prematurity that occur after the first week of life

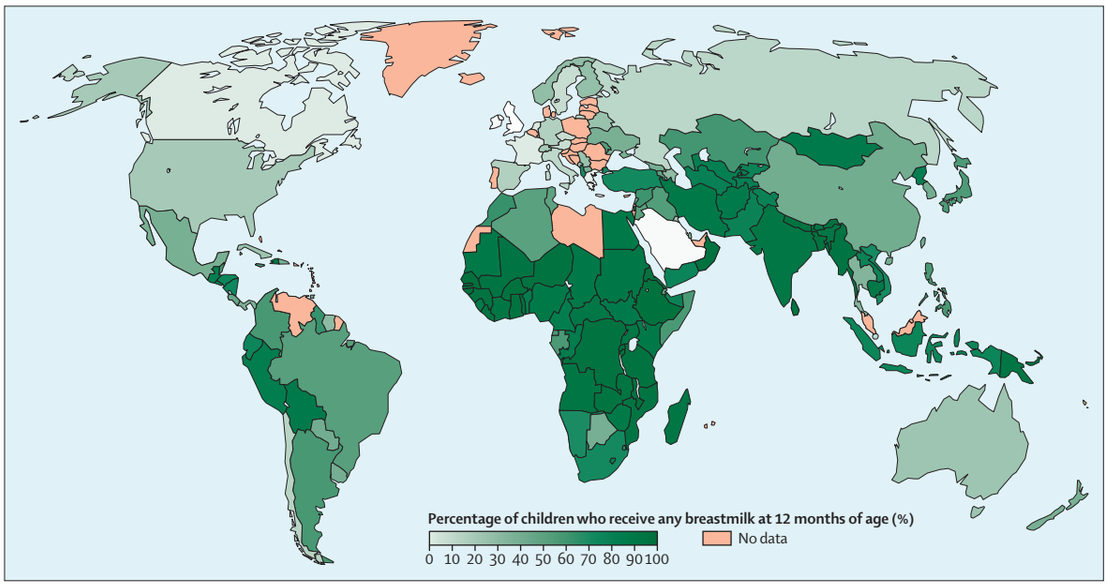

Figure 1: **Global distribution of breastfeeding at 12 months**
Data are from 153 countries between 1995 and 2013.

(appendix pp 31–36). We also estimated the potential number of deaths from breast cancer that could have been prevented by extending the duration of breastfeeding (appendix pp 37–38).

Epidemiology: levels and trends

We obtained complete information about 127 of the 139 LMICs (appendix pp 5–12), accounting for 99% of children from such countries. For high-income countries, we obtained data for 37 of 75 countries, but for several countries, only a subset of the indicators were available (appendix pp 13–17): these data should, therefore, be interpreted with caution.

Globally, the prevalence of breastfeeding at 12 months is highest in sub-Saharan Africa, south Asia, and parts of Latin America (figure 1). In most high-income countries, the prevalence is lower than 20% (appendix pp 13–17). We noted important differences—eg, between the UK (<1%) and the USA (27%), and between Norway (35%) and Sweden (16%).

We assessed breastfeeding indicators according to country income groups (figure 2). Information about early initiation or exclusive or continued breastfeeding at 2 years was not available for most high-income countries. We noted a strong inverse correlation (Pearson's r=–0·84; p<0·0001; appendix p 39) between breastfeeding at 6 months and log gross domestic product per person; our regression analyses showed that for each doubling in the gross domestic product per head, breastfeeding prevalence at 12 months decreased by ten percentage points.

Most mothers in all country groups started breastfeeding; only three countries (France, Spain, and the USA) had rates below 80% for ever breastfeeding. However, early initiation was low in all settings, as was exclusive breastfeeding (figure 2). Breastfeeding at 12 months was widespread in low-income and lower-middle-income settings, but uncommon elsewhere.

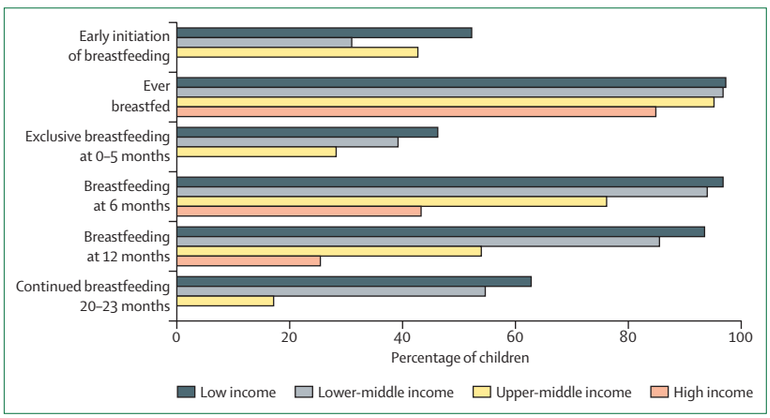

Figure 2: **Breastfeeding indicators by country income group in 2010**
Data are from national surveys that used standard indicators, and were weighted by national populations of children under 2 years. Data for up to 153 countries.

Except for early initiation, prevalence of all indicators decreased with increasing national wealth. Low-income countries had a high prevalence of breastfeeding at all ages, but the rates of initiation and exclusive breastfeeding are unsatisfactory even in these countries.

Surprisingly, most national level breastfeeding indicators were not strongly correlated (appendix p 39). We found only a moderate correlation (Pearson's r=0·54) between exclusive and continued breastfeeding at 1 year in LMICs. Although the prevalence of

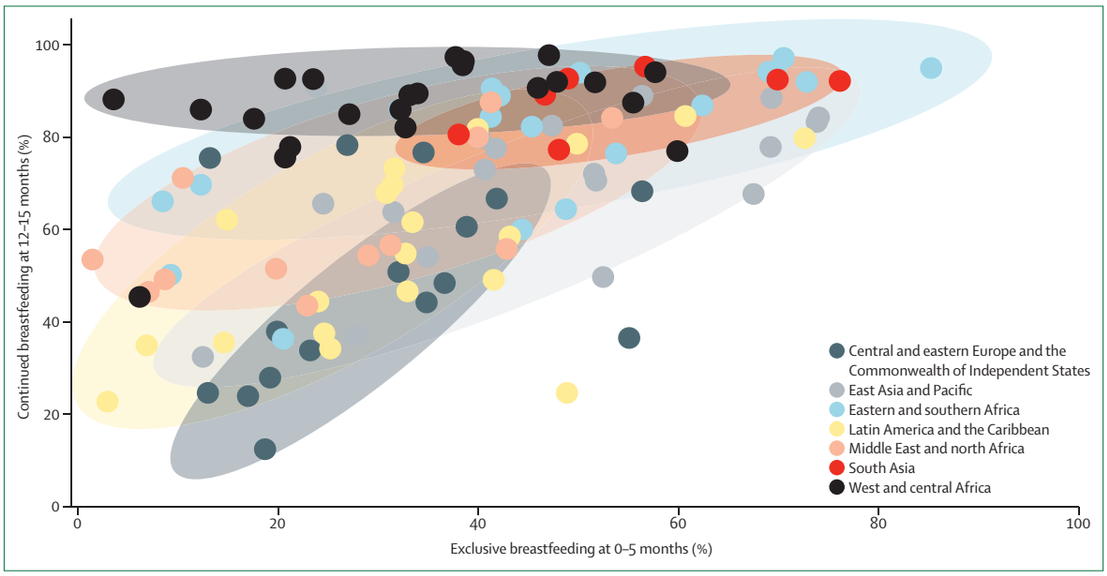

Figure 3: **The relation between exclusive breastfeeding at 0–5 months and continued breastfeeding at 12–15 months, by region**
Datapoints are countries (values from the most recent survey from 117 countries, 2000–13) and are coloured according to their region. The shaded ellipses include at least 80% of the points in each region.

continued breastfeeding was high throughout west and central Africa, rates of exclusive breastfeeding varied widely (figure 3). Countries from eastern and southern Africa tended to have on average lower rates of continued breastfeeding but higher rates of exclusive breastfeeding than did those in west Africa. In Latin America and the Caribbean, and in central and eastern Europe and the Commonwealth of Independent States, both indicators tended to be lower than in Africa. South Asian countries had high rates of both indicators whereas countries in the Middle East and north Africa had lower rates. Countries from east Asia and the Pacific region had moderate to high prevalence of both indicators.

In children younger than 6 months in LMICs, 36·3 million (63%) were not exclusively breastfed at the time of the most recent national survey. The corresponding percentages were 53% in low-income countries, 61% in lower-middle-income countries, and 63% in upper-middle-income countries. In children aged 6–23 months in LMICs, 64·8 million (37%) were not receiving any breastmilk at the time of the most recent national survey, with corresponding rates of 18% in low-income, 34% in lower-middle-income, and 55% in upper-middle-income countries. 101·1 million children in LMICs were not breastfed according to international recommendations.

In most LMICs, data were available from several surveys over time, making it possible to explore time trends both at the national level and for children in the poorest and richest 20% of families. Our analyses were restricted to surveys for which breakdown of breastfeeding indicators by wealth quintiles was possible (214 surveys for exclusive and 217 for continued breastfeeding; appendix pp 18–22), accounting for 83% of the total 2010 population of children younger than 2 years of age in LMICs. We reported linear trends because there was no evidence of departures from linearity. Exclusive breastfeeding rates increased slightly from 24·9% in 1993 to 35·7% in 2013 (figure 4). In the richest 20% of families, the increase was much steeper, whereas the poorest 20% followed the general trend. Continued breastfeeding at 1 year (12–15 months) dropped slightly at the global level (from 76·0% to 73·3%), partly due to a decline among the poorest 20% in each country (figure 4).

Epidemiology: within-country inequalities

We analysed 98 surveys from LMICs to investigate within-country inequalities according to wealth quintile (appendix p 40). Wealth-related inequalities in exclusive breastfeeding were small but disparities in continued breastfeeding rates were consistent: poorer people tend to breastfeed for longer than their richer counterparts in all country groupings, but especially in middle-income countries. Similar results based on 33 countries have been reported elsewhere.[11]

Our review of studies from high-income countries showed that high-income, better-educated women breastfeed more commonly than do those in low-income groups with fewer years of formal education.[12–20] Breastfeeding initiation in the USA was more common in mothers with lower education up until the 1960s, but the social gradient has since reversed.[4]

Breastfeeding is one of few positive health-related behaviours in LMICs that is less frequent in rich people, both between and within countries. The low rates of continued breastfeeding in richer families raises the possibility that poorer mothers will move towards breastmilk substitutes as their income increases, a concern that is reinforced by decreasing rates in poor populations.

Short-term effects in children: mortality and morbidity

The results of 28 meta-analyses on the associations between breastfeeding and outcomes in the children and mothers, of which 22 were commissioned for this Series, are summarised in the table. Because studies varied with regard to their feeding classifications, for several outcomes we compared longer versus shorter breastfeeding durations (eg, never *vs* ever breastfed, breastfed for less or more than a given number of months, and for a few outcomes longer *vs* shorter durations of exclusive breastfeeding). We tested for heterogeneity due to the type of breastfeeding categorisation, and in its absence we pooled the different studies. We described the results of randomised trials on how breastfeeding promotion affects health, nutrition, or developmental outcomes, but not of trials in which the endpoint was restricted to breastfeeding indicators; these are reviewed in the second article in the Series.[5]

Only three studies in LMICs provide information about mortality according to exclusive, predominant, partial, or no breastfeeding in the first 6 months of life (table). A strong protective effect was evident, with exclusively breastfed infants having only 12% of the risk of death compared with those who were not breastfed.[10] Another three studies in LMICs showed that infants younger than 6 months who were not breastfed had 3·5-times (boys) and 4·1-times (girls) increases in mortality compared with those who received any breastmilk, and that that protection decreased with age.[33] These results are lent support by studies of children aged 6–23 months, in whom any breastfeeding was associated with a 50% reduction in deaths (table).

Breastfeeding might also protect against deaths in high-income countries. A meta-analysis of six high-quality studies showed that ever breastfeeding was associated with a 36% (95% CI 19–49) reduction in sudden infant deaths.[34] Another meta-analysis of four randomised controlled trials showed a 58% (4–82) decrease in necrotising enterocolitis,[34] a disorder with high case-fatality in all settings.[35]

In terms of child morbidity, overwhelming evidence exists from 66 different analyses, mostly from LMICs and including three randomised controlled trials, that breastfeeding protects against diarrhoea and respiratory infections (table).[21] About half of all diarrhoea episodes and a third of respiratory infections would be avoided by breastfeeding. Protection against hospital admissions due to these disorders is even greater: breastfeeding could prevent 72% of admissions for diarrhoea and 57% of those for respiratory infections. We discuss the risks associated with breastmilk substitutes in terms of biological and chemical contamination in appendix p 41.

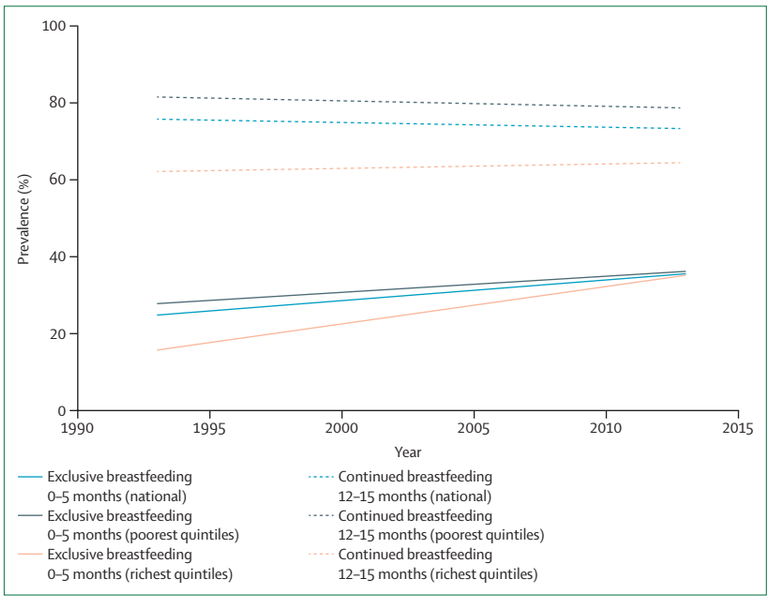

Figure 4: **National and wealth quintile-specific time trends in exclusive and continued breastfeeding, 1993–2013**
Data are weighted by national populations of children younger than 2 years at the time of the survey. Analyses restricted to 66 countries with information about household wealth.

Our reviews suggest important protection against otitis media in children younger than 2 years of age, mostly from high-income settings, but inconclusive findings for older children (table).[22] We saw no clear evidence of protection against allergic disorders: no association with eczema or food allergies and some evidence of protection against allergic rhinitis in children younger than 5 years.[23] When we analysed the 29 studies of asthma, we noted statistically significant evidence of a 9% (95% CI 2–15) reduction in asthma with breastfeeding, but effects were smaller and non-significant when we restricted analyses to the 16 studies with tighter control of confounding (a reduction of 5% [–6 to 15]) or to the 13 cohort studies (6% reduction [–11 to 20]).

On the basis of 49 studies done mostly in LMICs, our analyses of oral health outcomes (table) showed that breastfeeding was associated with a 68% reduction (95% CI 60–75) in malocclusions.[26] Most studies were restricted to young children with deciduous teeth, but malocclusion in this age group is a risk factor for malocclusion in permanent (adult) teeth.[36,37] However, breastfeeding for longer than 12 months and nocturnal feeding were associated with 2–3-times increases in dental caries in deciduous teeth, possibly due to inadequate oral hygiene after feeding.[25]

	Outcome	Types of comparison (breastfeeding categories)	Studies (n)	Age range of outcome	Pooled effect (95% CI)	Confounding and effect modification	Other biases	Conclusions
Effects on children, adolescents, or adults according to breastfeeding pattern								
Sankar et al (2015)[10]	Mortality due to infectious diseases	Exclusive versus predominant	3	<6 months	OR 0·59 (0·41–0·85)	All studies from LMICs, where confounding by SEP would probably underestimate the effect of breastfeeding. Confounder-adjusted studies showed similar effects	Studies that avoided reverse causation (breastfeeding stopped because of illness) showed similar effects. No evidence of publication bias but very few studies available	Consistent evidence of major protection. Few studies used the four breastfeeding categories in young infants, but evidence from other studies comparing any versus no breastfeeding is very consistent
Sankar et al (2015)[10]	Mortality due to infectious diseases	Exclusive versus partial	3	<6 months	OR 0·22 (0·14–0·34)	See above	See above	See above
Sankar et al (2015)[10]	Mortality due to infectious diseases	Exclusive versus none	2	<6 months	OR 0·12 (0·04–0·31)	See above	See above	See above
Sankar et al (2015)[10]	Mortality due to infectious diseases	Any versus none	9	6–23 months	OR 0·48 (0·38–0·60)	See above	See above	See above
Horta et al (2013)[21]	Diarrhoea incidence	More versus less breastfeeding (eg, exclusive *vs* non-exclusive; predominant *vs* partial; partial *vs* none; any breastfeeding *vs* no breastfeeding)	15	<5 years	RR 0·69 (0·58–0·82)	Most studies were from LMICs, where confounding would probably underestimate an effect. Confounder-adjusted studies showed similar effects. Three RCTs of breastfeeding promotion (not included in the meta-analysis) showed protection against diarrhoea morbidity (pooled OR 0·69 [0·49–0·96])	Few studies that allowed for reverse causation also showed protection. Publication bias is unlikely to explain the findings because results from large and small studies were similar	Strong evidence of major protection against diarrhoea morbidity and admissions to hospital, particularly in young infants, based on a large number of studies
Horta et al (2013)[21]	Diarrhoea incidence	See above	23	<6 months	RR 0·37 (0·27–0·50)	See above	See above	See above
Horta et al (2013)[21]	Diarrhoea incidence	See above	11	6 months to 5 years	RR 0·46 (0·28–0·78)	See above	See above	See above
Horta et al (2013)[21]	Admission to hospital for diarrhoea	See above	9	<5 years	RR 0·28 (0·16–0·50)	See above	See above	See above
Horta et al (2013)[21]	Lower respiratory infections (incidence or prevalence)	See above	16	<2 years	RR 0·68 (0·60–0·77)	Most studies were from LMICs, where confounding would probably underestimate the effect of breastfeeding. Confounder-adjusted studies showed similar effects	Studies that avoided reverse causation showed similar effects. No evidence of publication bias	Strong evidence of a reduction in severe respiratory infections in breastfed children, based on a large number of studies
Horta et al (2013)[21]	Admissions to hospitals for respiratory infections	See above	17	<2 years	RR 0·43 (0·33–0·55)	The only available RCT showed an RR of 0·85 (0·57–1·27), a non-significant reduction in admissions to hospital	See above	See above

(Table continues on next page)

Information about breastfeeding and child growth was derived from 17 studies, including 15 randomised controlled trials, mostly from middle-income countries.[24] Attained weight and length at about 6 months did not differ, but there was a small reduction (*Z* score –0·06 [95% CI –0·12 to 0·00]) in body-mass index (BMI) or bodyweight for length in children whose mothers received the breastfeeding promotion intervention compared with those whose mothers did not receive the promotion intervention (table).

Long-term effects in children: obesity, non-communicable diseases, and intelligence

We updated existing meta-analyses[38] on the associations between breastfeeding and outcomes related to non-communicable diseases (table). Most studies are from high-income settings. Based on all 113 studies identified, longer periods of breastfeeding were associated with a 26% reduction (95% CI 22–30) in the odds of overweight or obesity.[27] The effect was consistent across income classifications. The only breastfeeding promotion trial

	Outcome	Types of comparison (breastfeeding categories)	Studies (n)	Age range of outcome	Pooled effect (95% CI)	Confounding and effect modification	Other biases	Conclusions
(Continued from previous page)								
Bowatte et al (2015)[22]	Acute otitis media	More versus less breastfeeding (ever *vs* never; exclusive breastfeeding at 6 months *vs* not exclusive breastfeeding at 6 months; any breastfeeding for ≥3–4 months *vs* <3–4 months)	11	≤2 years	OR 0·67 (0·62–0·72)		Egger's test for small study effects showed weak evidence for publication bias (p=0·360)	Consistent evidence of reduction in acute otitis media during the first 2 years of life associated with longer durations of breastfeeding, based on 11 studies. No evidence of protection after 2 years
Bowatte et al (2015)[22]	Acute otitis media	See above	5	>2 years	OR 1·21 (0·60–2·45)	Most studies were done in HICs. Several studies did not adjust for important confounders	High heterogeneity (I^2=84%) among the five studies of children older than 2 years	See above
Lodge et al (2015)[23]	Eczema	More versus less breastfeeding (ever *vs* never; exclusive breastfeeding at 6 months *vs* not exclusive breastfeeding at 6 months; any breastfeeding for ≥3–4 months *vs* <3–4 months)	17	≤2 years	OR 0·95 (0·85–1·07)	About a third of the studies were from LMICs, and results are similar to those from HICs. Few studies in young children account for reverse causation. Several studies did not adjust for essential confounders	Some evidence of publication bias, with smaller pooled effect sizes in larger studies	No evidence of an association between breastfeeding and eczema
Lodge et al (2015)[23]	Ezcema	See above	20	>2 years	OR 1·09 (0·99–1·20)	See above	See above	See above
Lodge et al (2015)[23]	Food allergies	See above	10	≤5 years	OR 1·07 (0·90–1·26)	See above	The ten studies on food allergy in children ≤5 years were highly heterogeneous (I^2=88%)	No evidence of an association between breastfeeding and food allergies
Lodge et al (2015)[23]	Food allergies	See above	4	>5 years	OR 1·08 (0·73–1·26)	See above	See above	See above
Lodge et al (2015)[23]	Allergic rhinitis	See above	5	≤5 years	OR 0·79 (0·63–0·98)	See above	See above	Possible protection against allergic rhinitis in children <5 years, based on only five studies
Lodge et al (2015)[23]	Allergic rhinitis	See above	9	>5 years	OR 1·05 (0·99–1·12)	See above	See above	No evidence for those older than 5 years
Lodge et al (2015)[23]	Asthma or wheezing	See above	29	5–18 years	OR 0·91 (0·85–0·98)	The protective effect of asthma was smaller and not significant in 16 studies with thorough control for confounders (OR 0·95 [0·85–1·06]) and in the 13 cohort studies (OR 0·94 [0·80–1·11]). There were too few studies to estimate association with asthma in adults	See above	Inconclusive evidence for the association between breastfeeding and the risk of asthma or wheezing

(Table continues on next page)

that reported on this outcome did not detect an association; in this trial, the investigators reported important early differences between intervention and comparison groups in terms of exclusive breastfeeding, but at 12 months of age only 19% of children in the intervention group and 11% of children in the comparison group were breastfed.[39,40] A 2005 meta-analysis[41] of breastfeeding and mean BMI included 36 articles of which 11 included adjustment for socioeconomic status, maternal smoking, and maternal BMI; their pooled effect did not suggest an association with breastfeeding. In our review,[27] 23 high-quality studies with sample sizes of

	Outcome	Types of comparison (breastfeeding categories)	Studies (n)	Age range of outcome	Pooled effect (95% CI)	Confounding and effect modification	Other biases	Conclusions
(Continued from previous page)								
Giugliani et al (2015)[24]	Length	Randomised trials or quasi-experiments comparing children receiving breastfeeding promotion interventions with control children	17	About 6 months (range 3–24)	*Z* score 0·03 (−0·02 to 0·08)	Most studies are from middle-income countries. Confounding is unlikely because 15 of the 17 studies were randomised trials. Analyses were by intent to treat, so that low compliance with breastfeeding promotion might underestimate the magnitude of the effect	Evidence of publication bias for BMI, with small studies showing larger reductions	No evidence of an effect on breastfeeding promotion on length at 6 months of age
Giugliani et al (2015)[24]	Weight	See above	16	See above	*Z* scores 0·03 (−0·06 to 0·12)	See above	See above	No evidence of an effect on breastfeeding promotion on weight at 6 months of age
Giugliani et al (2015)[24]	BMI or weight for length	See above	11	See above	*Z* scores −0·06 (−0·12 to 0·00)	See above	See above	Some evidence supporting a reduction in BMI or weight for length
Tham et al (2015)[25]	Dental caries	Breastfeeding >12 months versus ≤12 months	4	<6 years	OR 2·69 (1·28–5·64)	Most studies did not control for the introduction of sugary foods and drinks. Most studies were from HICs, where high SEP would be expected to negatively confound the association	Publication biases veer toward studies that show an association between breastfeeding beyond 12 months or on demand and dental caries	Consistent evidence that breastfeeding >12 months has detrimental effects on deciduous teeth
Tham et al (2015)[25]	Dental caries	Breastfeeding on demand or nocturnal feeding versus not (in breastfed children)	6	<6 years	OR 2·90 (2·33–3·60)	See above	See above	Consistent evidence that breastfeeding on demand has detrimental effects on deciduous teeth
Peres et al (2015)[26]	Malocclusion	Never versus ever breastfeeding; longer versus shorter duration of exclusive breastfeeding; or longer versus shorter duration of any breastfeeding	41	Childhood, adolescence, and adulthood	OR 0·32 (0·25–0·40)	80% of the studies were from LMICs. Because malocclusions are not associated with SEP or any other known determinant of breastfeeding patterns, it is unlikely that these results are affected by confounding	Some evidence of publication bias but the association was also present in the larger and better designed studies	Consistent evidence of a major, two-thirds reduction in malocclusions in deciduous teeth in breastfed individuals
Horta et al (2015)[27]	Systolic blood pressure	Never versus ever breastfed; or longer versus shorter breastfed duration	43	Childhood, adolescence and adulthood	−0·80 mm Hg (−1·17 to −0·43)	Three-quarters of the studies were from LMICs. Evidence of residual confounding as effect in studies from HIC but not in those from LMICs	Evidence of publication bias in systolic blood pressure studies	No evidence of a reduction in blood pressure associated with breastfeeding
Horta et al (2015)[27]	Diastolic blood pressure	Never versus ever breastfed; or longer versus shorter breastfeeding duration	38	Childhood, adolescence, and adulthood	−0·24 mm Hg (−0·50 to 0·02)	See above	Evidence of publication bias in diastolic blood pressure studies	See above
Horta et al (2015)[27]	Overweight or obesity	Never versus ever breastfed; longer versus shorter duration of exclusive breastfeeding; or longer versus shorter duration of any breastfeeding	113	Childhood, adolescence, and adulthood	OR 0·74 (0·70–0·78)	In HICs, residual confounding by SEP is a possibility; however, the effect size was similar in studies from LMICs (a third of all studies). 23 high-quality studies showed a smaller pooled reduction of 13% (95% CI 6–19)	Some evidence of publication bias with larger effects in small studies, but even large and well controlled studies showed a 20% reduction in prevalence	Suggestive evidence of protection, including high-quality studies and those from low-income or middle-income settings

(Table continues on next page)

	Outcome	Types of comparison (breastfeeding categories)	Studies (n)	Age range of outcome	Pooled effect (95% CI)	Confounding and effect modification	Other biases	Conclusions
(Continued from previous page)								
Horta et al (2015)[27]	Total cholesterol	Never versus ever breastfed; or longer versus shorter breastfeeding duration	46	Childhood, adolescence, and adulthood	−0·01 mmol/L (−0·05 to 0·02)	No evidence of heterogeneity with nearly all studies showing small effects. Three-quarters of the studies were from HICs	No evidence of an association	No evidence of an association
Horta et al (2015)[27]	Type 2 diabetes	Never versus ever breastfed; longer versus shorter duration of exclusive breastfeeding; or longer versus shorter duration of any breastfeeding	11	Childhood, adolescence, and adulthood	OR 0·65 (0·49–0·86)	Only two of 11 studies were from LMICs; these studies showed 14% reduction; residual confounding might have affected HIC studies	Few available studies; no evidence of publication bias	Restricted evidence of protection, based on 11 studies
Horta et al (2015)[28]	Intelligence	Never versus ever breastfed; or longer versus shorter breastfeeding duration	16	Childhood, adolescence, and adulthood	IQ points: 3·44 (2·30–4·58)	In HICs (14 of the 16 studies), residual confounding by SEP was a possibility; however, the effect was also present in two studies from LMICs. One high-quality RCT showed a statistically significant increase in IQ of more than 7 points	Some evidence of publication bias with larger effects in small studies, but even large studies showed an effect. Nine studies with adjustment for maternal IQ showed difference of 2·62 points (1·25–3·98)	Consistent effect of about 3 IQ points in observational studies; also present a large RCT on this topic
Effects on women who breastfed								
Chowdhury et al (2015)[29]	Lactational amenorrhoea	Highest versus lowest duration of breastfeeding	13	Women (<1 year post partum)	RR 1·17 (1·04–1·32)	Most studies were from LMICs. Residual confounding unlikely. Strongest effects when exclusive or predominant breastfeeding are compared with partial (RR 1·21) or no breastfeeding (RR 1·23)	No evidence of publication bias	Consistent effect on prolonging lactational amenorrhoea, especially for exclusive or predominant breastfeeding
Chowdhury et al (2015)[29]	Breast cancer	Highest versus lowest duration of breastfeeding	76	Adult women	OR 0·81 (0·77–0·86)	Three-quarters of the studies were from HICs. Parity reduces the risk of breast cancer and is also associated with greater lifetime breastfeeding duration. Most studies did not adjust appropriately for parity and therefore tended to exaggerate effect size. A thoroughly adjusted pooled analysis of 47 studies shows an OR of 0·96 for each 12 months of breastfeeding[30]	Some evidence of publication bias but the association was also present in the larger and better designed studies	Consistent protective effect of breastfeeding against breast cancer in 47 well designed studies, of a 4·3% reduction per 12 months of breastfeeding in the better controlled studies
Chowdhury et al (2015)[29]	Ovarian cancer	Highest versus lowest duration of breastfeeding	41	Adult women	OR 0·70 (0·64–0·75)	Only six studies from LMICs. Confounding by parity might affect the results but socioeconomic confounding is unlikely. Studies with fine adjustment for parity and exclusion of nulliparous women showed less protection with an OR of 0·82 (0·75–0·89)	Some evidence of publication bias, with smaller pooled effect sizes in the 22 studies with samples larger than 1500 women (OR 0·76 [0·69–0·84])	Suggestive evidence of a protective effect of breastfeeding
Chowdhury et al (2015)[29]	Osteoporosis (distal radius)	Highest versus lowest duration of breastfeeding	4	Adult women	SDS −0·132 (−0·260 to −0·003)	All studies from HICs. High heterogeneity in the distal radius analyses with the largest study showing no association and smaller studies showing protection	Not assessed because of small number of studies	Insufficient evidence

(Table continues on next page)

	Outcome	Types of comparison (breastfeeding categories)	Studies (n)	Age range of outcome	Pooled effect (95% CI)	Confounding and effect modification	Other biases	Conclusions
(Continued from previous page)								
Chowdhury et al (2015)[29]	Osteoporosis (femoral neck)	Highest versus lowest duration of breastfeeding	4	Adult women	SDS −0·142 (−0·426 to 0·142)	All studies from HICs. None of the studies showed an association	Not assessed because of small number of studies	Insufficient evidence
Aune et al (2013)[31]	Type 2 diabetes	Highest versus lowest duration of breastfeeding	6	Adult women	RR 0·68 (0·57–0·82)	Several confounding factors were adjusted for. Significant protection also seen for 3-month and 12-month increases in breastfeeding duration. Five of the six studies were from HICs. All six studies showed protection	Few available studies; no evidence of publication bias	Restricted evidence of protection against type 2 diabetes in women who breastfed for longer periods
Neville et al (2014)[32]	Post-partum weight change	Qualitative review	45	Women (<2 years post partum)	Not estimated because of different outcome measures at variable post-partum ages	Studies were highly variable. Most studies saw no association. Of the five studies with high methodological quality, four reported beneficial effects. Nearly all studies from HICs	Not assessed in the published review	The role of breastfeeding on post-partum weight change is uncertain

Data are odds ratio (95% CI), risk ratio (95% CI), *Z* score (95% CI), mm Hg (95% CI), mmol/L (95% CI), intelligence quotient (95% CI), or standard deviation scores (95% CI). In 22 sets of analyses, the summary effect sizes are the pooled results of studies comparing longer versus shorter breastfeeding durations (either never *vs* ever breastfed; exclusive breastfeeding for more than a specific number of months *vs* less than that number of months; or any breastfeeding for more than a specific number of months *vs* less than that number of months). Separate results for each type of categorisation are available in the appendix. OR=odds ratio. LMICs=low-income and middle-income countries. SEP=socioeconomic position. RR=risk ratio. RCT=randomised controlled trial. HICs=high-income countries. BMI=body-mass index. IQ=intelligence quotient. SDS=SD score.

Table: **Results of meta-analyses on the associations between breastfeeding and outcomes in children and mothers**

more than 1500 participants and adjustment for socioeconomic status, maternal BMI and perinatal morbidity showed a pooled reduction in the prevalence of overweight or obesity of 13% (95% CI 6–19).

For the incidence of type 2 diabetes, the pooled results from 11 studies indicate a 35% reduction (95% CI 14–51). We deemed only three studies to be of high quality, which indicated a potentially important, but not statistically significant, reduction of 24% (95% CI ranging from a 60% reduction to a 47% increase).[27] The direction and magnitude of the association with diabetes are consistent with findings for overweight. An earlier review of six studies indicated a possible protective effect against type 1 diabetes.[34] The meta-analyses for systolic (43 studies) and diastolic (38 studies) blood pressure, and total cholesterol (46 studies) showed no evidence of protective effects of breastfeeding.[27]

Breastfeeding was consistently associated with higher performance in intelligence tests in children and adolescents, with a pooled increase of 3·4 intelligence quotient (IQ) points (95% CI 2·3–4·6) based on the findings of 16 observational studies that controlled for several confounding factors including home stimulation (table).[28] Nine studies also adjusted for maternal intelligence, showing a pooled effect of 2·6 points (1·3–4·0). A large randomised trial reported an increase of more than 7 IQ points at 6·5 years of age,[42] and a similar effect was reported in a non-randomised trial in which preterm infants were fed formula or breastmilk.[43] Positive associations with attained schooling were reported from the UK,[44,45] New Zealand,[46] and Brazil,[47] but a joint analysis of four cohorts in LMICs showed mixed results.[48] A study in Brazil including 30 years of follow-up suggested an effect of breastfeeding on intelligence, attained schooling, and adult earnings, with 72% of the effect of breastfeeding on income explained by the increase in IQ.[49] A review of 18 studies suggested that breastfeeding is associated with a 19% reduction (95% CI 11–27) in the incidence of childhood leukaemia.[50]

Effects on the mother

The table shows the results of new reviews (published in July, 2015) on lactational amenorrhoea, breast and ovarian cancer, type 2 diabetes, and osteoporosis.[29] We also cite existing reviews on diabetes, weight retention, and maternal depression. Most studies were from high-income countries, except for those on lactational amenorrhoea.

The role of breastfeeding in birth spacing is well recognised. In 2003, it was estimated that in countries where continued breastfeeding is prevalent, eg, Uganda and Burkina Faso, 50% more births would be expected in the absence of breastfeeding.[51] Our review confirms that increased breastfeeding, and especially exclusive or predominant breastfeeding, were associated with longer periods of amenorrhoea.[29] Findings from randomised controlled trials of breastfeeding promotion interventions also confirm this effect.[52]

Evidence exists of a robust inverse association between breastfeeding and breast cancer (table). The largest individual-level analysis on this topic included about 50 000 patients with cancer from 47 studies,[30] which is about half those included in our meta-analysis. Each 12-month increase in lifetime breastfeeding was associated with a reduction of 4·3% (95% CI 2·9–6·8) in the incidence of invasive breast cancer. This analysis included thorough adjustment parity and other confounders; nulliparous women were excluded. The results did not vary substantially according to menopausal status. Our meta-analysis suggests a higher magnitude of protection, but when restricted to the 14 studies with fine adjustment for parity and exclusion of nulliparous women, the reduction comparing longer versus shorter breastfeeding durations was 7% (95% CI 3–11).[29]

The meta-analysis of 41 studies on breastfeeding and ovarian cancer shows a 30% reduction associated with longer periods of breastfeeding (95% CI 25–36). Confounding by parity might affect the results but socioeconomic confounding is unlikely because socioeconomic status is only weakly associated with ovarian cancer incidence. The pooled reduction, based on studies with fine adjustment for parity and exclusion of nulliparous women, was 18% (14–42).[29] We also reviewed the evidence on osteoporosis, finding no evidence of an association between breastfeeding and bone mineral density in the four studies available (table).[29]

A meta-analysis of six cohort studies on type 2 diabetes showed an odds ratio of 0·68 (95% CI 0·57–0·82).[31] In view of this finding, an association could be predicted with overweight, but a review of 54 articles on the possible role of breastfeeding on postpartum weight change was inconclusive.[32] Few studies are available for the long-term association between nursing and adiposity. After the review of studies on overweight and breastfeeding was published, an analysis of 740 000 British women with long-term follow-up showed that mean BMI was 1% lower for every 6 months that the woman had breastfed.[53] A qualitative review of 48 studies showed clear associations between breastfeeding and reduced maternal depression,[54] but it is more likely that depression affects breastfeeding than the opposite.

Estimating lives saved for children and mothers

The Lives Saved Tool[8] estimates that 823 000 annual deaths would be saved in 75 high-mortality LMICs in 2015 if breastfeeding was scaled up to near universal levels. This corresponds to 13·8% of the deaths of children under 2 years of age. For preventable deaths, 87% would have occurred in infants younger than 6 months due to a combination of high death rates and low prevalence of exclusive breastfeeding.

We also estimated the potential effect of breastfeeding on breast cancer mortality (appendix pp 31–37). Using the estimates of protection from the pooled study, we estimate that existing global rates of breastfeeding avert 19 464 annual breast cancer deaths compared with a scenario in which no women breastfed (table).[30] The low-income regions with long breastfeeding durations (Africa and south Asia) account for 58% of currently prevented deaths, despite only accounting for 36% of the global population included in this analysis. We also estimate that an additional 22 216 lives per year would be saved by increasing breastfeeding duration from present levels to 12 months per child in high-income countries and 2 years per child in LMICs. We cannot model the same effect in all countries given the differences in data availability and the fact that very few children in high-income countries are breastfed for longer than 12 months. Latin America, central and eastern Europe, the Commonwealth of Independent States, and high-income countries would benefit most because of their higher incidence of breast cancer and also shorter breastfeeding durations at present.

Conclusions

The fact that the reproductive cycle includes breastfeeding and pregnancy[1] has been largely neglected by medical practice, leading to the assumption that breastmilk can be replaced with artificial products without detrimental consequences. This neglect is particularly important in high-income countries, where fewer than one in every five children are breastfed by the age of 12 months. For each doubling in national gross domestic product per person, breastfeeding prevalence at 12 months decreases by 10 percentage points.

Findings from epidemiology and biology studies substantiate the fact that the decision to not breastfeed a child has major long-term effects on the health, nutrition, and development of the child and on women's health. Possibly, no other health behaviour can affect such varied outcomes in the two individuals who are involved: the mother and the child. Findings from immunology, epigenetic, microbiome, and stem-cell studies done over the past two decades that elucidate potential mechanisms through which breastfeeding can improve outcomes will probably be followed by other, even more exciting discoveries on the exquisite personalised medicine provided by human milk (panel).

Our global analyses show that more than 80% of neonates receive breastmilk in nearly all countries. However, only about half begin breastfeeding within the first hour of life, even though such a recommendation was issued by WHO more than 25 years ago.[70] Because 60% of the world's children are now delivered by skilled assistants,[9] further promotion of early initiation is possible. In most countries, rates of exclusive breastfeeding are well below 50%, and the correlation with the duration of any breastfeeding is only moderate. This finding signals the need to tailor breastfeeding support strategies to specific patterns recorded in each country. In the poorest countries, late initiation and low rates of exclusive breastfeeding are the main challenges. In middle-income and high-income

Panel: Breastmilk—a personalised medicine

The nutritional advantages of breastfeeding and its protection against infection are well known. In the past two decades, the possibility that crucial imprinting events might be modulated during breastfeeding, with potential lifelong effects for the infant, has become apparent.[55] These events might be mediated directly or through effects on the infant microbiome. The ability of the microbiome to regulate host responses in infancy depends on individual bacterial species, which modulate T-cell polarisation and immune regulation, metabolic responses, adipogenesis, and possibly even brain development and cognitive functioning.[56,57] Abnormal colonisation patterns have a deleterious long-term effect on immune and metabolic homoeostasis. It is therefore remarkable that a mother's breastmilk transmits elements of her own microbiome and immune responses, and also provides specific prebiotics to support growth of beneficial bacteria.

Delivery mode initially established whether the gut flora of the mother (vaginal delivery) or the skin flora of the birth attendants (caesarean section) dominates the initial colonisers,[58] which induce an important immune response in the infant. Feeding mode is the second fundamental determinant of the infant microbiome. Breastfed infants maintain persistent microbial differences, independent of delivery mode,[59,60] owing to the effects of human milk oligosaccharides (HMOs). Human milk contains a much wider variety of sugars than other mammalian milks: up to 8% of its calorific value is provided in the form of indigestible HMOs, which function as prebiotics to support growth of specific bacteria. They cannot be used by most enteric organisms, but support growth of *Bifidobacterium longum* biovar *infantis*, which has co-evolved to express the enzymes needed for the utilisation of HMOs.[55] Substantial inter-individual variation exists in maternal HMO production, which in turn underpins the pattern of flora acquisition by the infant.[61] Therefore, there is specificity of the interaction between breastmilk and the infant microbiome, causing different bacterially induced effects on the infant's metabolism and immunity.

This specificity of interaction is further underpinned by the mother's enteromammary axis. To maintain her own gut homoeostasis, the mother's intestinal dendritic cells take up individual bacteria from the lumen and transport them to gut lymphoid follicles,[56] where T cells are committed to a regulatory phenotype and B cells shifted towards immunoglobulin A. Programmed dendritic cells and lymphocytes then re-enter the circulation before homing back to the gut through interaction between their induced β7 integrins and locally expressed mucosal vascular addressin cell adhesion molecule (MAdCAM-1). MAdCAM-1 is expressed in the mammary endothelium during pregnancy, allowing selective uptake by the breast of gut-programmed cells.[62] The consequences of enteromammary trafficking include the release of dendritic cells containing live maternal gut bacteria, T cells expressing gut-derived β7 integrins, and plasma cells producing immunoglobulin A specific for maternal gut bacteria into the colostrum and breastmilk. Breastmilk therefore contains a dominance of immune cells of gut-related phenotype (γδ cells, β7+ cells) that have matured within the mother's intestine.[63] Breastmilk cytokines also vary depending on the mother's immunological experiences. Therefore, there is coordinated input to the infant's nascent mucosal immune system, specific for the mother's microbiome, in which individual bacterial types are favoured and tolerogenic immune responses are transmitted. Caesarean section, perinatal antibiotics, and failure to breastfeed are the three major factors that affect this co-evolved imprinting process. Findings from a study of flora acquisition and immune responses in primates identified clear differences in both gut bacterial composition and mucosal immune responses in breastfed compared with formula-fed macaques, with the responses persisting into adult life.[64]

In addition to changes mediated through the flora, individual breastmilk components might directly affect epigenetic programming of the infant.[65] The usual adverse effect of peroxisome proliferator-activated receptor-γ polymorphisms on adiposity and metabolism is prevented by breastfeeding, possibly due to the content of peroxisome proliferator-activated receptor-modulating constituents such as long-chain polyunsaturated fatty acids and prostaglandin J.[66] Protection against breast cancer for a breastfeeding mother might also be mediated through peroxisome proliferator-activated receptor modulation.[66] Lactoferrin, a major breastmilk component, binds bacterial CpG motifs and blunts mucosal NF-κB responses to the flora. Microvesicles called exosomes are secreted into breastmilk, and might inhibit atopic sensitisation dependent on maternal immune experience.[67] Breastmilk fat globules contain many secreted micro-RNAs, the expression of which is modulated by maternal diet, which are predicted to target several genes in the infant.[68] Evidence also exists that multipotential stem cells are secreted into breastmilk and can persist within infants.[69]

Human breastmilk is therefore not only a perfectly adapted nutritional supply for the infant, but probably the most specific personalised medicine that he or she is likely to receive, given at a time when gene expression is being fine-tuned for life. This is an opportunity for health imprinting that should not be missed.

countries, short overall duration of breastfeeding is an additional challenge.

Our time-trend analyses show that, for LMICs as a whole, exclusive breastfeeding has increased by about 0·5 percentage points per year since 1993, reaching 35% in 2013. In 2012, the 56th World Health Assembly set as a target for 2025 to "increase the rate of exclusive breastfeeding in the first 6 months up to at least 50%".[71]

To achieve this goal would need a doubling of the recent annual increase, to more than 1 percentage point a year in the next decade, which is already the rate for the richest 20% of people. In view of the benefits of exclusive breastfeeding and of present achievements by leading countries, could a more ambitious target not be aimed for? The Assembly did not set a goal for continued breastfeeding.

In terms of inequalities, our findings show that breastfeeding is one of the few positive health behaviours that is more prevalent in poor than in rich countries. They also show that poor women breastfeed for longer than rich women in LMICs, whereas in high-income countries the pattern is reversed. These results suggest that breastfeeding patterns are contributing to reducing the health gaps between rich and poor children in LMICs, which would be even greater in the absence of breastfeeding.

In LMICs, there are no inequalities between rich and poor mothers in exclusive breastfeeding rates. Findings from our time-trend analyses suggest that this is because rich mothers are adopting exclusive breastfeeding at a much faster rate than are poor mothers—only 20 years ago, the poorer mothers had substantially higher rates of exclusive breastfeeding. Continued breastfeeding is still more common in poor mothers than in wealthy mothers, but rates seem to be dropping among these while remaining stable in rich mothers. Protecting breastfeeding in the world's poorest populations is therefore a major priority.

Our systematic reviews emphasise how important breastfeeding is for all women and children, irrespective of where they live and of whether they are rich or poor. Appropriate breastfeeding practices prevent child morbidity due to diarrhoea, respiratory infections, and otitis media. Where infectious diseases are common causes of death, breastfeeding provides major protection, but even in high-income populations it lowers mortality from causes such as necrotising enterocolitis and sudden infant death syndrome. Available evidence shows that breastfeeding enhances human capital by increasing intelligence. It also helps nursing women by preventing breast cancer. Additionally, our review suggests likely effects on overweight and diabetes in breastfed children, and on ovarian cancer and diabetes in mothers. The only harmful consequence of breastfeeding we detected was an increase in tooth decay in children breastfed for more than 12 months. In view of the many benefits of breastfeeding, this observation should not lead to discontinuation of breastfeeding but rather to improved oral hygiene.

Findings from our systematic reviews are restricted by the observational nature of most of the available data for breastfeeding and by the limitations of meta-analyses.[72,73] Experimental data are scarce because breastfeeding promotion activities must be highly effective to change feeding patterns to an extent that leads to a measurable effect on short-term and long-term outcomes. Moreover, confounding can occur because breastfeeding is associated with higher socioeconomic position in high-income countries. Our reviews included subanalyses of studies with tight control for confounding. Whenever possible, we also did separate analyses of studies from LMICs, because poor individuals tend to breastfeed for longer than rich people in these countries (appendix p 40), an association that is reversed in high-income countries. Interpretation of associations is also affected by the fact that non-breastfed infants receive different diets in different countries—eg, animal milk in most poor societies and formula in middle-income and high-income populations. The association between breastfeeding and overweight, for example, is probably affected by the diet of infants who are not breastfed.

No consensus exists about whether or not breastfeeding can protect against a child's later risk of overweight or diabetes,[34,38,41] largely because of potential residual confounding. Although the evidence is not as strong as it is for infections or intelligence, we argue that the evidence linking breastfeeding with protection from later overweight or diabetes is growing. Findings from our meta-analyses showed that the association persisted when restricted to only high-quality studies, and also when restricted to studies from only low-income and middle-income settings. The association seems to be specific—eg, we noted no effect on blood pressure or blood lipid concentrations, for which confounding patterns are similar. Finally, findings from randomised trials of breastfeeding promotion in infancy indicate a reduction in adiposity.

The scaling up of breastfeeding practices to almost universal levels is estimated to prevent 823 000 annual deaths, or 13·8% of all deaths of children younger than 24 months in the 75 Countdown to 2015[9] countries. The target of 95% of all infants younger than 6 months having exclusive breastfeeding is ambitious because at present the highest national prevalences are 85% in Rwanda and 76% in Sri Lanka. We also used a target of 90% for any breastfeeding from 6–23 months, but five countries already have levels that are above this target (Nepal, Rwanda, Ethiopia, Burundi, and Guinea). We acknowledge that these targets are ambitious, but the estimates show the potential for lives saved if mothers and children adhered to international recommendations. Despite differences in methods, our estimates about potential lives saved are consistent with those from the 2013 *Lancet* Nutrition Series (804 000 deaths)[74] but higher than those from the 2010 Global Burden of Disease study (540 000 deaths),[75] in which the assumptions and methods were not sufficiently detailed to understand the reasons for the discrepancy. Breastfeeding is potentially one of the top interventions for reducing under-5 mortality, and the modest changes in breastfeeding rates since 2000 have contributed to the fact that most LMICs did not reach the fourth Millennium Development Goal,

to reduce under-5 mortality by two-thirds.[76] We show that increasing exclusive breastfeeding should be among the top priorities for reducing infant deaths.

As an example of the potential to save women's lives, we estimated that present rates of breastfeeding prevent almost 20 000 annual deaths from breast cancer, and an additional 20 000 are preventable by scaling up breastfeeding practices (appendix). To achieve its full effect, breastfeeding should continue up to the age of 2 years. Protection against mortality and morbidity from infectious diseases extends well into the second year of life—eg, breastfeeding prevents half of deaths caused by infections in children aged 6–23 months. Protection against otitis media, a common childhood illness throughout the world, also extends to 2 years and possibly beyond. Findings from studies of overweight and obesity show that longer durations of breastfeeding are associated with lower risk, as do studies of IQ showing a clear dose–response association with duration. Breast cancer is reduced by lifetime duration of breastfeeding in women, with a 6% reduction for every 12 months.[50] Findings from ethnographical research show that total duration of breastfeeding ranges between 2 and 4 years in most traditional societies,[77] and our review of the literature lends support to international recommendations about the total duration of breastfeeding, in both high-income and low-income countries.

Data availability for breastfeeding patterns shows an unusual distribution. Health authorities and researchers in high-income countries seem to neglect breastfeeding to such an extent that most of these countries are unable to report on reliable, standardised indicators. This situation contrasts sharply with the high quality of data for breastfeeding in LMICs, as a consequence of the regular conduct of standardised surveys such as the Demographic and Health Surveys and Multiple Indicator Cluster Surveys.

Our findings show how essential the protection, promotion, and support of breastfeeding is for the achievement of many of the newly launched Sustainable Development Goals by 2030. Breastfeeding is clearly relevant to the third sustainable goal, which includes not only maternal and child health but also non-communicable diseases such as breast cancer and diabetes as well as overweight and obesity. It is also relevant to the second goal (on nutrition). The effect of breastfeeding on intelligence and on human capital is relevant to the fourth goal (education), the first goal (poverty), and the eighth goal (inclusive economic growth). Finally, by helping close the gap between rich and poor, breastfeeding can contribute to goal number ten—reducing inequalities.

Contributors

CGV and NCR had the idea for the paper. CGV was the primary author. The other co-authors contributed specific sections: SM (biological mechanisms), SH (breast cancer cases averted), NW (child lives saved), MJS (meta-analysis on child mortality), and RB (early initiation of breastfeeding). AJDB, GVAF, and JK collected and analysed the data. All authors revised the draft report and approved the final version.

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Declaration of interests

SH has received grants from WHO during the conduct of the study, and SM has received personal fees from Nutricia and Mead Johnson, outside the submitted work. NCR has received grants from the Bill & Melinda Gates Foundation during the conduct of the study. CGV, RB, AJDB, GVAF, JK, MJS, and NW declare no competing interests.

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Breastfeeding 2

Why invest, and what it will take to improve breastfeeding practices?

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Despite its established benefits, breastfeeding is no longer a norm in many communities. Multifactorial determinants of breastfeeding need supportive measures at many levels, from legal and policy directives to social attitudes and values, women's work and employment conditions, and health-care services to enable women to breastfeed. When relevant interventions are delivered adequately, breastfeeding practices are responsive and can improve rapidly. The best outcomes are achieved when interventions are implemented concurrently through several channels. The marketing of breastmilk substitutes negatively affects breastfeeding: global sales in 2014 of US$44·8 billion show the industry's large, competitive claim on infant feeding. Not breastfeeding is associated with lower intelligence and economic losses of about $302 billion annually or 0·49% of world gross national income. Breastfeeding provides short-term and long-term health and economic and environmental advantages to children, women, and society. To realise these gains, political support and financial investment are needed to protect, promote, and support breastfeeding.

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This is the second in a **Series** of two papers about breastfeeding

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See **Online** for appendix

Introduction

Breastfeeding improves the survival, health, and development of all children.[1] It saves women's lives and contributes to human capital development. The benefits span populations living in high-income, middle-income, and low-income countries.[1] In the second paper in this Series, we summarise the evidence on determinants of, and interventions to improve, breastfeeding practices. We discuss the effect of the breastmilk substitute industry on breastfeeding practices, and explore the reasons why some countries have been more successful in improving breastfeeding than others. We also estimate some of the economic costs and environmental consequences of not breastfeeding.

The Innocenti Declaration: an ideal not yet realised

Breastfeeding became less common in high-income countries during the 20th century.[2] Similar patterns were also seen in better-educated, wealthier, and urban women in low-income and middle-income countries.[1,3] Breastmilk substitutes were perceived as modern and prestigious, and breastfeeding was associated with being poor and unsophisticated.[4] In August, 1990, policy makers and international agencies adopted the Innocenti Declaration,[5] which affirmed that all infants should receive "exclusive breastfeeding from birth to 4–6 months of age [WHO recommendations amended to 6 months in 2001[6]] and thereafter should continue to be breastfed". In the same year, the UN Convention on the Rights of the Child enshrined health and health care, including the advantages of breastfeeding, as a legal right of the child and the promotion of breastfeeding as a legal obligation of countries that ratified the Convention. The Convention called for states to take appropriate measures for children of working parents, and to protect the public from improper and biased information that persuades mothers to give up breastfeeding.[7] In 1991, the Baby Friendly Hospital Initiative (BFHI) was launched to scale up ten interventions in birthing facilities to protect, promote, and support successful breastfeeding (appendix p 1).[8]

Despite these initiatives being established 25 years ago, global breastfeeding rates remain far below international targets,[9] and commitment to breastfeeding, in terms of policy and investment, is in a state of fatigue.[10] For all low-income and middle-income countries with data, exclusive breastfeeding rates increased from 25% in 1993 to 37% in 2013; in the wealthiest 20% in each country, breastfeeding increased from 16% to 36%, whereas the poorest 20% followed the general trend. Continued

Key messages

- The world is still not a supportive and enabling environment for most women who want to breastfeed.
- Countries can rapidly improve breastfeeding practices by scaling up known interventions, policies, and programmes.
- Success in breastfeeding is not the sole responsibility of a woman—the promotion of breastfeeding is a collective societal responsibility.
- The breastmilk substitute industry is large and growing, and its marketing undermines efforts to improve breastfeeding.
- The health and economic costs of suboptimal breastfeeding are largely unrecognised. Investments to promote breastfeeding, in both rich and poor settings, need to be measured against the cost of not doing so.
- Political support and financial investment are needed to protect, promote, and support breastfeeding to realise its advantages to children, women, and society.

breastfeeding at 12–15 months decreased from 76% to 73% globally, driven largely by the decrease in prevalence in poor populations.[1]

Determinants of breastfeeding

We did a systematic review of available studies to identify the determinants of breastfeeding (appendix pp 2–86), and reviewed and revised previous conceptual frameworks. The conceptual model (figure 1) includes the determinants that operate at multiple levels and affect breastfeeding decisions and behaviours over time. Nearly all women are biologically capable of breastfeeding, bar very few with severely limiting medical disorders.[11] However, breastfeeding practices are affected by a wide range of historical, socioeconomic, cultural, and individual factors (figure 1).

Social and cultural attitudes and market factors shape the structural context for breastfeeding.[12] Breastfeeding is often portrayed as the ideal for babies, demonstrating maternal devotion. However, in some settings women who want to breastfeed in public experience negative reactions.[13,14] Some employers and fellow employees report being uncomfortable with women breastfeeding at work.

In health systems, health-care providers influence and support feeding decisions at key moments before and after birth and later, when challenges occur, to maintain exclusive and continued breastfeeding.[15] Nevertheless, substantial gaps in knowledge and skills to support breastfeeding are reported at all levels of health-care staff.[16,17]

High-risk pregnancies,[18] assisted delivery and long hospital stays,[19] maternal illness,[20] and preterm, ill, or low-birthweight newborn babies,[21] can result in breastfeeding starting later, as can hospital practices such as mother–infant separation,[22] prelacteal supplementation, and free samples of breastmilk substitutes.[23] Within families, the practices and experience of female relatives affect the incidence and duration of breastfeeding.[24,25] In many traditional societies, colostrum is viewed as harmful and discarded,[26] and prelacteal feeds can delay breastfeeding for several days.[27] The attitudes and preferences of fathers can also affect breastfeeding: women whose partners support breastfeeding breastfeed for longer.[28,29]

Women's work is a leading motive for not breastfeeding or early weaning. Its effect is multi-dimensional, including fatigue, practicality, and intensity.[30] The increasing numbers of women in the workforce draw attention to the importance of work-time breaks and on-site rooms for breastfeeding and the provision of maternity leave.[31,32] Most studies report negative effects of work on breastfeeding;[33–35] women planning to return to work after childbirth are less likely to begin or continue breastfeeding.[36,37] Short maternity leave (<6 weeks) leads to a four-times increase in the odds of either not establishing or early cessation of breastfeeding.[38]

At the personal level, breastfeeding intentions are generally established by the third trimester.[39] Subjective norms and benefits of breastfeeding are the most frequently cited reasons for intending to breastfeed. Intention is strongly predictive of initiation[40] and of duration,[41] provided the context is supportive.[42]

Individual factors, including advice and practices that undermine maternal confidence and self-efficacy, negatively affect breastfeeding.[43,44] Poor breastfeeding positioning and latching[45] as well as inadequate support, especially in the first weeks after birth, and anticipation of breastfeeding difficulties are common reasons for abandoning breastfeeding. Mothers who do not successfully breastfeed are less likely to attempt breastfeeding in subsequent pregnancies.[46] Infant crying or fussiness, perceived hunger, and the inability to settle her infant[47,48] often cause a mother to assume that she has insufficient milk and to introduce breastmilk substitutes.[49]

Individual-level factors, including smoking,[50,51] overweight and obesity,[52] and depression,[53] are important determinants because of the large number of women affected.[54,55] In the past 20 years, the HIV epidemic has significantly affected policy and programmatic recommendations, community and family attitudes, and health-care worker confidence in breastfeeding, all of which have detrimentally affected individual feeding practices (appendix pp 87–88).[56–62]

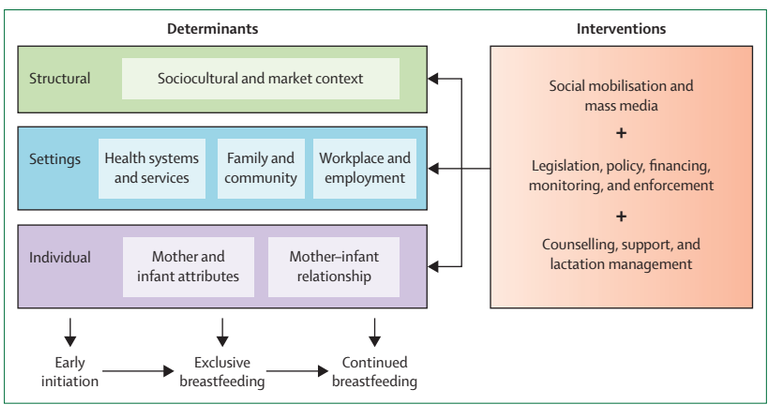

Figure 1: **The components of an enabling environment for breastfeeding—a conceptual model**
The structural level refers to the social factors that affect the whole population. For determinants, these factors include social trends, advertising, media, and products available in stores; interventions at the structural level include legislation, policy, and media and social mobilisation to change social attitudes and practices. These factors are distal and unidirectional. The population is uniformly exposed to them, but they are not uniformly interpreted. Pregnant women and women with young children are affected in more direct and personalised ways than are women with no children and men and community members. This effect occurs through various interactions, attitudes, practices, and information in the three main settings, which are, in turn, affected by the social, cultural, and market context. At the most intimate level, women's breastfeeding behaviour is influenced by personal attributes such as her age, weight, education, and confidence, and by attributes of her baby such as sex, wellbeing, and temperament. Breastfeeding is a behaviour that entails a relationship between mother and baby. Moment-by-moment interactions between them, including whether the baby is thought to be satisfied and content, are the result of the mother's internalisation of the influences at the level of structural determinants and settings.

Interventions to improve breastfeeding practices

Many aforementioned determinants of breastfeeding are amenable to interventions to protect, promote, or support improved breastfeeding.[63] We examined the effects of interventions according to settings identified in the

conceptual model: health systems and services, family and community, and workplace and employment. We also reviewed available data for policies to address structural factors that create an enabling environment for breastfeeding. We did a systematic review and meta-analysis[64] of interventions delivered in these settings according to the conceptual model. We also examined combined interventions—ie, those delivered concurrently in more than one setting. We assessed four outcomes: breastfeeding initiation within 1 h of birth, exclusive breastfeeding up to 6 months, continued breastfeeding from 12 months to 23 months, and any breastfeeding up to 6 months of age (see appendix pp 89–96 for further information about our methods and findings).

Health systems

For our meta-analyses we considered several interventions included in the BFHI: individual counselling or group education, immediate breastfeeding support at delivery, and lactation management. These interventions increased exclusive breastfeeding by 49% (95% CI 33–68) and any breastfeeding by 66% (34–107; table 1).

An earlier meta-analysis reported a negative association between caesarean sections and early breastfeeding but no effect at 6 months.[19] Our findings suggest that in the presence of adequate support, a caesarean section is not necessarily a barrier to timely breastfeeding initiation (risk ratio [RR] 0·95 [95% CI 0·84–1·07]) or to exclusive breastfeeding (1·08 [0·82–1·41]; data not shown).

Family and community

We did a meta-analysis of interventions providing antenatal and postnatal support to mothers, fathers, and other family members at home, including community health workers and peer-to-peer counsellors: counselling by a nurse, trained lactation counsellor, or other health provider, including post-discharge telephone calls combined with home visits. Fathers were targeted individually, and in group counselling sessions. Home and family-based interventions were effective at improving exclusive (RR 1·48 [95% CI 1·32–1·66]), continued (1·26 [1·05–1·50]), and any (1·16 [1·07–1·25]) breastfeeding, and tended to improve early initiation (1·74 [0·97–3·12]). Interventions that provided antenatal and postnatal counselling were more effective than were those targeting one period only, whereas interventions targeting fathers gave mixed results.

Community-based interventions, including group counselling or education and social mobilisation, with or without mass media, were similarly effective, increasing timely breastfeeding initiation by 86% (95% CI 33–159) and exclusive breastfeeding by 20% (3–39). We identified no studies that examined the effect of community-level interventions on continued breastfeeding. Findings from the one study we identified on the effect of mass or social media on breastfeeding suggested that it has a major effect on early initiation of breastfeeding (RR 5·33 [2·33–12·19]). Social media needs additional study in view of its wide and effective use to market breastmilk substitutes and other products.[65]

The workplace, maternity protection, and nursing breaks for working mothers

Although nearly all countries have maternity protection legislation, only 98 (53%) of 185 countries meet the International Labour Organization's 14-week minimal standard and only 42 (23%) meet or exceed the recommendation of 18 weeks' leave;[32] large informal work sectors further compound these inadequacies. Consequently, hundreds of millions of working women have no or inadequate maternity protection, the overwhelming majority (80%) of whom live in Africa and Asia. The few data available suggest that maternity leave policies are effective at increasing exclusive breastfeeding (RR 1·52 [1·03–2·23]). Breastfeeding can be continued after a return to work in settings where maternity leave[37] or child care is available and where breastfeeding or the expressing of breastmilk is supported.[66]

The reduction of barriers for working mothers to breastfeed by providing lactation rooms and nursing breaks are low-cost interventions that can reduce absenteeism and improve workforce performance, commitment, and retention.[32] An analysis of national policies in 182 countries showed that breastfeeding breaks with pay were guaranteed in 130 countries (71%), unpaid breaks were offered in seven countries (4%), and 45 countries (25%) had no policy. In multivariate models, paid-break guarantees for at least 6 months were associated with an 8·9% point increase in exclusive breastfeeding.[67] Findings from a study in the USA showed that lactation rooms and breaks to express breastmilk increased breastfeeding at 6 months by 25% (95% CI 9–43).[68]

Other enabling policies and interventions

Most studies reviewed explored the effects of direct interventions, rather than the role of policies and enabling interventions on breastfeeding outcomes. Enabling interventions operate by removing structural and societal barriers that interfere with women's ability to breastfeed optimally. Examples include maternity and workplace policies or regulations to restrict marketing of breastmilk substitutes; health insurance or other financing mechanisms for lactation support; and baby-friendly hospital certification.

Data about the effect of policies are rarely reported. However, a study from 14 countries with baseline exclusive breastfeeding rates lower than 30% showed that rates had a 1% point increase per year in countries that scored highly on a composite indicator rating implementation of pro-breastfeeding policies and programmes. By contrast, little change (0·2% point

	Early initiation of breastfeeding (within 1 h of birth)	Exclusive breastfeeding for 0–5 months	Continued breastfeeding for 12–23 months	Any breastfeeding up to 6 months
Health systems and services				
Overall	29 studies: RR 1·11 (1·06–1·16)	51 studies: RR 1·46 (1·37–1·56)	Eight studies: RR 1·18 (1·03–1·35)	47 studies: RR 1·40 (1·30–1·52)
Baby-friendly support	Ten studies: RR 1·20 (1·11–1·28)	15 studies: RR 1·49 (1·33–1·68)	Three studies: RR 1·26 (0·96–1·64)	13 studies: RR 1·66 (1·34–2·07)
Counselling* or education	Ten studies: RR 1·12 (1·05–1·19)	28 studies: RR 1·66 (1·43–1·92)	Five studies: RR 1·15 (0·99–1·35)	24 studies RR 1·47 (1·29–1·68)
Special training of health staff	Three studies: RR 1·09 (1·01–1·18)	Five studies: RR 1·36 (1·14–1·63)	No studies	Five studies RR 1·33 (1·07–1·67)
Family and community				
Home and family	Five studies: RR 1·74 (0·97–3·12)	43 studies: RR 1·48 (1·32–1·66)	Two studies: RR 1·26 (1·05–1·50)	36 studies: RR 1·16 (1·07–1·25)
Counselling* or education	Five studies: RR 1·74 (0·97–3·12)	38 studies: RR 1·58 (1·39–1·80)	One study: HR 1·22 (1·01–1·47)	33 studies: RR 1·17 (1·08–1·27)
Family or social support	No studies	Five studies: RR 0·95 (0·87–1·02)	One study: RR 1·69 (0·95–2·99)	Three studies: RR 1·02 (0·86–1·22)
Community	Five studies: RR 1·86 (1·33–2·59)	Six studies: RR 1·20 (1·03–1·39); one study: OR 1·10 (0·60–1·80)	No studies	No studies
Group counselling* or education	Four studies: RR 1·65 (1·38–1·97)	One study: RR 1·61 (0·95–2·71); one study: OR 1·10 (0·60–1·80)	No studies	No studies
Integrated mass media, counselling, and community mobilisation approach	One study: RR 5·33 (2·33–12·19)	Five studies: RR 1·17 (1·0–1·36)	No studies	No studies
Work environment				
Work environment	No studies	Four studies: RR 1·28 (0·98–1·69)	One study: RR 3·33 (1·43–10·0)	Four studies: RR 1·31 (1·10–1·56)
Maternal leave policy	No studies	Two studies: RR 1·52 (1·03–2·23)	No studies	One study: RR 0·99 (0·8–1·29)
Workplace support	No studies	Two studies: RR 1·08 (0·74–1·60)	No studies	One study: RR 1·25 (1·09–1·43)
Employment status	No studies	No studies	One study: RR 3·33 (1·43–10·0)	Two studies: RR 1·49 (1·12–1·98)
Combination of settings				
Combination of settings	Ten studies RR 1·57 (1·24–1·97)	26 studies RR 1·79 (1·45–2·21)	Seven studies RR 1·97 (1·74–2·24)	30 studies RR 1·30 (1·06–1·61)
Health systems and services and home and family	Six studies: RR 1·36 (1·07–1·73)	16 studies: RR 1·63 (1·27–2·10)	Six studies: RR 1·34 (1·01–1·81)	21 studies: RR 1·23 (1·08–1·40); two studies: OR 2·08 (1·32–3·28)
Home and family and community	Three studies: RR 1·85 (1·08–3·17)	Three studies: RR 1·42 (1·21–1·66)	No studies	Three studies: RR 1·00 (0·89–1·12)
Health systems and services and community	One study: RR 2·09 (1·64–2·67)	Seven studies: RR 2·52 (1·39–4·59)	One study: RR 10·2 (7·66–13·74)	Six studies: RR 1·74 (0·84–3·39)

Data are risk ratio (RR; 95% CI) or odds ratio (OR; 95% CI). All estimates of effect and methods are provided in Sinha and colleagues.[64] *Antenatal counselling focused on infant feeding decision making and preparation for breastfeeding; periodic postnatal home and family encounters focused on establishing exclusive breastfeeding, managing problems and challenges, and continued breastfeeding.

Table 1: **Effects of interventions on breastfeeding outcome measures, by setting**

change per year) was recorded in countries with low composite scores.[69] Such data emphasise that societies also need to protect women's personal decisions, and policies are a means of empowering women to breastfeed while conveying social value to breastfeeding as a norm.

In summary, our meta-analyses indicate that breastfeeding practices are highly responsive to interventions delivered in health systems, communities, and homes. Maternity leave and workplace interventions are also beneficial, although studies are few and are generally limited to high-income settings. The largest

effects of interventions on breastfeeding outcomes are achieved when interventions are delivered in combination. For example, combined health systems and community interventions increase exclusive breastfeeding by 2·5 times (table 1).

The International Code of Marketing of Breastmilk Substitutes

Compelling accounts of inappropriate and unethical marketing of breastmilk substitutes and of many infants becoming malnourished or dying from contaminated or diluted breastmilk substitutes[70] were followed by the adoption of the International Code of Marketing of Breastmilk Substitutes at the 34th World Health Assembly in 1981. The Code implicitly recognised that health workers, women, and families are susceptible to direct and indirect marketing strategies. It consists of 11 articles which, along with subsequent resolutions from the World Health Assembly, outline the responsibilities of governments, health-care systems, and workers, and of the companies that market or manufacture breastmilk substitutes. The Code represents the collective will of the member states of the UN and so carries substantial political and moral weight. However, it depends on national legislation, monitoring, and enforcement for its effectiveness. Violations of the Code remain prevalent[71] and show that without enforceable legislation and investment to support monitoring, it will have limited effect (appendix p 97).

Contextual factors on breastfeeding trends

Findings from case studies complement quantitative data by showing how synergies created through a mixture of interventions can improve breastfeeding. We discuss three pairs of countries (representing about a quarter of all children younger than 4 years worldwide) that are similar in economic development but differ in breastfeeding trends to explore why breastfeeding prevalence has increased, stagnated, or declined with time (panels 1 and 2). In addition to having large populations, these countries reflect the world's largest regions and comprise different mixes of public and private health care. Bangladesh is a low-income country and Nigeria is a lower middle-income country, Brazil and China are upper middle-income countries, and the UK and the USA are high-income countries (see appendix p 98 for breastfeeding practices and trends in each country).

These case studies show that breastfeeding can increase when countries implement and coordinate two or more actions. In Bangladesh, the focus was on comprehensive health-worker training, strategic use of data, and mass media. Brazil also focused on health-worker training while at the same time made hospitals baby friendly and strengthened maternity protection and the implementation of the Code. In the USA, there were policy changes and strategic collection and use of data. Strong civil society engagement and participation was a common element across all three of these countries, whereas it was weak in the countries that had static or declining breastfeeding rates.

The effect of industry

Knowledge of the breastmilk substitute market and marketing practices are essential for understanding the competing environment in which efforts to protect, promote, and support breastfeeding operate. Market research was commissioned for this Series from Euromonitor International (specific methods, definitions, and results are in appendix pp 99–114; market research terminology to describe baby milk formula are used— standard: for infants <6 months; follow-on: for infants 7–12 months; toddler: 13 months onward; special: for specific medical conditions; and "all baby milk formula": all of these together).

The retail value of the baby milk formula industry is growing. Unlike other commodities, baby milk formula seems to be resilient to market downturns. In 2014, global sales of all baby milk formula were about US$44·8 billion—by 2019, the market value is projected to reach $70·6 billion (figure 2). In 2009, when the growth of real gross domestic product turned negative globally, baby milk formula sales still grew by 8% annually in constant value terms (figure 2).

Marketing by the infant feeding industry and the availability of formula, including the distribution of free samples,[77–79] increase rates of bottle-feeding.[80,81] Formula advertisements portray formula milk to be as good as or better than breastmilk, or present it as a lifestyle choice rather than a decision with health and economic consequences.[82] Mothers report that media is an important source of information, and findings from studies in several countries associate recollection of formula advertisements with decreased breastfeeding.[83,84] Marketing messages can also convey that breastfeeding is difficult and that breastmilk substitutes help to settle fussy babies.[85] Findings from a 2008 population-based study in the USA showed that 67% of mothers had received free milk formula samples, and that such gifts were associated with shorter breastfeeding duration.[86] Industries selling breastmilk substitutes and related products often sponsor health professional associations[87,88]—for which comprehensive funding data are scarce—which might introduce conflicts of interest in their support of breastfeeding.

Per-child consumption of all types of formula (total retail volumes divided by the population of children aged 0–36 months, corrected for population growth) is highest in western Europe and Australasia, followed by North America. However, projected growth from 2014 to 2019 in these regions is only about 1%. Although present consumption is lower in other regions, the corresponding increase in the Middle East and Africa is expected to be more than 7% and in the Asia Pacific it is expected to be more than 11%.

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Panel 1: Case studies from low-income and middle-income countries

Bangladesh and Nigeria

Bangladesh has overall higher breastfeeding rates than Nigeria. In the past 6–8 years, exclusive breastfeeding has increased in both countries, although the percentage-point increase in Bangladesh is double that of Nigeria (13% *vs* 6%; appendix p 98). In Bangladesh, comprehensive health-worker training, community mobilisation, and media campaigns that reached much of the population probably explain a large part of this difference since both countries have adopted the International Code of Marketing of Breastmilk Substitutes (although weakly implemented) and both have a low potential reach of the Baby Friendly Hospital Initiative (about two-thirds of births occur at home). Bangladesh has benefited from strategic technical expertise from the Alive and Thrive Initiative, UNICEF, and civil society, which focused on reaching scale, addressing known barriers, the use of evidence, the alignment of diverse groups into common or harmonised messages, and advocacy to policy makers.[72] Maternity leave in Bangladesh is 6 months (compared with only 16 weeks in Nigeria), which, although it affects few women in view of their low participation in the formal labour market, signals a high degree of political commitment to breastfeeding in the country.

Actions to support breastfeeding in Nigeria, while ongoing, are challenged by the fragmented health-care system and less comprehensive and intensive approach compared with Bangladesh. The Code was last updated in 2005 and enforcement has been weak. Compared with Bangladesh, health-worker training has not been as comprehensive, a media campaign has not been implemented, and the strategic use of advocacy for policy change has been absent. Implementation of the Baby Friendly Hospital Initiative has slowed because of a shortage of funding. In Nigeria, the retail value of the milk formula market in 2019 is projected to reach US$42·8 million, or 0·06% of the global market (the 58th largest consumer worldwide; appendix p 111), and coupled with the shortage of comprehensive health-worker training, media campaigns, and advocacy, might explain to some extent why the increases in exclusive breastfeeding have been quite low (appendix p 98; comparable data for the breastmilk substitute market are not available for Bangladesh).

Brazil and China

Brazil and China have vastly different breastfeeding histories: between 1996 and 2006, any breastfeeding at 12 months in Brazil had a point increase of 15%, whereas between 2003 and 2008, a 5% point decrease occurred in China (figure 2). In Brazil, breastfeeding duration increased from 2·5 months in 1974–75 (one of the shortest in any low-income or middle-income country) to 14 months by 2006–07.[73] Brazil exemplifies a country in which policies and programmes addressing all three levels of the conceptual framework (individual, settings, and structural) have been implemented simultaneously.[74] The Code, enacted shortly after adoption by the World Health Assembly, has been updated three times and is rigorously monitored for compliance. Paid leave is available to mothers (24 weeks) and fathers (3 days). A systematic process for certification and recertification of hospitals as "Baby Friendly" to maintain quality standards has been instituted and health-worker training has been extensive. An innovative network of human-milk banks in more than 200 hospitals has established the use of human milk and breastfeeding as a valued and normative practice. Visible government leadership and investment and active civil society participation underpin Brazil's breastfeeding achievements. Nonetheless, it is the tenth largest market for baby milk formula, and is projected to reach $951 million by 2019.

Breastfeeding promotion in China faces unique challenges because of the country's enormous population and large number of maternity facilities (about 600 000). Although China enacted Code legislation in 1995, it has not been updated to take into account new marketing tactics, and implementation and enforcement are weak or non-existent. Independent monitoring in 2012 showed that 40% of new mothers reported receiving at least one free formula sample.[75] Of these, 60% reported being provided the sample by staff of breastmilk-substitute companies and 37% reported being offered the sample by health workers. Although the Baby Friendly Hospital Initiative is actively implemented by the Ministry of Health, no public information is available about the number of hospitals certified because there is no centralised process for the monitoring and reporting of implementation. Furthermore, authorities can only assess few facilities per year, with certification almost entirely based on self-assessment. Maternity leave is only 14 weeks, and in 2010 China had the highest female labour participation rate of high-income and middle-income countries studied (67% *vs* 60% for Brazil).[32] It is also the largest market for baby milk formula, valued at $17 783 million in 2014 and is projected to more than double by 2019. Lack of a well-coordinated government programme, active civil society participation, and a lower level of maternity protection than that of Brazil combined with aggressive unchecked marketing of breastmilk substitutes, might explain the decreases in breastfeeding in China.

As expected, per-person annual expenditure (total retail sales divided by the population of children aged 0–36 months, corrected for population growth) is greater in high-income countries ($2528) than it is in high middle-income countries ($209) and low-income and middle-income countries ($151; appendix pp 106–114). In high-income markets, sales of standard milk formula (for infants aged <6 months) are static or decreasing because of market maturity, decreasing birth rates, and legislation on advertising and sales. The enormous difference in market sales between high-income and middle-income countries is due to large and increasing sales of follow-on and toddler milks: these products are often not covered under national Code-related laws and regulations. In middle-income countries, year-on-year total sales until 2019 are expected to grow by 8%, mainly due to standard

Panel 2: **Breastfeeding in the USA and the UK**

Rates of breastfeeding, although low, are increasing in both countries, with the USA achieving greater gains (appendix p 98). In the USA, although it has no Code legislation and maternity leave of 12 weeks is unpaid, other efforts to support breastfeeding have greatly expanded and were further galvanised by the Surgeon General's Call to Action to Support Breastfeeding in 2011.[76] Breastfeeding targets and actions to improve breastfeeding, such as peer and professional support and implementation of the Baby Friendly Hospital Initiative, are reported by the US Centers for Disease Control and Prevention in a yearly Breastfeeding Report Card, thus helping to create accountability. Breastfeeding in public is protected through legislation in nearly all states, and a civil society coalition, comprising nearly 50 groups and institutions, plans and coordinates actions. Historic 2012 national health-care legislation included mandatory insurance coverage for lactation counselling and breastmilk pumps as well as requirements for employers to provide space and time for breastmilk expression. A government programme covering more than half of newborn babies—one which provides free milk formula—was reformed to enhance incentives for women to breastfeed. A robust set of policy changes along with active civil society engagement could explain why, despite being the second largest market for milk formula, the USA is one of only two countries where growth is projected to be negative.

By contrast with the USA, the UK provides a full year of paid maternity leave. Additionally, in the UK a far larger proportion of maternity services (estimated at about 40%) and public health nursing services than in the USA have "Baby Friendly" accreditation. Code legislation exists but it is not comprehensive and is poorly enforced despite continual, independent monitoring and reporting. Although many active non-governmental organisations exist, a coalition similar to that in the USA does not presently exist in the UK. Much like in the USA, the UK has legislation protecting breastfeeding in public, although it is not well publicised. Rates of improvements in breastfeeding are larger in Scotland, Wales, and Northern Ireland, where local government has been proactive in implementing comprehensive policies and programmes. However, when the data are combined, the larger population of England compared with the other countries in the UK dilutes improvements elsewhere in the UK where attention to breastfeeding has led women to take advantage of the maternity benefits and favourable hospital conditions (a high proportion of hospitals are Baby Friendly Hospital Initiative accredited). In the UK, the milk formula market is the eleventh largest in the world and growing, with sales projected to reach US$907 million in 2019.

formula sales. In high-income countries, it is follow-on and toddler milks that will drive the estimated future 15·2% growth. Similar data are not available for low-income countries. France and the USA are the only two major economies where the market growth rate is expected to turn negative (–2·5% in France and –0·3%, in the USA): the decreases are the result of legislation, public awareness campaigns, and actions by civil society in support of breastfeeding.

Brazil exemplifies how vulnerable breastfeeding practices can be during economic transitions. Even though breastfeeding is deeply valued, and government and civil society have invested in its support, per-baby consumption of breastmilk substitutes is projected to increase by 6·8% between 2014 and 2019, making Brazil's one of the highest growth rates in the world (appendix pp 106–114). This increase is probably due to increased purchasing power and replacement of locally available animal milk by breastmilk substitutes, rather than a decrease in breastfeeding rates.

Data for marketing budgets for breastmilk substitutes were not available, but these budgets are assumed to be large. The trajectories of retail sales indicate that marketing strategies are effective, which emphasises the importance of comprehensive national laws and regulations to curb inappropriate marketing practices with adequate monitoring and meaningful penalties to protect breastfeeding.

The economic argument for investment in breastfeeding

Improved breastfeeding practices would prevent 823 000 annual deaths in children younger than 5 years of age and 20 000 annual deaths in women caused by breast cancer.[1] Breastfeeding also reduces morbidity and improves the educational potential of children and probably their earnings as adults.[1]

We will now discuss the economic value of breastfeeding, using new data for relative risks from a series of systematic reviews (the first paper in this Series).[1] We first provide global estimates of the economic magnitude of the cognitive benefits associated with breastfeeding, and then of reduced direct treatment costs associated with lower child morbidity in four countries. We have taken a conservative approach by restricting our analysis to children—ie, by excluding women's cancers and not estimating the economic value of non-treatment-related savings, such as time and travel-related savings for caregivers and patients.

The economic cost of lower cognition

We modelled the economic benefits of improved cognition based on estimates from a 2015 meta-analysis,[89] the findings of which showed that longer breastfeeding duration was associated with a 2·6 point (95% CI 1·25–3·98) increase in intelligence quotient (IQ) score, which is equivalent to 0·17 standard deviations (SDs) in

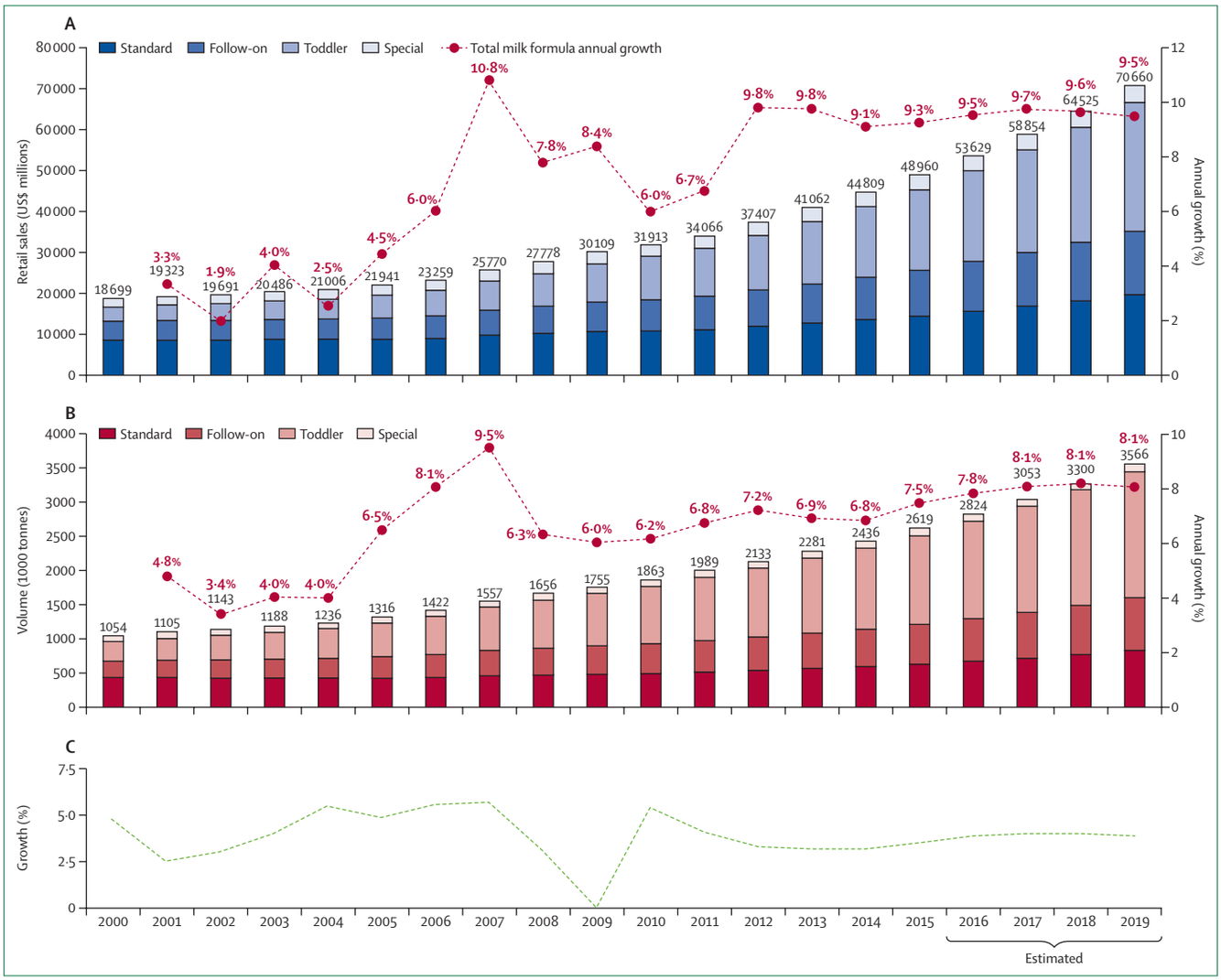

Figure 2: **The total baby milk formula market by value (A) and volumes (B) and growth in real gross domestic product (C) from 2000 to 2014 and estimated growth from 2015 to 2019**
Price sensitivity was more evident in high-income countries as milk formula growth rates decreased, whereas most emerging markets saw income growth despite the global economic recession. Emerging market consumers in effect drove the purchase in milk formula. Data for these graphs were provided by Euromonitor International (2015).

cognitive score. The investigators reported a dose effect in that greater benefits are achieved with longer durations of breastfeeding. However, because of data limitations we can only model the effect of extending breastfeeding to 6 months or longer. On the basis of a detailed survey of published studies, Hanushek and Wössmann estimated that one SD increase in cognitive scores (ie, 15 IQ points) is associated with a 12% increase in hourly earnings in high-income countries and a 16% increase in low-income and middle-income countries.[90] We assumed that labour income is about half of total national income (as estimated by the World Bank World Development Indicators), and that cognitive improvements affect only this half of national income.

We use the effect size for breastfeeding on IQ, to estimate the global loss of gross national income (GNI) associated with present levels of any breastfeeding at 6 months, as compared with all children receiving any breastfeeding up to 6 months of age. We chose "all" children receiving any breastfeeding at 6 months for comparison, because 40 of the 103 countries for which we had data already exceed 90%, and six countries exceed 99%.

Table 2 summarises our estimates, for which we used a prevalence-based method (see appendix pp 115–116 for methods and additional data related to cognition economic analyses). The losses amount to $302 billion annually, or 0·49% of world GNI. Losses in low-income and middle-income countries account for $70·9 billion,

or 0·39% of their GNI, whereas the losses for high-income countries are $231·4 billion, or 0·53% of their GNI. Five countries (Belgium, France, Greece, Saudi Arabia, and the United Arab Emirates) lose more than 0·75% of GNI. These estimates are similar in magnitude to GNI losses attributed to iron-deficiency anaemia, previously calculated for five low-income or lower middle-income countries.[92]

The economic cost of childhood morbidity

To show the potential effects of reduced morbidity on health-care costs, we estimated the treatment costs of five common infectious diseases in childhood in four countries (for the USA, we also include another four childhood diseases); we report what the respective treatment costs would be if exclusive and continued breastfeeding had a point increase of 10% from current levels or if 90% coverage was achieved. Meta-analyses reviewed in the first paper in this Series[1] indicate that substantial protective effects of breastfeeding on otitis media, diarrhoea, necrotising enterocolitis, and pneumonia exist. For a fifth disorder, bronchiolitis, we used the same relative risk as we did for pneumonia (similar to relative risks reported elsewhere for reduced bronchiolitis in breastfed infants[93,94]). Breastfeeding probably protects against other disorders, which, for three of the four countries, are not included—eg, obesity, diabetes mellitus, sudden infant death syndrome, and malocclusion. Our estimates are therefore conservative.

We provide these estimates for the UK, the USA, Brazil, and China. National treatment costs for the UK and the USA come from two studies.[95,96] In the UK study, the investigators estimated the effect on treatment costs if breastfeeding prevalence increased to 45%.[95] In the USA study, another four childhood disorders (asthma, leukaemia, type 1 diabetes, and childhood obesity) were included in the original calculations and are also included in our analyses. For Brazil, we used data from a national database on expenditures for admissions to hospital made available by the Ministry of Health. The China analysis uses unpublished data provided by the China National Health Development Research Centre for October, 2013, to September, 2014. These data were used to estimate treatment costs for the 53% of China's population (appendix pp 117–20) living in urban areas;[97] no information is available for those in rural areas (see appendix pp 117–120 for additional details of this analysis). The required data were not available for Bangladesh and Nigeria.

A 10% point increase in exclusive breastfeeding up to 6 months or continued breastfeeding up to 1 year or 2 years (depending on country and disorder) would translate into reduced treatment costs of childhood disorders of at least $312 million in the USA, $7·8 million in the UK, $30 million in urban China, and $1·8 million in Brazil (all values in 2012 US$). Alternatively, improved breastfeeding from present levels to 90% for USA, China, and Brazil, and to 45% for the UK (45% coverage for the UK, based on design, data available, and definitions used in the original study[95]) would reduce treatment costs by at least $2·45 billion in the USA, $29·5 million in the UK, $223·6 million in urban China, and $6·0 million in Brazil (all values in 2012 US$; appendix p 120). The estimates for Brazil are less comparable because data for treatment expenditures were available only at federal level and not at state level and were therefore less generalisable than were those of other countries.

	Estimated percentage loss in gross national income	Estimated loss in 2012 US$
Eastern and southern Africa	0·04%	$0·1 billion
West and central Africa	0·06%	$0·3 billion
Middle East and north Africa	0·97%	$11·8 billion
South Asia	0·05%	$1·0 billion
East Asia and Pacific	0·31%	$28·1 billion
Latin America and the Caribbean	0·39%	$12·1 billion
Eastern Europe and central Asia	0·75%	$17·6 billion
Subtotal (low-income and middle-income countries)	0·39%	$70·9 billion
High-income countries	0·53%	$231·4 billion
World	0·49%*	$302·0 billion (total estimated loss)

Estimates are based on data for 96 countries (of 197 countries in the UNICEF's 2014 database).[91] For details about data and included countries, and country-level results, see appendix pp 115–16. *Global average, weighted by gross national income.

Table 2: **Estimated economic losses from cognitive deficits associated with regional infant feeding practices compared with every infant breastfeeding until at least 6 months of age**

The environmental costs of not breastfeeding

Although not yet quantifiable in monetary terms, environmental costs are also associated with not breastfeeding. Breastmilk is a "natural, renewable food" that is environmentally safe and produced and delivered to the consumer without pollution, unnecessary packaging, or waste.[98] By contrast, breastmilk substitutes leave an ecological footprint and need energy to manufacture, materials for packaging, fuel for transport distribution, and water, fuel, and cleaning agents for daily preparation and use,[99] and numerous pollutants are generated across this pathway.[100] More than 4000 L of water are estimated to be needed along the production pathway to produce just 1 kg of breastmilk-substitute powder.[101] In the USA, 550 million cans, 86 000 tons of metal, and 364 000 tons of paper, annually used to package the product, end up in landfills.[102] Breastfeeding and human milk's contribution to environmental sustainability and food security year-round should be considered in climate-smart development goals at national and global levels.

Investment levels and trends in breastfeeding support

We were not able to ascertain national or overseas aid budgets for the protection or support of breastfeeding but the little data available show a global decrease.

Historically, the United States Agency for International Development (USAID) has been a major supporter of breastfeeding programmes. One analysis showed that their funding for breastfeeding promotion increased from $8·3 million in 1989 to $16·6 million in 1999, and subsequently decreased to $13·3 million in 2003 and $2·3 million in 2005.[10] In 2008, 79% of breastfeeding coordinators in 15 Latin American countries reported a decrease in funding for breastfeeding promotion between 2000 and 2008 compared with funding levels in the 1990s.[10] In 2013, the US Women, Infant and Children Program (WIC), which covers more than half of all US infants, spent $210 million on breastfeeding promotion and peer counselling and an additional $110·4 million on an enhanced food package as an incentive for breastfeeding women, which contrasts sharply with the 2010 expenditure of $926·6 million on infant formula.[103]

Discussion

Our Series shows that breastfeeding contributes to a world that is healthier, better educated, more equitable, and more environmentally sustainable. But the relevance of breastfeeding is questioned across society. Women are drawn to substitutes for breastmilk and doubt their own ability to breastfeed. They, their families, and health professionals are not fully convinced by the benefits of breastfeeding: breastfeeding in public can generate embarrassment and has even been prohibited whereas bottle-feeding causes little reaction; the Code is not legislated, enforced, or monitored in all countries, and the breastmilk substitute industry attempts to circumvent the Code to protect sales.

Although breastfeeding is cited as a reason for women leaving the job market (appendix pp 9–10), the evidence shows that the reverse—women remaining in work and at school and using breastmilk substitutes or stopping breastfeeding—is more common. Too few women are appropriately supported through adequate maternity and workplace entitlements to be able to work or attend school and still breastfeed; either they are not provided or the women are working in the informal economy and are not eligible.

We did not estimate the cost of scaling up interventions to promote and support breastfeeding, nor did we quantify the global net gain or loss associated with the promotion of breastfeeding. Our data show that the patterns and drivers of suboptimal breastfeeding vary by setting. Therefore, the mixture of interventions and investments needed to implement them, including the cost of maternity entitlement, are likely to differ greatly between settings. Without more robust data, reliable estimates of the costs and benefits of the actions needed to support optimal breastfeeding are difficult to calculate. Estimated costs vary widely: one study estimated that it will cost $653 million annually to scale up counselling interventions in 34 countries,[104] and another study estimated that it will cost $17·5 billion globally for a larger set of interventions.[105] This latter estimate is driven by the recurring costs of maternity entitlements for poor women: to attribute all these cost to the promotion of breastfeeding would be inappropriate because the same investment would have many benefits beyond breastfeeding. From our analyses, the economic consequences of cognitive losses and the conservative estimates of reduced treatment costs suggest that the economic benefits for countries of promoting breastfeeding are likely to be substantial. Nevertheless, research into the costs of breastfeeding-enabling policies and programmes relative to their full range of benefits, including maternity entitlements, is urgently needed.

Sustainability and development are imperatives and crucial considerations for our world that is undergoing demographic and social change. In low-income and middle-income countries, the improvement of breastfeeding will contribute to the unfinished agenda of preventable infant and child deaths. In both high-income and low-income countries, improvements in breastfeeding will improve human capital and help to prevent non-communicable diseases in women and children[1,89,106] that today account for more deaths than does undernutrition. Low-income and middle-income countries are at a crossroads of deciding whether to act to avoid the downward trends in breastfeeding practices that have been noted in high-income countries in the past century. High-income countries need to attribute value again to the benefits of breastfeeding for children and women beyond protection from diseases of poverty.

The review of the evidence and country case studies show that successful protection, promotion, and support of breastfeeding need measures at many levels, from legal and policy directives to social attitudes and norms, women's work and employment conditions, and health and services to support women and their families to breastfeed optimally. So how would policy makers and programme managers approach the challenge? We propose six action points.

The first is to disseminate the evidence. The promotion of breastfeeding starts with robust dissemination of evidence for its fundamental role, for both rich and poor societies. Scientists, policy makers, programme managers, health workers, and communities too often do not recognise the value of breastfeeding as a powerful intervention for health and development that benefits children and women alike.

The second action point is to foster positive societal attitudes towards breastfeeding. Negative societal attitudes—as shown by inadequate maternity leave, lack of opportunity to breastfeed or express milk at the workplace, and restrictions on breastfeeding in public—are all too common. Breastfeeding is generally thought to be an individual's decision and the sole responsibility of a woman to succeed, ignoring the role of society in its support and protection. Establishment of a high value of

breastfeeding within society needs, as stated in the Innocenti Declaration, "the reinforcement of a 'breastfeeding culture' and its vigorous defence against incursions of a 'bottle-feeding culture'".[5] In an age of expert social marketing and communication innovations, redressing the misperceptions of breastfeeding should be possible.

Third is to show political will. Politicians need to demonstrate they appreciate that breastfeeding promotion saves lives and money. The promotion of breastfeeding is entirely different from the scaling up of commodity-based interventions, such as vaccines or drugs, which are appealing because their implementation is easier to measure, and commercial pressures are in their favour rather than against. Breastfeeding should be mainstreamed into preventive programmes for non-communicable diseases for both children and women, as well as for the prevention of morbidity and mortality from infections of early childhood. The economic gains provided by breastfeeding through increased intelligence, reduced health-care costs, and the benefits of breastfeeding to the environment should be fully appreciated and evaluated when funding for the promotion and protection of breastfeeding is assessed.

Fourth is to regulate the breastmilk-substitute industry. Breastmilk substitutes are a multi-billion-dollar industry, the marketing of which undermines breastfeeding as the best feeding practice in early life. No new interventions are needed—the Code is an effective mechanism for action. However, much greater political commitment is needed to enact and enforce the relevant, comprehensive legislation and national investment to ensure implementation and accountability. Without these commitments, agreed principles of responsible marketing will continue to be violated. As such, breastfeeding is an important way for governments to fulfil their obligations to ensure "to the maximum extent possible the survival and development of the child" (International Convention on the Rights of the Child).[7]

The fifth action point is to scale up and monitor breastfeeding interventions and trends in breastfeeding practices. Our review shows that it is possible to substantially improve breastfeeding practices with use of tested interventions. We show that interventions to support women in their homes and communities and through health services are effective. Interventions should be tailored in response to patterns of suboptimal breastfeeding in each given setting. Interventions should be delivered at scale to benefit all mothers and children, and feeding patterns should be monitored regularly to provide feedback to implementers. Periodic population-wide assessments will enable the monitoring of important breastfeeding trends.

The sixth and final action point is for political institutions to exercise their authority and remove structural and societal barriers that hinder women's ability to breastfeed. Democratic governments are entrusted to protect and promote wellbeing in the communities that elect them—this includes breastfeeding. Countries that have ratified the Convention of the Rights of the Child are also accountable for specific actions to protect children and promote their health. Legislation and accountability mechanisms should ensure that maternity protection and workplace interventions that support breastfeeding are implemented (although these will not reach women who are self-employed or in informal employment, such as street vending, domestic work, or agriculture) and that all maternity health services comply with the Code and the BFHI.

All 194 member states of the World Health Assembly have agreed on breastfeeding targets for 2025. In the first paper in this Series, we showed that these targets are realistic and could even be exceeded. Breastfeeding is not explicitly mentioned in the Sustainable Development Goals, but our Series shows that improvements in breastfeeding would help achieve the targets for health, food security, education, equity, development, and the environment. Without commitment and active investment by governments, donors, and civil society, the promotion, protection, and support for breastfeeding will remain inadequate and the outcome will be major losses and costs that will be borne by generations to come.

Contributors

All authors contributed to the design, writing, and revision of the final version of the report.

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Spotlight on infant formula: coordinated global action needed

Breastfeeding has often been described as cost free.[1] It is not free. Breastfeeding requires investment to overcome the sociopolitical barriers that exist in many countries[2,3] through the effective approaches and practices described in the second paper of the *Lancet* Breastfeeding Series.[4] As shown in the first Series paper, infants, children, and mothers who do not breastfeed experience an increased risk of mortality and morbidity.[5] Breastfeeding is nutritionally, immunologically, neurologically, endocrinologically, economically, and ecologically superior to breastmilk substitutes (BMS), and does not require quality control of manufacture, transport, storage, and feeding mechanisms.[4,5]

The active and aggressive promotion of BMS by their manufacturers and distributors continues to be a substantial global barrier to breastfeeding.[6,7] The reach and influence of the BMS industry is growing fast. The retail value of the industry is projected to reach US$70·6 billion by 2019.[4] In many low-income and middle-income countries, growth in sales of BMS exceeds 10% annually.[8] Global sales of milk formula (including infant formula and follow-on milks) have increased from a value of about $2 billion in 1987[9] to about $40 billion in 2013,[10] and account for two-thirds of all baby food sales internationally.[10] Sales of BMS in China, worth more than $12 billion in 2012,[11] are projected to increase annually by 14%.[12] This growth is not difficult to understand, given that investment in promoting BMS exceeds the spending by many governments on efforts to promote, protect, and support breastfeeding.[13] Promotion and marketing have turned infant formula, which should be seen as a specialised food that is vitally important for those babies who cannot be breastfed, into a normal food for any infant.

The International Code of Marketing of Breast-milk Substitutes and its subsequent resolutions (the Code) are intended to protect the public and health-care providers from inappropriate marketing strategies used by BMS companies.[14] However, recent examination of six country case studies (Bangladesh, Brazil, Indonesia, Nigeria, the Philippines, and the UK) in a report by Save the Children showed inadequate implementation and enforcement of the Code.[15] Although all six countries have enacted the full Code or many of its provisions into law, there are insufficient national regulations for implementation of those laws, ineffective monitoring, and an absence of penalties for companies that violate laws.[15] In-country efforts to monitor violations of the Code have been hampered by insufficient resources in Nigeria, the Philippines, and Bangladesh.[15] The 2011 WHO report on the Code found that less than a quarter of 199 countries have a functioning implementation and monitoring system in place.[16]

Reports by WHO and Save the Children suggest that, in direct contravention of the Code, some representatives of BMS companies promote their products directly to pregnant women and new mothers, undermining their confidence about breastfeeding.[8,15] Examples of this are described in the Save the Children report,[15] and an internet search identifies companies that currently offer free gifts for those who join their mother and baby clubs. BMS companies circumvent the ban on advertising infant

Hedinn Halldorsson/Save the Children

formula by promoting follow-on milks that are not nutritionally necessary and for which companies make exaggerated claims.[7] In some countries, including Bangladesh, Brazil, and the UK, BMS companies were reported to seek to influence health professionals through inappropriate sponsorship of health conferences,[15] promotion of their products (eg, by offering incentives to health professionals who sell or promote their products),[17] and forming links with national health professional associations.[8,17] Inadequate implementation, monitoring, and enforcement of the Code allows BMS companies to engage improperly with governments and health professionals in these and other ways, often under the guise of improving maternal and child nutrition.

Coordinated action is urgently needed to ensure that the public, health professionals, and decision makers do not continue to be exposed to the dominance of the promotion of BMS. Coordination has helped to strengthen protection for breastfeeding. In the Philippines, interagency collaboration with the Department of Health resulted in the banning of donations of BMS in response to Typhoon Haiyan and implementation of a plan for the transport and distribution of expressed breastmilk in emergencies.[15] This interagency coalition also advocated against proposed changes to weaken enactment of the Code in the Philippines, changes which had been lobbied for by BMS companies.[15] In this case, breastfeeding won. However, conflicts of interest at policy and implementation levels between BMS companies and government, policy makers, and health-care providers, and competing political priorities, are also a fundamental obstacle to political commitment to breastfeeding.[15] Conflicts of interest are undermining global, country-level, and local efforts to protect and support women to breastfeed.[15]

The omission of breastfeeding from the Millennium Development Goals, and the resultant lost opportunities to improve child survival, must not be repeated in the Sustainable Development Goals, for which the indicators will be decided in early 2016. Breastfeeding is too often siloed within agendas on nutrition or infant and young child feeding rather than treated as a key public health approach that can help prevent communicable and non-communicable disease, reduce infant mortality, and lessen inequity.[18] Infant feeding cuts across health, education, social protection, child protection, trade, and commerce portfolios, and is therefore everybody's responsibility. Most importantly, political commitment, investment, and effective international, national, and local leadership are needed to end promotion of products that compete with breastfeeding.

Strengthened international leadership is needed to coordinate and stimulate strategic action across countries and identify where investment is needed. Such action should include mechanisms that hold governments to account for progress on international breastfeeding targets; address the increasing use of BMS; ensure implementation, monitoring, and enforcement of the Code; and leverage financial resources to strengthen policies and scale up programmes that enable more women to breastfeed.[19] The Global Breastfeeding Advocacy Initiative, led by UNICEF and WHO in collaboration with international partners, could provide this leadership. As one important step, WHO and UNICEF have created a Network for Global Monitoring and Support for Implementation of the International Code (NetCode) with the purpose of strengthening capacity for Code monitoring and implementation. Without such coordinated and effective action, activities aimed at protecting, promoting, and supporting breastfeeding, and ultimately improving the health and economies of nations, will continue to be substantially weakened.

For more about the **Global Breastfeeding Advocacy Initiative** see http://www.unicef.org/nutrition/files/Breastfeeding_Advocacy_Strategy-2015.pdf

For more on **NetCode** see http://www.who.int/nutrition/topics/seminar_wbw_7aug2014/en/

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Breastfeeding: a smart investment in people and in economies

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If breastfeeding did not already exist, someone who invented it today would deserve a dual Nobel Prize in medicine and economics. For while "breast is best" for lifelong health, it is also excellent economics. Breastfeeding is a child's first inoculation against death, disease, and poverty, but also their most enduring investment in physical, cognitive, and social capacity.

When we nourish a child, we drive future economic growth.[1,2] The *Lancet* Breastfeeding Series[3,4] shows why breastfeeding is one of the highest impact interventions providing benefits for children, women, and society. Breastfeeding reduces infant morbidity and mortality, increases Intelligence Quotient (IQ) score, improves school achievement, and boosts adult earnings[3,4]—all essential for reducing poverty. It also contributes to equity by giving all children a nutritional head start for success in life.

For the first time in history, less than 10% of the world's population lives in extreme poverty.[5] Strong economic growth in developing countries coupled with smart investments in human development have driven this change. But progress must accelerate if we are to achieve the World Bank's goals—and the new global Sustainable Development Goals—to end extreme poverty and boost shared prosperity by 2030.[5]

In this context, never has the breastfeeding agenda been more timely. For many people living in poverty, malnutrition remains a prime contributor to stunted development, and this *Lancet* Series documents how breastfeeding can make a lasting difference.[3,4]

But knowing isn't the same as doing. The challenge now is to scale up breastfeeding. Paradoxically, breastfeeding is one of the few positive health behaviours that is more common among the poor than among the richer countries.[3] Data on poverty from the World Bank suggest that rising inequality and social exclusion seem to accompany rising prosperity in many countries.[5]

This Series suggests that alongside other factors, breastfeeding could have an important role in addressing inequality by providing equal opportunity to all children to grow and contribute to national economies, and countries such as Bangladesh and Brazil show that it is possible to increase breastfeeding with comprehensive strategies.[4]

The World Bank Group is committed to support the expansion of breastfeeding. We are enhancing our own investments in breastfeeding through health, social protection, agriculture, gender, labour and jobs programmes as reflected in our current portfolio. We are sharing global knowledge on delivering these interventions effectively. We are making the economic case to ministers of health, finance, and planning, as well as to political leaders. And we are emphasising the importance of an enabling policy environment—such as labour laws and maternity leave—while bringing to bear the latest knowledge from behavioural economics to change mental models and social norms around breastfeeding.[6]

The evidence on breastfeeding leaves no doubt that it is a smart and cost-effective investment in a more prosperous future. Let's ensure that every child—and every nation—can reap the benefits of breastfeeding.

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I am Vice President for Human Development, World Bank Group. I declare no competing interests.

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