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]

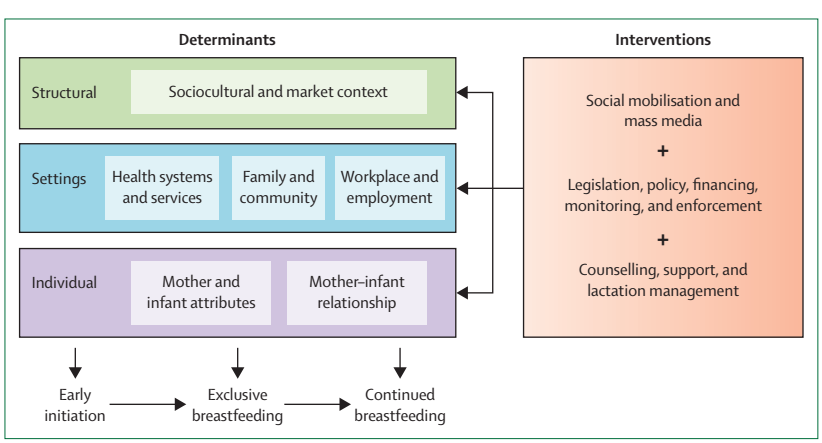

Figure 1: **The components of an enabling environment for breastfeeding—a conceptual model**
The structural level refers to the social factors that affect the whole population. For determinants, these factors include social trends, advertising, media, and products available in stores; interventions at 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

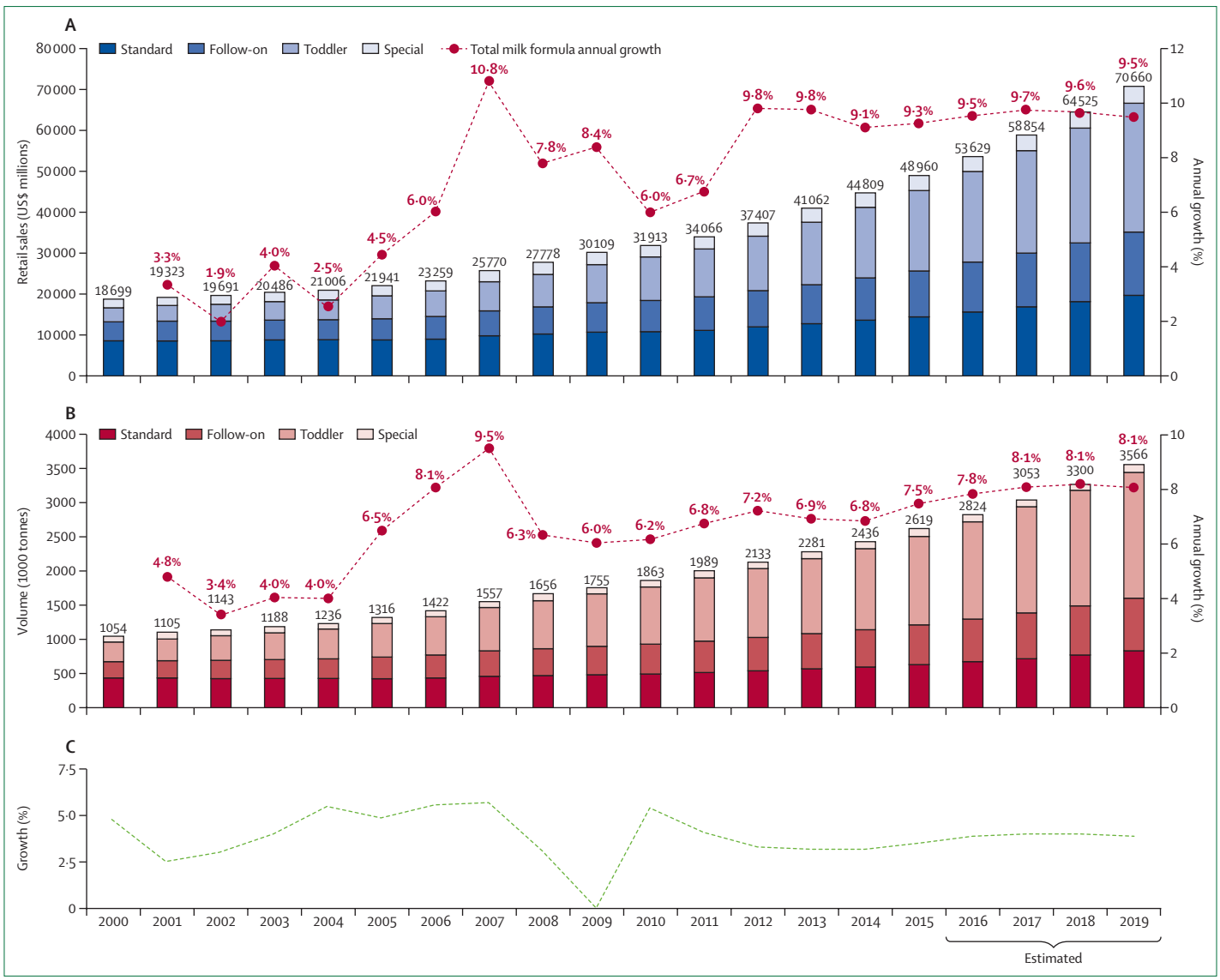

Figure 2: **The total baby milk formula market by value (A) and volumes (B) and growth in real gross domestic product (C) from 2000 to 2014 and estimated growth from 2015 to 2019**
Price sensitivity was more evident in high-income countries as milk formula growth rates decreased, whereas most emerging 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).[31] 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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THE LANCET

Supplementary appendix

This appendix formed part of the original submission and has been peer reviewed. We post it as supplied by the authors.

Supplement to: Rollins NC, Bhandari N, Hajeebhoy N, et al, on behalf of *The Lancet* Breastfeeding Series Group. Why invest, and what it will take to improve breastfeeding practices? *Lancet* 2016; **387:** 491–504.

Web annex 1.

The Baby Friendly Hospital Initiative (BFHI)

www.who.int/nutrition/topics/bfhi/en/

The Baby Friendly Hospital Initiative (BFHI) was launched by WHO and UNICEF in 1991 following the Innocenti Declaration of 1990. The initiative is a global effort to implement practices that protect, promote and support breastfeeding. The BFHI includes training materials as well as self-appraisal and monitoring tools. Hospitals which meet the criteria of the BFHI may apply to be externally assessed to receive accreditation as "Baby Friendly". In 1998 the "Ten Steps to Successful Breastfeeding" were included as an integral part of BFHI criteria:

WHO Ten Steps to Successful Breastfeeding (1998)

www.tensteps.org

1. Have a written breastfeeding policy that is routinely communicated to all health care staff.
2. Train all health care staff in skills necessary to implement this policy.
3. Inform all pregnant women about the benefits and management of breastfeeding.
4. Help mothers initiate breastfeeding within a half-hour of birth.
5. Show mothers how to breastfeed, and how to maintain lactation even if they should be separated from their infants.
6. Give newborns no food or drink other than breastmilk, unless *medically* indicated.
7. Practice rooming in – allow mothers and infants to remain together – 24 hours a day.
8. Encourage breastfeeding on demand.
9. Give no artificial teats or pacifiers (also called dummies or soothers) to breastfeeding infants.
10. Foster the establishment of breastfeeding support groups and refer mothers to them on discharge from the hospital or clinic.

Web annex 2. Determinants of breastfeeding: Methods and an integrative review

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Highlights:

1. The determinants of breastfeeding are similar to many known social determinants of health inequalities.
2. Over time, interventions to change attitudes, improve knowledge and limit the marketing of breast milk substitutes (BMS) through international agreements are showing benefits in some low, middle and high income countries. Much more needs to be done, especially in low and middle income settings to change the dangerous confluence of BMS marketing and traditional practices that undermine early initiation and exclusive breastfeeding.
3. Public attitudes to breastfeeding must be changed, including through protective legislation.
4. Women's feeding intentions are formed during pregnancy and are a strong determinant of breastfeeding.
5. A sense of confidence and competence is core to optimal breastfeeding, and women need continuous information, support and encouragement during pregnancy and in the days and weeks after birth.
6. More attention needs to be paid to the deleterious effects on breastfeeding of smoking, obesity and poor mental health, all of which adversely affect already disadvantaged women.
7. Families, especially fathers, need to be included in breastfeeding support.
8. In addition to expanding baby-friendly practices in hospitals, the attitudes, knowledge and practices of health workers must be improved, including their own breastfeeding practices.
9. Maternity leave is necessary to protect breastfeeding among working women, as is the milieu, time and facilities provided in the workplace to breastfeed babies or to express milk.

Aims:

The review aims to describe the determinants of breastfeeding since 1970 on a global scale reflected in published quantitative and qualitative studies. The integrative review methodology followed that of Whittemore and Knafl (1). The full search strategy is attached as Appendix 1.

Method:

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (http://www.prisma-statement.org) was used as a guide in conducting the review.

Data collection for the review was conducted over four steps. Firstly, nine online databases namely, African Journal Online, Biomedcentral, Cochrane Database, Ebscohost Web, EMBASE, International Breastfeeding Journal, POPline, Pubmed and Sciencedirect, were searched for articles from 1970 to October 2014, to allow coverage of a broad range of determinants over time (Table 1). Non-English papers were searched for in the following databases: BabelMeSH, Bireme, Scielo, Index Medicus, Médecins Sans Frontières, WHOLIS, CAJ and LILACS. Search terms included *Breast*, breastfed, colostrum, human AND milk, infant AND feed, wet AND nurse, lactate AND milk, exclusive AND breastfeeding, baby AND formula, breastfeed formula supplementation, breastfeeding formula substitute, neonatal AND milk, neonatal AND breast, child AND health AND breast AND milk, nursing AND breast AND feed, knowledge AND attitude AND breast AND feed, breast AND feed AND determinant (Table 1). This step resulted in a 75 373 titles.

In the second step, one reviewer removed duplicates as well as non-peer reviewed articles and filtered for relevance based on the article titles using a second set of criteria (Table 2). Some of the criteria indicated in Table 2 could be effected through macros, others required reading the abstracts. Articles were also excluded if the full text could not be found after passing through three independent searches. Hand searches of bibliographies of published review articles were also done. Results were imported and consolidated into Endnote X6.

The studies covered a broad range of objectives and designs and included studies using qualitative and quantitative methods. As the goal was to conduct a comprehensive descriptive review of breastfeeding determinants, we did not perform a quality appraisal of each study included in the compilation. However, for studies that reported both univariate and multivariate statistical models, we used the multivariate model results.

In the third step, another reviewer categorized the 3 739 remaining articles into two groups based on the abstract or full text: (1) primary studies of original research that directly investigated breastfeeding determinants and (2) secondary articles, which might have had a different purpose but described breastfeeding determinants in the text, such as intervention studies. The primary studies (n = 1 911) also included reviews and case studies. The secondary articles (n = 1 674) were excluded from the data extraction. During this process, broad themes were identified, for example, studies indicating intention to breastfeed, or describing social attitudes.

In the fourth step, two reviewers abstracted primary studies into a predefined template. Briefly, the template consisted of the following fields: details of reference (title, author, publication year), study characteristics, design and setting, breastfeeding status as well as determinants of breastfeeding categorised by maternal, paternal, infant, home, family, health system, work, community, policy, marketing and economic factors. Breastfeeding status included the intention to breastfeed, early initiation, pre-lacteal feeds, exclusive breastfeeding, continued breastfeeding or any breastfeeding (Table 3). Information from the template was summarised into broad determinants.

Results:

The online search from all nine databases produced 75 373 articles. These were subjected to a second level of combined electronic and manual filtering, resulting in the selection of 3 739 titles (Table 2, Figure 1). These were categorized into primary and secondary studies, as described above. Of the 3 739, 1 674 were categorised as secondary studies and 2 065 were entered into the primary studies database for further analysis. Sorting through full-text versions of the references eliminated a further 151 studies as unsuitable, with 1 911 studies remaining in the primary database and included in the review.

Not all 1 911 studies are referred to in the text, where preference has been given to representing the diversity of countries and regions in which research has been conducted, studies across the timespan of the review to indicate how long a particular issue has been highlighted, reviews and overviews, and discrepant findings. Papers not cited in the text are listed alphabetically in Appendix 2.

Limitations of the review:

Because we wanted to include all studies we could find from all countries, we did not account for heterogeneity in study designs such as sample size, random selection, self-administered surveys, and self–reported outcome measures, the latter introducing recall, volunteer and selection biases. Introducing quality metrics would have significantly reduced the number of studies included from many low and middle income countries, which would have constrained the considerable agreement on major determinants that seems to exist across the temporal period of the review and across regions of the world.

Table 1: Eligibility criteria for study selection using electronic search procedures

Inclusion criteria	Exclusion criteria
Published studies 1970 – current in all text fields	Animal studies
Breast breastfed colostrum human AND milk infant AND feed wet AND nurse lactate AND milk exclusive AND breastfeeding baby AND formula breastfeed formula supplementation breastfeeding formula substitute neonatal AND milk neonatal AND breast child AND health AND breast AND milk nursing AND breast AND feed knowledge AND attitude AND breast AND feed breast AND feed AND determinant	adenosis allergies angiolipoma NOT arthritis bioassays breast augmentation autoimmune diseases autism bacterial studies bird cancer, carcinoma, biopsy, cervical, chemotherapy, grafting, malignant BRCA1, BRCA2 cardiac, cardiovascular celiac disease cholesterol cystic ductal dysplasia endocrine enzyme fibrocystic fluorescent genetic inflammatory imaging immunosuppress* implant* infect* kinase lesions lymph mamm* mastectomy metastatic molecular *monkey* murine mycotoxin neoplasm* neurotoxic physiolog* pollutant* prosthesis radiation *radiography* reconstruction* surgery swim* tissue treatment tumor*/tumour* ultrasound ultrasono* x-ray

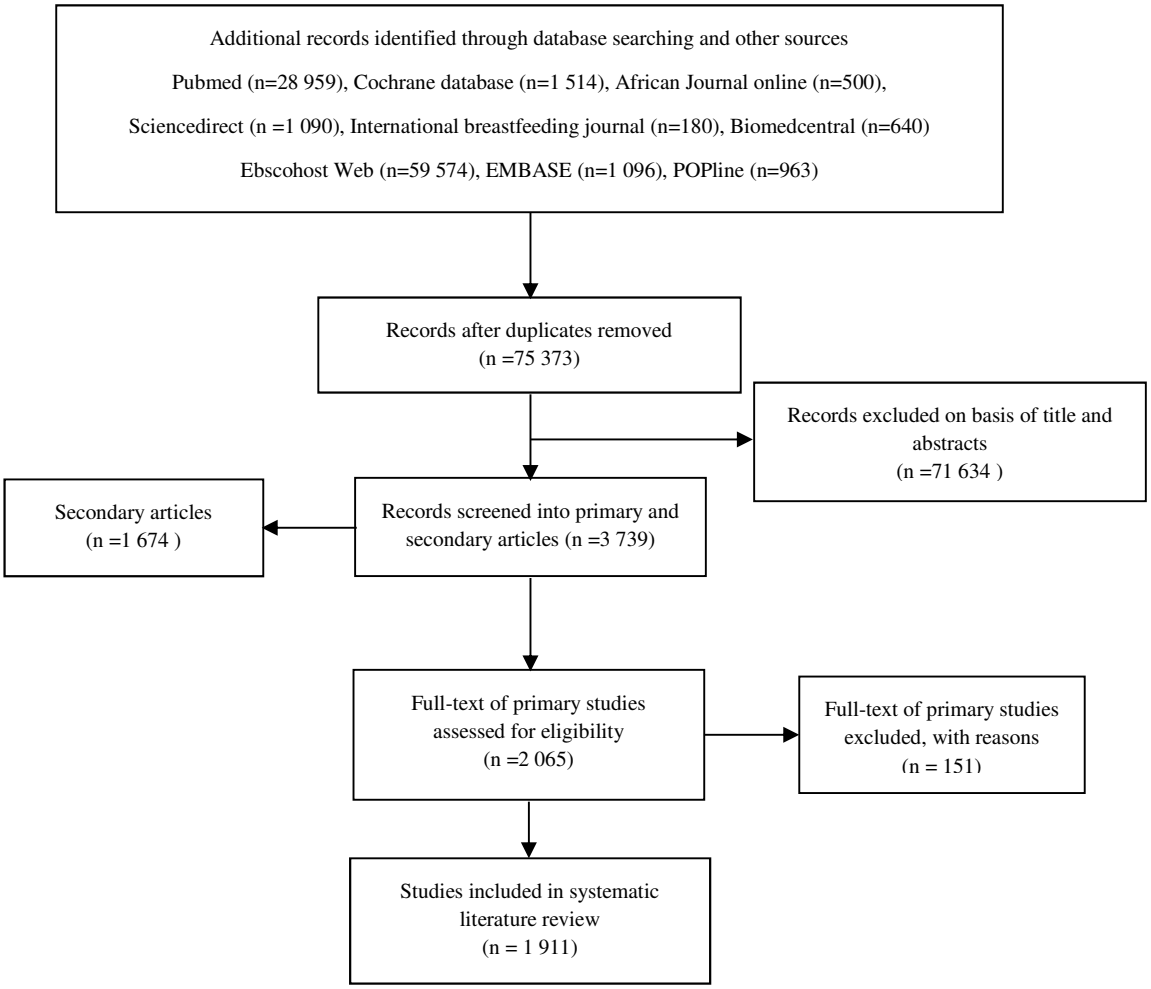
Table 2: Inclusion and exclusion criteria for a second level of combined electronic and manual search procedures

Inclusion criteria	Exclusion criteria
breastfeeding education	Immunity
breastfeeding initiation	allergy, asthma, eczema
breastfeeding continuation	childhood cancer
exclusive breastfeeding	benefits of breastfeeding
Parity	growth rates
Weaning	milk volume
any determinants of breastfeeding or some influence on initiation, exclusive, duration and any breastfeeding at the levels of policy, social, community, home/family, mother, infant	breast feeding as a risk factor for growth and developmental issues e.g. malnutrition, stunting and motor skills
use of drugs of medications whilst breastfeeding, included if determinants are mentioned in these studies	HIV – vertical transmission, guidelines on breastfeeding if HIV positive, effects of breastfeeding on the health of HIV positive women
breast feeding during political crises and disasters, emergencies	testing breast milk concentration
workplaces such as military	studies that assessed interventions only, including changes attributed to the introduction of the Ten Steps or Baby Friendly Hospital Initiative.
baby friendly initiative studies (intended consequences), WIC studies (unintended consequences or inhibiting)	mothers with special needs
donor milk, milk banks, milk sharing studies if they relates to policy determinants to encourage breastfeeding explicitly	babies in neonatal care
fertility, contraception, amenorrhea if these are determinants	
marketing infant formula health system promotion of breastfeeding	
any country	
reviews, case reports	
strategies to improve breastfeeding, studies showing no effect of health promotion on rate of breastfeeding	
change in determinants over time due to policy and other external influences	

Table 3: Description of outcome measures for breastfeeding status used in data extraction

Breastfeeding status	Outcome measure
intention	planning to feed baby breast milk
colostrum/ early initiation	contact with breast within 1 hour after birth
exclusive breastfeeding	feeding baby breast milk only for six months
continued	breastfeeding after six months and beyond 12 months whilst supplementing with other foods
any breastfeeding	feeding baby breast milk with formula or other food
pre-lacteal	food given prior to breast feeding becoming established
social attitudes towards breastfeeding	attitudes towards breastfeeding among groups other than mothers, such as family members, health facility staff, school children, university students

Figure 1: PRISMA Flow Diagram for Review of Breastfeeding Determinants



Integrative review: Major findings

"Breastfeeding is the biological norm for infant feeding, but is also a social construct. As such, its rates and practices are determined by the same social determinants that shape health inequalities and inequities" (Cattaneo, 2012, p.3)(2)

Broad social trends in breastfeeding

Some broad trends in breastfeeding are well known (3-5): firstly, a progressive decline in high income countries associated with marketing of BMS, women's work and changing social attitudes(6, 7); alarm about this was raised in the 1970's (8, 9). Secondly, there were declines from near universal, though partial, breastfeeding in LMICs among better educated, higher SES individuals living in urban areas (10-15), especially those working outside the home (16). This decline was associated with breast milk substitutes (BMS) being perceived as modern and prestigious and breastfeeding being associated with poverty and lack of sophistication (17-26). Reversal of these trends began in the latter part of the twentieth century in wealthier countries – especially amongst the higher classes – (27-30) and poorer countries (31-34), in the USA (35) and Brazil (36-38) for example, as illustrated in the case studies in this paper. The stabilization or reversal of declines in breastfeeding are attributed to changes in health service policies and practices (39), social attitudes responsive to the dissemination of scientific findings about the benefits of breastfeeding, and efforts to limit the marketing of breast milk substitutes (36).

These broad trends arise from educational, socioeconomic and cultural variation (40-50), the latter clearly demonstrated by ethnic and racial differences even within countries (51-66). In some cultural settings, mixed feeding beginning days after birth, including water and diluted porridge, is deep-rooted (67-92) and frequently based on the belief that it improves the nutritional quality of the child's diet (93-100). This, together with continued colostrum disposal, and pre-lacteal mixed feeding (69, 101-129), indicates the need for more effective culturally-tailored interventions, including among diverse groups in high income countries (130-135).

Breastfeeding: A practice that unfolds over time in the context of social attitudes

Breastfeeding is a practice that unfolds over time (136) subject to the social-cultural environment in which a woman's knowledge and attitudes to feeding develop; during pregnancy when her intentions about feeding take form; based on her particular experiences and that of her baby during birth and neonatal care, and following on through the personal, family, social and work conditions under which her infant is cared for and fed.
Ambient social and cultural attitudes create an important context in which breastfeeding takes place (137). Public attitudes, surveyed in low, middle and high income countries, are supportive of breastfeeding but continue to indicate discomfort with public feeding (138-156). These findings stress the importance of social attitudinal changes to increase acceptance of breastfeeding (157-159), as well as their potential amenability to intervention, starting in childhood and adolescence (160, 161).

Intention to breastfeed

Infant feeding intentions are generally established by the third trimester of pregnancy (162-164), except among adolescents who tend to be more indecisive (165). Subjective norms about the value of breastfeeding (166-174) and benefits of breastfeeding for the baby are the most frequently cited reasons for intending to breastfeed (175-184). Breastfeeding intentions are strongly influenced by information advice given during the antenatal period (170, 185-192). Consistent with psychological theory (171, 193-196), intention is strongly predictive of breastfeeding at birth, during the early post-natal period (197-209) and, in some cases, of breastfeeding duration (200, 205, 210-219), provided the context is supportive (220-224).

Reasons cited for frustration of breastfeeding intentions include high-risk pregnancy (225, 226), assisted delivery (58, 227-252), maternal illness (253-256), child born of low birth weight, pre-term or ill (176, 257-266), and hospital practices (separation, pre-lacteal supplementation, and early introduction of pacifiers) that work against effective initiation of breastfeeding (109, 124, 207, 267-279). Women are vulnerable to breastfeeding cessation or supplementing breastfeeding in the first 2-3 weeks after birth, a time when they particularly need support (280-293). Women who don't fulfill their breastfeeding intentions report feeling discouraged, including from attempting

breastfeeding in subsequent pregnancies (294-296). Later discontinuation of intended BF occurs because of a lack of supportive conditions during infancy (297), as outlined below.

Early initiation

Building on intentions, early initiation sets the stage for subsequent breastfeeding. In many traditional societies, colostrum has long been thought to be harmful and discarded (298-305), while breastfeeding might be delayed for several days during which time newborns are provided with pre-lacteal feeds (245, 306-322), including tastes of culturally valued foodstuffs (75, 123). As indicated above, hospital practices of delaying contact (323-325), separating mother and child (326, 327) and providing newborns with sugar water or formula milk also delay initiation and therefore mitigate against the effective establishment of breastfeeding (271, 314, 328-331), and significantly reduce prevalence and duration of breastfeeding (332-335).

Exclusive and continued breastfeeding: A conceptual model

Continuing exclusive breastfeeding beyond the newborn period, and delaying supplementation until 6 months, is dependent on a range of enabling factors, illustrated in the Conceptual Model, including: characteristics of the mother, child and their relationship; her family and community; health systems and services; working conditions, and the broad socio-cultural and marketing milieu, with many of these factors working together (292, 336-367).

Mother, child and their relationship

In terms of characteristics of the mother, child and their relationship, the need for clinical intervention and care during pregnancy and delivery presents challenges for breastfeeding, although it overwhelmingly need not prevent or curtail breastfeeding if sufficient support is provided (202, 368-392).

In addition to clinical care, the most pervasive maternal and child factors that disrupt breastfeeding can be summarized by the following characteristics, again frequently working together:

1) maternal confidence and self-efficacy (143, 185, 196, 204, 323, 393-438) (as indexed also by education (41, 177, 282, 439-469), social class (365, 470-489) migrant or minority status (25, 297, 490-504), marital status (505-514), age (270, 515-537), previous BF experience (538-551), information (552-561) (including of optimum feeding recommendations) (562-566), stress and anxiety (567-579), concerns about body shape (580-582), levels of support (583-588), and anticipation of difficulties and inconvenience (281, 589-592));

2) poor breastfeeding technique (593-596) (positioning, latching, and feeding frequency, sometimes associated with very early or excessive pacifier use) (283, 441, 557, 597-620);

3) infant crying, fussiness, perceived hunger and relationship difficulties (621-635), leading to the conclusion by the mother and/or people with influence that:

4) the mother has insufficient milk to adequately feed her baby (102, 582, 636-672).

Smoking, obesity and depression

Over the last decade, several papers and reviews, have reported the adverse effects on breastfeeding of smoking (230, 248, 260, 267, 355, 400, 427, 430, 442, 445, 520, 535, 673-700), overweight and obesity (173, 348, 527, 701-713), and depression (410, 714-729). These determinants are important, also because they affect large number of women, especially in low and middle income countries with potential knock-on effects on national rates of breastfeeding. For example, an estimated 20 percent of women in developing countries smoke (730), up to 37% are overweight or obese (731) and in the region of 31% experience post-partum depression (732). Sometimes these occur together (288, 390, 575, 733, 734), and with other risk factors, such as low SES, being single, and having an assisted delivery (398, 580, 723, 733-737). Neither depression nor obesity have a physiological effect on breastfeeding, and that of smoking is debatable (738, 739). Rather, it seems they occur together with motivational and attitudinal conditions that work against breastfeeding (740, 741). In the case of depression, many studies do not

separate it as a consequence rather than an antecedent of not being able to breastfeed in line with mother's intentions (742-749).

Families, social networks and communities

Families, social networks and communities are important influences on women's decisions to breastfeed and breastfeeding duration (155, 750-757), including whether other women in the family breastfed their children, and whether friends and associates did or are breastfeeding (758-760). The attitudes and preferences of the father or partner weigh substantially in women's intentions to breastfeed, and more women whose partners give them support breastfeed for longer (163, 761-778), including working mothers (779). The majority of men who have been surveyed want to be supportive (780-784). Nonetheless, some women report choosing to bottle feed because they want to ensure father involvement in child care and help with household tasks (785, 786), or because they think that the father might not approve of breastfeeding (787). The reported benefits of partner support have led to calls for more systematic approaches to involving fathers (788-797). In addition to fathers, grandmothers (798) and other authoritative women powerfully sway a women's decision to breastfeed and to continue breastfeeding, including advice to introduce BMS and solids (330, 426, 799-808). Broader community support has also been shown to increase breastfeeding, both in parent groups (809) and through protective municipal provisions (810).

Health services and health workers

Health services and health workers play a critical role in supporting women to breastfeed (222, 306, 811-828), especially vulnerable women, such as adolescents (829-839), through the provision of information and support (840), antenatal classes (762, 841) and post-natally (842-846). But there are many ways in which health services and health workers must improve their support of breastfeeding. These include:

1) Ensuring compliance with all breastfeeding best practices (532, 847-859) (including early skin contact and feeding the baby colostrum (860-863), not providing early supplementation (269, 864-866), not advising women to use formula (867, 868) or distributing formula discharge packs (257, 869-872)), and expanding the adoption of best practices to all health facilities (873-875);

2) Improving the ability of health workers to give effective support by: a) warranting they have the required training and professional upgrades, because studies from around the world indicate substantial gaps in the attitudes, knowledge and skills of pre-clinical students, nutritionists, nurses and physicians (70, 156, 754, 876-913), and b) encouraging health workers and providing work conditions that enable them to effectively breastfeed themselves (914). Several studies demonstrate early breastfeeding cessation among health workers (148, 914-927), as a result of which they are less able to model optimal breastfeeding, are less convincing in their advice and may subtly undermine breastfeeding based on their own discouraging experiences (876, 928); and

3) Improving what is oftentimes described by women as indifferent attitudes towards breastfeeding and the provision of late, inadequate or conflicting advice (223, 929-942).

Women's work outside the home

With very few exceptions (943), studies on women's work outside the home, report lower rates and/or duration of breastfeeding, including exclusive breastfeeding (944-968), with one study estimating that women's work accounts for up to a fifth of BMS use in developing countries (969) and contributes to lower BF rates among better educated women in LICs (970). Further, women who know they are returning to work after the birth of their child are less likely to intend, initiate or continue to breastfeed (971-979). The impact of work on breastfeeding is multi-dimensional, including fatigue (980) and practicality (981), and varies by length, if any, of maternity leave (982, 983), working hours (984, 985), and intensity of work (986), although maternal attitude and commitment to BF also plays a role (987), as does attitudes to expressing milk (988). In addition, some, particularly self-employed and professional, women fear job loss, social censure and career costs if they breastfeed at work (989, 990). The length of maternity leave a women has is positively associated with breastfeeding duration, with fewer than 6 weeks increasing fourfold the odds of either not establishing breastfeeding or early cessation (991).

Employers and co-workers do not see provisions for breastfeeding as a high priority employee benefit (992-995) and provisions to breastfeed at work are not always well communicated (996). Though some studies report discomfort (993), employers, co-workers and the general public are more supportive when legislation or policy is in place (997, 998) and when they have experience of working women breastfeeding or expressing milk (999, 1000). Breastfeeding can be continued after return to work in settings where maternity leave (1001-1003) and/or child care is available (1004), where breastfeeding or expressing is supported and properly accommodated in the place and time of work (1005-1012), when women have more control over their working conditions (1013, 1014), including some groups of professional women (1015), and among women doing home-, market- or field-based work in traditional settings who have family and community support (952, 1016-1019). However, women in poorly paid work outside of the home experience a number of difficulties in combining work and breastfeeding (458, 1020-1023), indicating the clear need for legislation and policy (1024).

Marketing of breast milk substitutes

It is widely agreed that marketing by the infant feeding industry and the availability of formula is related to the increase in bottle feeding in LMICs (169, 650, 1025-1028), including through the distribution of free samples (1029, 1030), though with some contrary or ambiguous findings (1031, 1032). Formula advertisements are interpreted by mothers to suggest that breastfeeding is difficult and that BMS help to settle fussy babies (331). Mothers in Malaysia and Laos report finding BMS advertisements on television attractive and that they were influenced, also by free milk samples, to buy a particular brand of formula (1033, 1034). A 2008 population-based US study found that 67% of mothers had received free discharge formula samples, and that receipt was associated with shorter breastfeeding duration (1035). An experimental comparison of hospital gift sample packs with information and pump packs also showed negative effects on breastfeeding (1036). Mothers report that media, including magazines and television, is an important source of information in high (44, 1037), middle and low income countries (1038) and studies in several countries report a relationship between recall of formula advertisements and decreased breastfeeding (1039-1041). While infant formula advertisements have declined in Australia since the adoption of the Code, it is reported that baby food and toddler formula advertisements have increased (1042).

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Appendix 1: Full electronic search strategy in Pubmed performed on 23rd September 2014

Restrict to articles published since 1970 and humans

Breast NOT adenosis NOT allerg* NOT animal NOT angiolipoma NOT arthritis NOT assay NOT augment* NOT autoimmune NOT autism NOT bacteria* NOT biopsy NOT biopsies NOT bird NOT BRCA1 NOT BRCA2 NOT cancer NOT carcinoma* NOT cardiac NOT cardiovascular NOT celiac NOT cervic* NOT chemotherapy NOT *cholesterol* NOT cyst* NOT ductal NOT dysplasia NOT endocrine NOT enzyme NOT ether* NOT fibrocystic NOT fluorescent NOT genetic NOT grafting NOT inflammatory NOT imaging NOT immunosuppress* NOT implant* NOT infect* NOT kinase NOT lesions NOT lymph NOT malignant NOT mamm* NOT mastectomy NOT metastatic NOT molecular NOT *monkey* NOT murine NOT mycotoxin NOT neoplasm* NOT neurotoxic NOT physiolog* NOT pollutant* NOT prosthesis NOT radiation NOT *radiography* NOT reconstruction* NOT surgery NOT swim* NOT tissue NOT treatment NOT tumor* NOT tumour* NOT ultrasound NOT ultrasono* NOT x-ray

Breastfed NOT adenosis NOT allerg* NOT animal NOT angiolipoma NOT arthritis NOT assay NOT augment* NOT autoimmune NOT autism NOT bacteria* NOT biopsy NOT biopsies NOT bird NOT BRCA1 NOT BRCA2 NOT cancer NOT carcinoma* NOT cardiac NOT cardiovascular NOT celiac NOT cervic* NOT chemotherapy NOT *cholesterol* NOT cyst* NOT ductal NOT dysplasia NOT endocrine NOT enzyme NOT ether* NOT fibrocystic NOT fluorescent NOT genetic NOT grafting NOT inflammatory NOT imaging NOT immunosuppress* NOT implant* NOT infect* NOT kinase NOT lesions NOT lymph NOT malignant NOT mamm* NOT mastectomy NOT metastatic NOT molecular NOT *monkey* NOT murine NOT mycotoxin NOT neoplasm* NOT neurotoxic NOT physiolog* NOT pollutant* NOT prosthesis NOT radiation NOT *radiography* NOT reconstruction* NOT surgery NOT swim* NOT tissue NOT treatment NOT tumor* NOT tumour* NOT ultrasound NOT ultrasono* NOT x-ray

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Human AND milk NOT adenosis NOT allerg* NOT animal NOT angiolipoma NOT arthritis NOT assay NOT augment* NOT autoimmune NOT autism NOT bacteria* NOT biopsy NOT biopsies NOT bird NOT BRCA1 NOT BRCA2 NOT cancer NOT carcinoma* NOT cardiac NOT cardiovascular NOT cats NOT celiac NOT cervic* NOT chemotherapy NOT *cholesterol* NOT cyst* NOT ductal NOT dysplasia NOT endocrine NOT enzyme NOT ether* NOT fibrocystic NOT fluorescent NOT genetic NOT grafting NOT inflammatory NOT imaging NOT immunosuppress* NOT implant* NOT infect* NOT kinase NOT lesions NOT lymph NOT malignant NOT mamm* NOT mastectomy NOT metastatic NOT molecular NOT *monkey* NOT murine NOT mycotoxin NOT neoplasm* NOT neurotoxic NOT physiolog* NOT pollutant* NOT prosthesis NOT radiation NOT *radiography* NOT reconstruction* NOT surgery NOT swim* NOT tissue NOT treatment NOT tumor* NOT tumour* NOT ultrasound NOT ultrasono* NOT x-ray

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Baby AND formula NOT adenosis NOT allerg* NOT animal NOT angiolipoma NOT arthritis NOT assay NOT augment* NOT autoimmune NOT autism NOT bacteria* NOT biopsy NOT biopsies NOT bird NOT BRCA1 NOT BRCA2 NOT cancer NOT carcinoma* NOT cardiac NOT cardiovascular NOT celiac NOT cervic* NOT chemotherapy NOT *cholesterol* NOT cronobacter NOT cyst* NOT ductal NOT dysplasia NOT endocrine Not enterobacter NOT enzyme NOT ether* NOT fibrocystic NOT fluorescent NOT genetic NOT grafting NOT inflammatory NOT imaging NOT immunosuppress* NOT implant* NOT infect* NOT kinase NOT lesions NOT

lymph NOT malignant NOT mamm* NOT mastectomy NOT meningitis NOT metastatic NOT molecular NOT *monkey* NOT murine NOT mycotoxin NOT neoplasm* NOT neurotoxic NOT physiolog* NOT pollutant* NOT prosthesis NOT radiation NOT *radiography* NOT reconstruction* NOT surgery NOT swim* NOT tissue NOT treatment NOT tumor* NOT tumour* NOT ultrasound NOT ultrasono* NOT x-ray

breastfeed formula supplementation
breastfeeding formula substitute
breastfeeding vs formula feeding
neonatal AND milk
neonatal AND breast
child AND health AND breast AND milk
nursing AND breast AND feed
knowledge AND attitude AND breast AND feed
breast AND feed AND determinant

Appendix 2: References identified in the search but not cited in the text

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Web annex 3 - Breastfeeding and HIV

For more than 20 years, women living with HIV in low and middle income countries faced an intolerable decision whether to breastfeed and place their infant at risk of HIV transmission or to give formula milk and risk death from diarrhoea, pneumonia and malnutrition. In this time, the HIV- and child survival communities respectively were polarised on whether to prioritise prevention of HIV transmission by avoiding breastfeeding, or to protect breastfeeding as a key child survival intervention. HIV undermined confidence in breastfeeding among health providers, mothers, and communities in high HIV prevalence, low resource settings. Today however, knowledge and circumstances have changed and the opportunity exists to capitalise on highly effective interventions and public health approaches to increase breastfeeding support for all affected communities.

The mechanism of HIV transmission through breastfeeding is not fully understood but both maternal and child factors are important(1). The transmission risk associated with exclusive breastfeeding is about half that associated with mixed breastfeeding feeding (2). On the other hand, not breastfeeding at all or stopping early is associated with growth failure and high mortality among HIV-exposed infants in low resource settings (3).

Only in 2010, 25 years after the first report of HIV presence in breastmilk (4), were highly effective interventions first recommended to prevent postnatal transmission through breastmilk (5). With good adherence, antiretroviral drugs (ARVs) reduce postnatal transmission to <1% with up to 12 months of breastfeeding. International recommendations and national policies no longer focus on counselling individual HIV-infected women in their choice of feeding but endorse public health approaches that promote one feeding practice for all HIV-infected mothers, either breastfeeding with ARVs or replacement feeding, depending on local epidemiology and causes of infant and child mortality (6).

Although ARVs have transformed the landscape, challenges remain. Will health workers have enough confidence in ARVs to recommend and support breastfeeding? Can health systems in resource limited settings effectively support HIV-infected mothers to adhere to ARVs? In high prevalence countries where replacement feeding was the national recommendation, studies are reporting a preference for breastfeeding when information and ARVs are reliably provided (7). Such evidence shows that combining new drug therapies and breastfeeding practices can – with investment and support – work symbiotically.

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Web annex 4

Interventions to Improve Breastfeeding Practices

Review methods, Prima diagram and sub-group analyses

Methods

We searched for existing systematic reviews, particularly Cochrane reviews on the effects of interventions on the above mentioned breastfeeding outcomes. As our objective was different from previous reviews, we planned for a new review. The search strategy is presented in the Box below. We searched published literature from PubMed, Cochrane Library and CABI databases to identify studies examining the effects of interventions to promote breastfeeding on the following outcomes: early initiation of breast feeding, exclusive breastfeeding in the first 6 months, continued breastfeeding between 12 and 23 months, and any breastfeeding. The search was conducted in October 2014. No language or date restrictions were employed in the searches.

Two review authors screened the titles and abstracts independently to identify potentially relevant citations. These review authors retrieved the full texts of all potentially relevant articles and independently assessed the eligibility of the studies using pre-defined inclusion criteria. Data extraction was done for all the articles which were found to be relevant by both. Any disagreements or discrepancies between reviewers were resolved by discussion and, if necessary, by consulting a third review author. In addition to the electronic search, reference lists of the articles identified were searched for any other relevant article. We used web based citation index for citing manuscripts of these identified articles.

Inclusion Criteria

We selected studies that were either randomized controlled trials (RCTs) including cluster randomized trials or quasi-experimental trials as well as observational studies (prospective/ retrospective cohort and case-control). All studies on interventions to improve breastfeeding that were delivered to mothers in the antenatal or postnatal period or both, were included. Studies were also included in which the interventions to improve breastfeeding were delivered to the families, community, health staff and other stakeholders. For articles not written in English, we searched for an English abstract English. If none of the key outcomes included in this review was mentioned in the abstract, the study was excluded. We did not exclude any article which examined the effect of interventions on breastfeeding outcomes, even if the outcomes were measured for preterms or babies in the Neonatal Intensive Care Unit.

Categorization of Interventions

Interventions were categorized into five settings based on the place or mechanism of intervention delivery. These were ‘Health Systems and Services’, ‘Home and Family Environment’, ‘Community Environment’, ‘Work Environment’ and ‘Policy’. Studies which examined the effect of the Baby Friendly Hospital Initiative, establishment of rooming in practices or organizational support on breastfeeding outcomes were grouped under ‘Health Systems and Services’. ‘Home and Family Support’ included studies on peer support, one-to-one counseling or education by home visits or telephone, home support by father or grandparent. Under the category of ‘Community Environment’ we included studies which examined effect of group counseling, group meetings, social mobilization, mass media or social media on breastfeeding outcomes. The ‘Work Environment’ category included studies on maternity leave, workplace support and employment status of the mothers. Studies included under the category of ‘Policy Environment’ examined the effect of Breast-milk Substitutes Act (or the Code of Marketing of Breast Milk Substitutes), National MCH Programs on breastfeeding. Studies where interventions were delivered at multiple settings, e.g. ‘Health Systems and Services’ together with ‘Home and Family Environment’, were categorized under ‘Combination of Settings’.

Each of the five categories of interventions was further sub-grouped according to the ‘nature of interventions’. The Health Systems and Services setting was subdivided into Baby Friendly Hospital Support Initiative, counseling or education, special training to health workers and caesarean section. Home

and Family Environment was subdivided into counseling or education and family or social support. Community Environment was subdivided into group counseling or education and integrated mass-media-counseling-community mobilization approach. Work Environment was subdivided into maternal leave policy, work place support and employment status. Policy environment included studies on breast milk substitute policies and maternal and child health program.

Abstraction, Analysis and Summary Measures

For the studies that met the final inclusion criteria, data abstraction was done by two review authors into a data abstraction form modified from the Cochrane data abstraction form. It included study identifiers and context, study design and limitations, intervention details and outcome effects. If within a study the outcomes had been assessed in two or more different populations or the effects of different interventions had been compared with the control group, these outcome estimates were examined separately. We converted odds ratios (OR) (both adjusted & unadjusted) to Relative Risk (RRs; unadjusted) for studies which provided OR only and used RR as our outcome estimate measure. To estimate the effect of interventions on breastfeeding outcomes, we conducted a meta-analysis using 'metan' command in Stata 11.2 (StataCorp, College Station, TX, US) and pooled Hazard Ratio, adjusted and unadjusted RR together and reported the pooled relative risk (RR) and corresponding 95% confidence interval (CI). High heterogeneity was defined either by a low P value (less than 0.05) and a large chi-squared statistic relative to its degree of freedom or an I^2 value greater than 60%. In cases of high heterogeneity random effects model was used and causes were explored by subgroup analysis and meta-regression. Subgroup analyses were carried out based on Intervention delivery settings (Health systems and services', 'Home and family environment', 'Community environment', 'Work environment', 'Policy' and 'Combination of settings'), Study size (< 500, 500 – 1499, ≥ 1500), country type (High income, Lower and middle income), Urban or Rural setting, study design (RCT, Observational, Quasi-experimental), control for confounding (Yes, No) and quality of study (Adequate, Inadequate). For control of confounding a judgment of 'Yes' was assigned to a study if it had controlled for socio-demographic factors like maternal age, family type, mother's education, working status of mother and other risk factors like parity, mode or place of delivery. To assess quality of study, we used the Cochrane risk of bias tool. We conducted subgroup analysis to examine the effect of the different nature of interventions under each setting on breastfeeding outcomes.

Outcomes and Definitions

We have specified breastfeeding outcomes according to the categories of breastfeeding defined by the WHO. Outcomes of interest were 'Early initiation of breastfeeding', 'Exclusive breastfeeding', 'Continued breastfeeding' and 'Any breast feeding'.

Early initiation of breastfeeding' was defined as Initiation of breastfeeding within one hour of birth irrespective of the mode of delivery. 'Exclusive breastfeeding' (up to six months) was defined as feeding breast milk from mother or wet nurse or expressed breast milk and no other liquids or solids except vitamin drops or syrups, mineral supplements or prescribed medicines. If the definition of breastfeeding practice assessed in a study for a child less than 6 months was different from that of exclusive breastfeeding, it was categorized under 'any breastfeeding'. A child aged 12 to 23 months if breastfed was considered as receiving 'continued breastfeeding'.

If a study examined Exclusive or Any breastfeeding rates at multiple time points e.g. 3, 4, 6 months, we used the longest time point data for pooling. Similarly, for continued breastfeeding we used the available longest time point data.

Results

The Prisma diagram is presented below as well as four tables that complement the findings presented in the main text under Table 1. The tables presented in this annex provide the results from the subgroup analyses.

SEARCH STRATEGY

1. (Breastfeeding OR Breast Feeding OR (Exclusive AND Breastfeeding [All Fields]) OR (Continued AND Breast feeding [All Fields]) OR Lactation OR Human Milk OR Breast Milk [MeSH Majr])
2. (Counseling OR Peer OR education OR (intervention[All Fields]) OR family practice OR support OR Groups OR health worker OR physician [MeSH terms])
3. (Social media OR social networking OR mass media OR health campaigns OR group OR meeting OR health promotion OR community [MeSH terms])
4. (BFHI [All Fields] OR (Baby Friendly Hospital [All Fields]) OR Rooming in OR Perinatal Care OR health services OR Hospital OR Facility OR health system OR health program[MeSH terms])
5. ((Infant food Marketing [All Fields]) OR (Code of Marketing [All Fields]) OR (Infant milk substitutes [All Fields]) OR (Breast milk substitutes [All Fields]) OR Policy OR Legislations OR law [MeSH terms] OR work OR Workplace)
6. (Addresses[ptyp] OR Autobiography[ptyp] OR Bibliography[ptyp] OR Biography[ptyp] OR pubmed books[filter] OR Case Reports[ptyp] OR Congresses[ptyp] OR Consensus Development Conference[ptyp] OR Directory[ptyp] OR Duplicate Publication[ptyp] OR Editorial[ptyp] OR Festschrift[ptyp] OR Guideline[ptyp] OR In Vitro[ptyp] OR Interview[ptyp] OR Lectures[ptyp] OR Legal Cases[ptyp] OR News[ptyp] OR Newspaper Article[ptyp] OR Personal Narratives[ptyp] OR Portraits[ptyp] OR Retracted Publication[ptyp] OR Twin Study[ptyp] OR Video-Audio Media[ptyp])
7. #1 AND (#2 OR #3 OR #4 OR #5)
8. #7 NOT #6

PRISMA Flow Diagram for Review of Interventions to Promote Breastfeeding

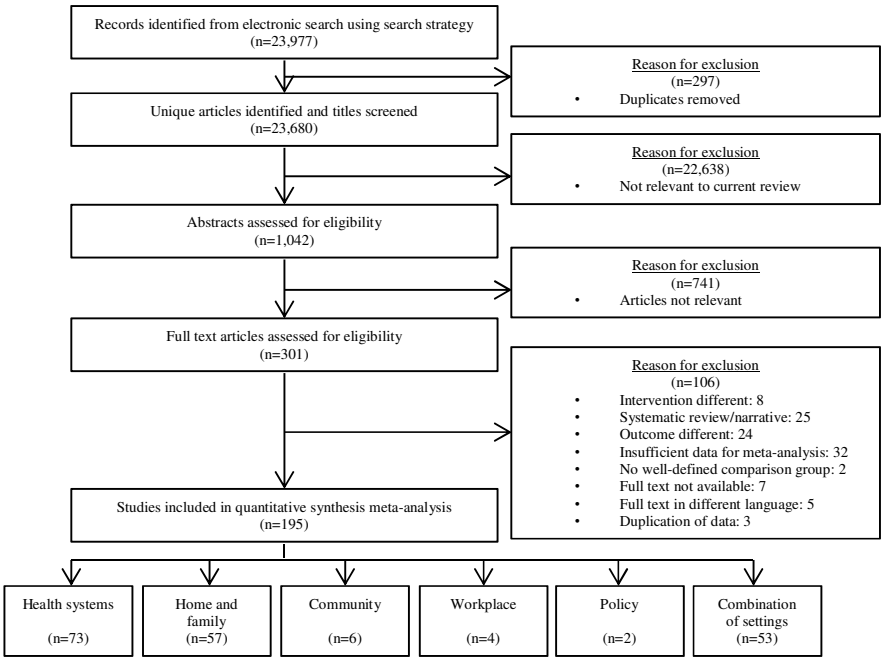


Table 1. Effect of Interventions on Early Initiation of Breastfeeding

Subgroup analysis	No. of estimates	Pooled odds ratio and 95% confidence interval	I^2 (%)	Meta regression p value
All interventions	49	1.25 (1.19-1.32)	90.6	
1.Intervention Delivery Setting				0.534
Health Systems and Services	29	1.11 (1.06; 1.16)	88.2	
Home and Family Environment	5	1.74 (0.97; 3.12)^	93.8	
Community Environment	5	1.86 (1.33; 2.59)	69.3	
Work Environment	-	-	-	
Combination of settings	10	1.57 (1.24; 1.97)	86.8	
2.Study size				0.871
< 500 participants	26	1.30 (1.18; 1.44)	86.2	
500 – 1499 participants	11	1.48 (1.24; 1.75)	92.1	
≥ 1500 participants	12	1.10 (1.03; 1.18)	93.8	
3.Country type				0.046
High income	31	1.13 (1.07; 1.19)	88.0	
Lower mid income	18	1.66 (1.44; 1.91)	92.8	
4.Urban/Rural#				0.773
Urban	27	1.24 (1.13; 1.36)	87.9	
Rural	8	1.72 (1.26; 2.36)	94.1	
Combined	1	1.35 (1.05; 1.73)	-	
5.Study design				0.835
RCT	12	1.48 (1.23; 1.79)	94.0	
Observational	15	1.20 (1.11; 1.30)	91.3	
Quasi experimental	22	1.19 (1.10; 1.29)	85.7	
6.Control for confounding				0.930
Yes	73	1.25 (1.18; 1.32)	92.8	
No	57	1.26 (1.12; 1.42)	84.6	
7.Quality of study*				0.283
Adequate	27	1.19 (1.13; 1.26)	91.4	
Inadequate	22	1.36 (1.19; 1.55)	89.2	
86.1% of the heterogeneity was explained by these 7 factors.				

^ Not significant; *Measured according to The Cochrane Collaboration's Tool for assessing Risk of bias; #Data for all studies were not available

Table 2. Effect of Interventions on Exclusive Breastfeeding

Subgroup analysis	No. of estimates	Pooled odds ratio and 95% confidence interval	I^2 (%)	Meta regression p value
All interventions	130	1.44 (1.38-1.51)	91.0	
1.Intervention Delivery Setting				0.482
Health Systems and Services	51	1.46 (1.37; 1.56)	94.7	
Home and Family Environment	43	1.48 (1.32; 1.66)	22.0	
Community Environment	6	1.20 (1.03; 1.39)	0.0	
Work Environment	4	1.28 (0.98; 1.69)^	0.0	
Combination of settings	26	1.79 (1.45; 2.21)	78.9	
2.Age at outcome measurement				0.806
<4 months	57	1.39 (1.31; 1.48)	93.7	
4 - 6 months	73	1.59 (1.44; 1.75)	85.9	
3.Study size				0.548
< 500 participants	69	1.66 (1.50; 1.84)	68.2	
500 – 1499 participants	39	1.51 (1.34; 1.70)	89.4	
≥ 1500 participants	22	1.30 (1.21; 1.40)	97.1	
4.Country type				0.028
High income	73	1.35 (1.26; 1.43)	87.3	
Lower mid income	57	1.69 (1.54; 1.86)	92.1	
5.Urban/Rural#				0.948
Urban	78	1.47 (1.36; 1.59)	80.0	
Rural	20	2.04 (1.52; 2.76)	94.5	
Combined	8	1.51 (1.21; 1.88)	71.2	
6.Study design				0.009
RCT	71	1.61 (1.46; 1.78)	83.3	
Observational	20	1.34 (1.24; 1.46)	97.4	
Quasi experimental	39	1.46 (1.31; 1.63)	81.7	
7.Control for confounding				<0.001
Yes	73	1.36 (1.28; 1.46)	84.8	
No	57	1.61(1.48; 1.75)	92.7	
8.Quality of study*				0.312
Adequate	45	1.43 (1.30; 1.59)	77.7	
Inadequate	85	1.46 (1.38; 1.54)	93.1	
78.1% of the heterogeneity was explained by these 8 factors.				

^Not significant; *Measured according to The Cochrane Collaboration's Tool for assessing Risk of bias; #Data for all studies were not available

Table 3. Effect of Interventions on Continued Breastfeeding

Subgroup analysis	No. of estimates	Pooled odds ratio and 95% confidence interval	I^2 (%)	Meta regression p value
All interventions	18	1.61 (1.17; 2.20)	92.0	
1.Intervention Delivery Setting				0.219
Health Systems and Services	8	1.18 (1.03; 1.35)	32.8	
Home and Family Environment	2	1.26 (1.05; 1.50)	10.8	
Community Environment	-	-	-	
Work Environment	-	-	-	
Combination of settings	7	1.97 (1.74; 2.24)	96.4	
2.Age at outcome measurement				0.327
≤12 months	14	1.67 (1.51; 1.84)	93.2	
12 - 23 months	4	1.19 (1.03; 1.37)	49.8	
3.Study size				0.312
< 500 participants	6	1.55 (1.29; 1.86)	56.6	
500 – 1499 participants	7	1.16 (1.05; 1.29)	26.7	
≥ 1500 participants	5	2.37 (0.83; 6.80)^	96.7	
4.Country type				0.368
High income	12	1.76 (1.04; 3.01)	94.0	
Lower mid income	6	1.22 (1.09; 1.37)	25.7	
5.Urban/Rural#				0.330
Urban	8	1.53 (1.03; 2.27)	72.0	
Rural	3	1.47 (1.19; 1.81)	0.0	
Combined	3	2.56 (0.57; 11.4)^	98.3	
6.Study design				0.140
RCT	8	1.22 (1.10; 1.35)	33.5	
Observational	6	2.32 (0.87; 6.14)^	96.0	
Quasi experimental	4	1.72 (1.04; 2.83)	74.8	
7.Control for confounding				0.115
Yes	7	1.22 (1.08; 1.40)	84.8	
No	11	1.67(1.03; 2.73)	94.6	
8.Quality of study*				0.312
Adequate	7	1.18 (1.37; 1.61)	30.7	
Inadequate	11	1.85 (1.10; 3.10)	94.3	
80.9% of the heterogeneity was explained by these 8 factors.				

^Not significant; *Measured according to The Cochrane Collaboration's Tool for assessing Risk of bias; #Data for all studies were not available

Table 4. Effect of Interventions on Any Breastfeeding

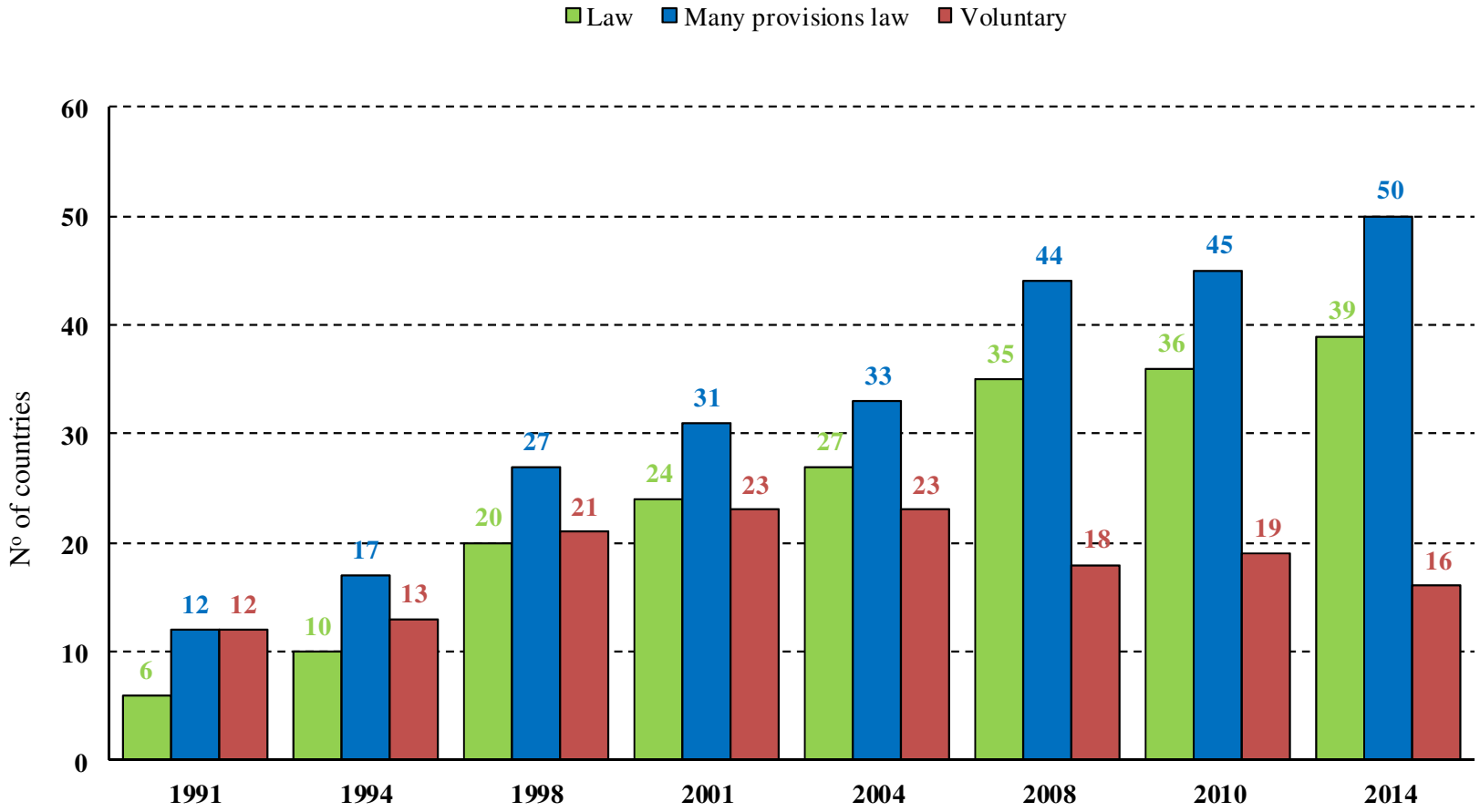
Subgroup analysis	No. of estimates	Pooled odds ratio and 95% confidence interval	I^2 (%)	Meta regression p value
All interventions	118	1.30 (1.23; 1.37)	92.1	
1.Intervention Delivery Setting				0.361
Health Systems and Services	47	1.40 (1.30; 1.52)	94.7	
Home and Family Environment	36	1.16 (1.07; 1.25)	63.5	
Community Environment	-	-	-	
Work Environment	4	1.31 (1.10; 1.56)	81.1	
Combination of settings	30	1.30 (1.06; 1.61)	93.6	
2.Age at outcome measurement				0.218
< 4 months	57	1.38 (1.28; 1.50)	94.5	
4 - 6 months	61	1.23 (1.13; 1.35)	87.2	
3.Study size				0.933
< 500 participants	65	1.34 (1.25; 1.44)	72.4	
500 – 1499 participants	29	1.14 (1.06; 1.23)	63.2	
≥ 1500 participants	24	1.36 (1.20; 1.53)	98.0	
4.Country type				0.418
High income	97	1.31 (1.23; 1.40)	94.0	
Lower mid income	21	1.27 (1.13; 1.42)	87.2	
5.Urban/Rural[#]				0.249
Urban	83	1.30 (1.22; 1.39)	88.1	
Rural	10	1.29 (1.08; 1.55)	66.0	
Combined	7	1.67 (0.93; 2.99)^	98.6	
6.Study design				0.105
RCT	48	1.07 (1.04; 1.10)	34.6	
Observational	32	1.59 (1.35; 1.88)	97.3	
Quasi experimental	38	1.34 (1.23; 1.45)	83.8	
7.Control for confounding				0.115
Yes	74	1.18 (1.12; 1.24)	86.9	
No	44	1.48 (1.28; 1.72)	93.9	
8.Quality of study*				0.517
Adequate	61	1.21 (1.13; 1.30)	86.4	
Inadequate	51	1.39 (1.26; 1.53)	94.0	
90.4% of the heterogeneity was explained by these 8 factors.				

^Not significant; *Measured according to The Cochrane Collaboration's Tool for assessing Risk of bias; [#]Data for all studies were not available

Web Annex 5

Progress in Code Implementation

State of the Code by Country 1991 to 2014



Source: UNICEF 2014

Law: These countries have enacted legislation or other legal measures encompassing all or substantially all provisions of the International Code.

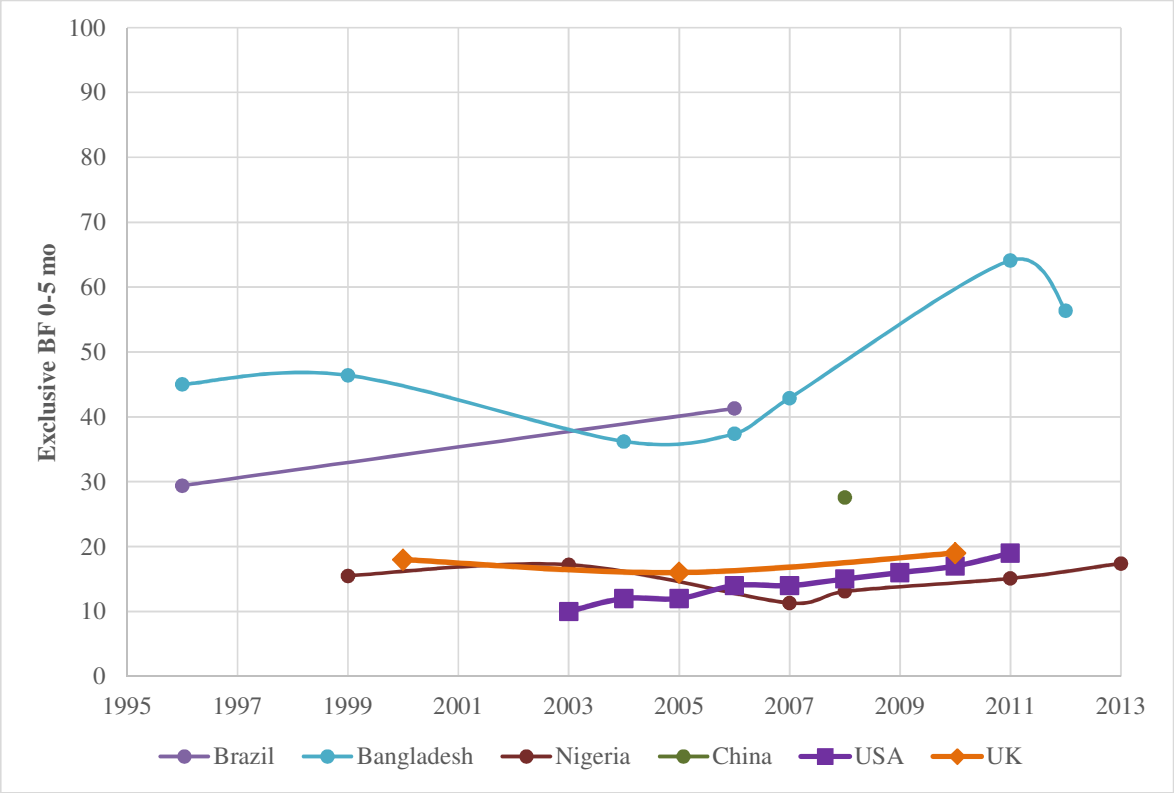
Many provisions law: The countries in this category have enacted legislation or other legal measures encompassing many of the provisions of the International Code.

Voluntary: In these countries, the government has adopted all, or nearly all provisions of the International Code through non-binding measures.

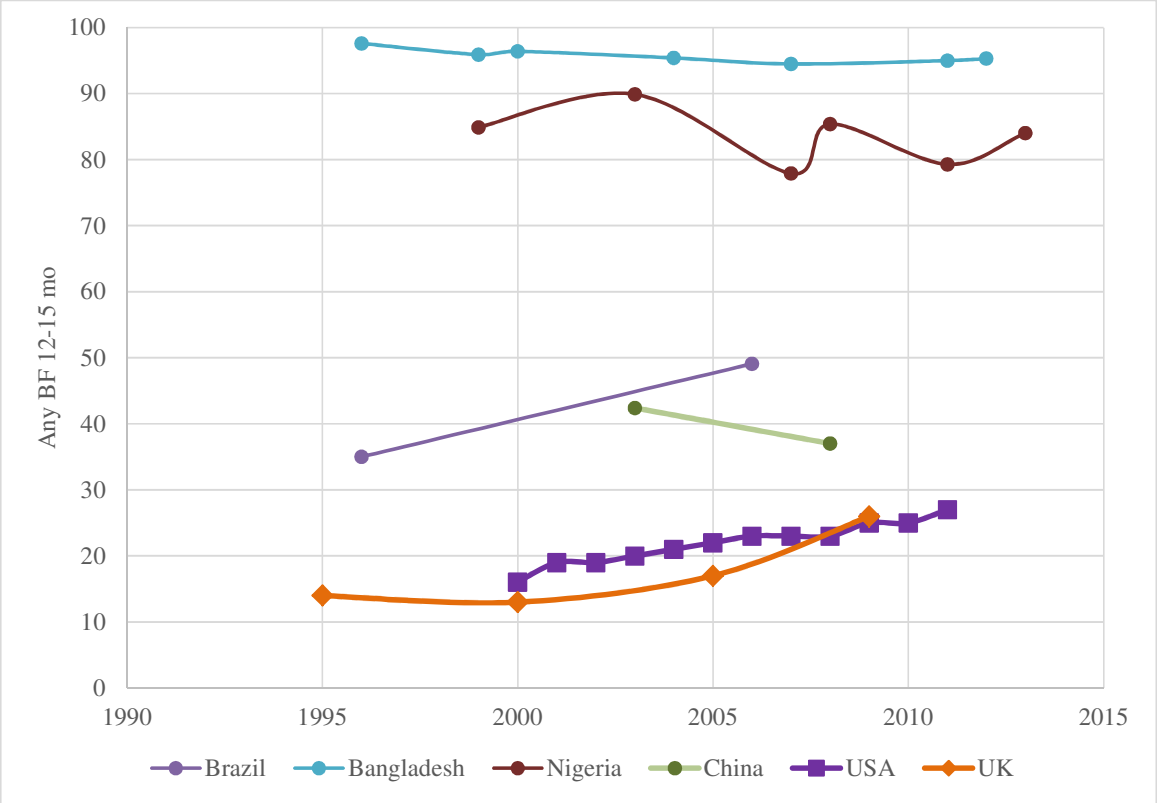
http://www.unicef.org/nutrition/files/State_of_the_Code_by_Country_April2011.pdf

Web annex 6. Breastfeeding trends in 6 case study countries*

Exclusive Breastfeeding 0-5 months



Any Breastfeeding at 12 months



* Data from the UK are at 9 months and therefore not strictly comparable.

Web Annex 7

GLOBAL INFANT FORMULA ANALYSIS

A custom report compiled by Euromonitor International for the World Health Organization

Final Report

16 February 2015

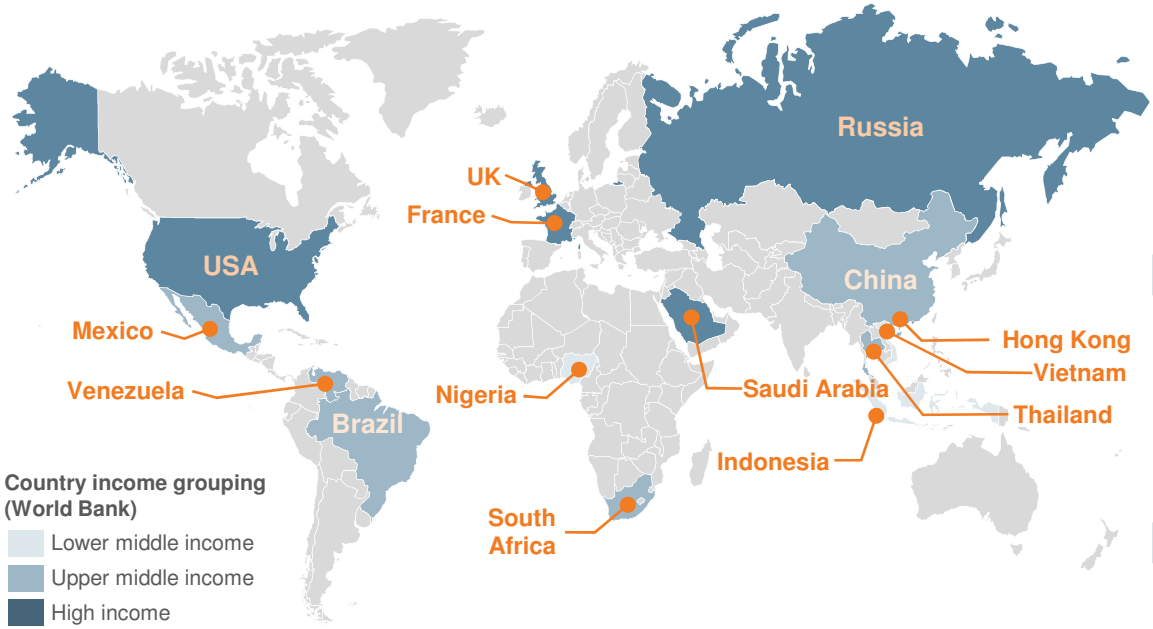
Project objectives, scope and parameters

Project Background and Objectives

The World Health Organisation, in collaboration with senior academics, is coordinating a report on breast-feeding and has approached Euromonitor to provide data and analysis on breast milk substitutes (infant formula) globally, regionally, and in key countries. Euromonitor will answer the attached questions using solely in-house sources:

- What is the size (US$) of the infant formula market by the geographies below?
- What was the impact of the global economic crisis on consumption?
- Which countries show the greatest growth potential for future sales of infant formula?
- What factors drive growth overall?
- In Brazil, China, Nigeria, South Africa, UK and USA how much do families spend on breast milk substitutes (BMS) and what does this represent as a proportion of their average income?

Geographical Coverage



Category Scope

- Standard Infant Formula – POWDER
- Standard Infant Formula – LIQUID
- Follow-on Infant Formula – POWDER
- Follow-on Infant Formula – LIQUID
- Toddler Infant Formula - POWDER
- Toddler Infant Formula – LIQUID

Data Parameters

- Historic Constant Prices, Forecast Constant 2014 Prices.
- Historic Fixed 2014 Exchange Rates, Forecast Fixed 2014 Exchange Rates
- Volume in tonnes

Time Period

- Review period 2000-2014
- Forecast period 2015-2018

Definitions

Milk Formula

Milk formula is the aggregation of standard, follow-on, toddler and special milk formula. All milk formula subcategories include liquid and powder variants.

Liquid variants include either ready-to-drink liquids or liquid concentrates which require further dilution prior to consumption.

Powder includes all powder concentrate variants, which must be rehydrated prior to consumption.

Note that any milk formula products containing cereals / wheat / oat or the like are excluded from milk formula.

Standard Milk Formula

Standard infant milk formulas are given to babies usually between birth and 6 months. Soy based formulas are excluded and tracked under Special Baby Milk Formula below.

Follow-on Milk Formula

Follow-on milk formulas are given to babies aged between 7 and 12 months. Soy based formulas are excluded here and tracked under Special Baby Milk Formula below.

Toddler Milk Formula

Toddler milk formulas are given to babies / toddlers from 13 months onwards. Note that many parents typically keep giving their babies 7-12 month follow-on milk formula – products excluded here. Recent developments include manufacturers developing milk formula with wider age bands, stretching to children up to six or even older. Such products, which are typically brand extensions of existing milk formula brands are included here. Soy based formulas are excluded.

Special Baby Milk Formula

Special baby milk formulae are given to babies to prevent or treat allergies to standard milk formula. This includes:

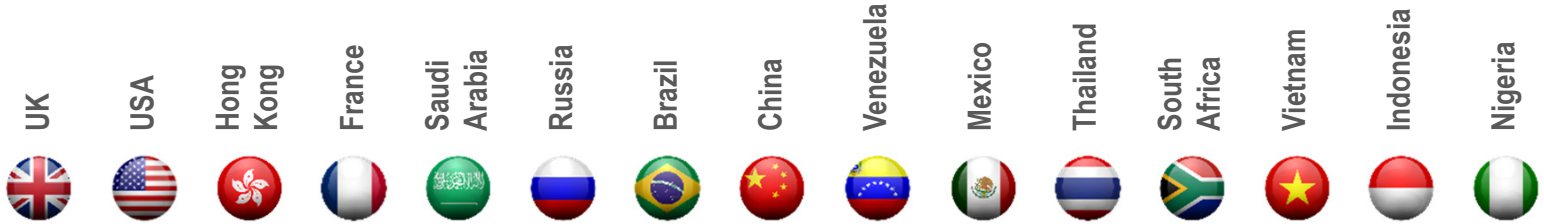
1) Allergy treatment aimed at children with allergies.

2) Allergy prevention / hypoallergenic includes partially hydrolyzed infant nutritional products. Recommended for high-risk infants before they show any sign of cow's milk allergy, these products are better tolerated and help reduce the onset of some allergic symptoms. Hypoallergenic formulae usually have the label 'HA'.

3) Lactose intolerance includes all formulae that are naturally lactose free, either soy based or processed to eliminate the lactose content.

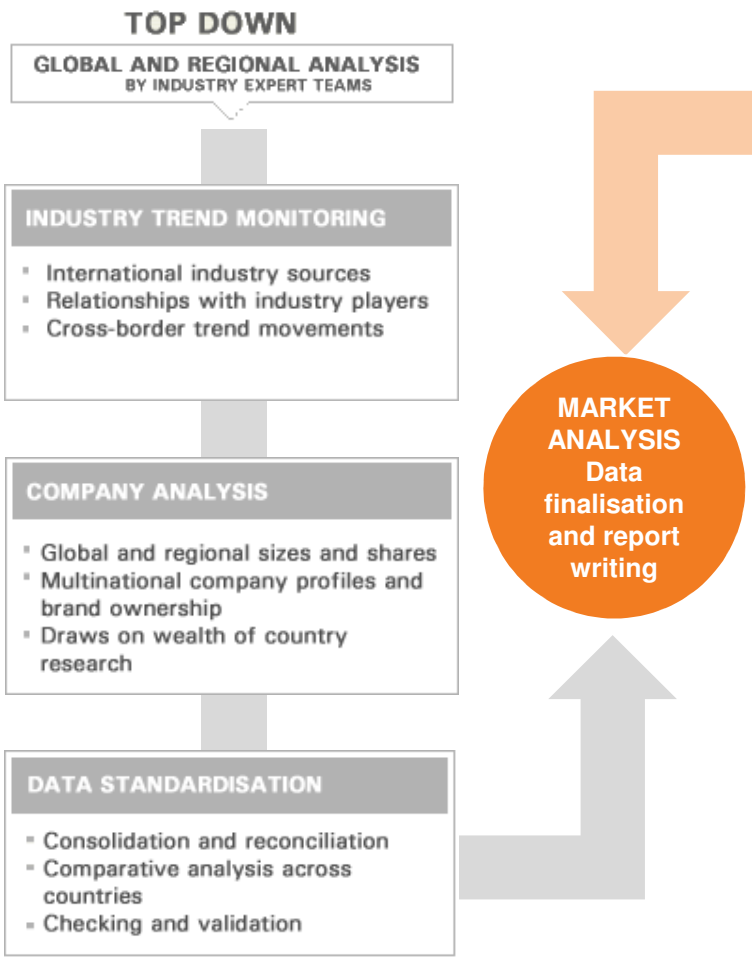
4) Other special formulae address specific conditions such as for premature babies, anti diarrhea, anti-regurgitation, digestive problems, reduced iron etc.

Country classification according to the IMF, UNDP and World Bank



IMF	Advanced economies	Emerging and developing economies		
	The International Monetary Fund's (IMF) classification of countries are not explained explicitly. Their grouping is according to i) per capita income levels, ii) the country's export diversification and iii) the degree of global financial system integration. Their country classification is grouped under advanced, and emerging and developing economies (IMF, 2014).			
UNDP	Very high human development	High human development	Medium human development	Low
	The United Nations Development Programme (UNDP) measures countries' achievements in longevity (life expectancy at birth), education (actual and expected years of schooling) and income (GNI per capita) using the HDI which is broken up in quartiles, very high human developed countries have quartiles larger than 75, high human developed countries are in the HDI quartile group 51-75, medium human development group quartile 26-50 and the low human development groups quartile under 26 (UNDP, 2014).			
World Bank	High income countries	High middle income countries	Low middle income countries	
	The World Bank's classification of countries, which is used here, uses the gross national income (GNI) per capita for classification. Low income countries earn US$1 025 or less, lower middle income: US$ 1 026 – US$ 4 035, upper middle income: US$4 036 – US$12 475 and high income: US$12 476 or more. Low middle income and low income countries are generally referred to as developing countries, while high middle income and high income countries are referred to as developed countries (World Bank, 2014).			

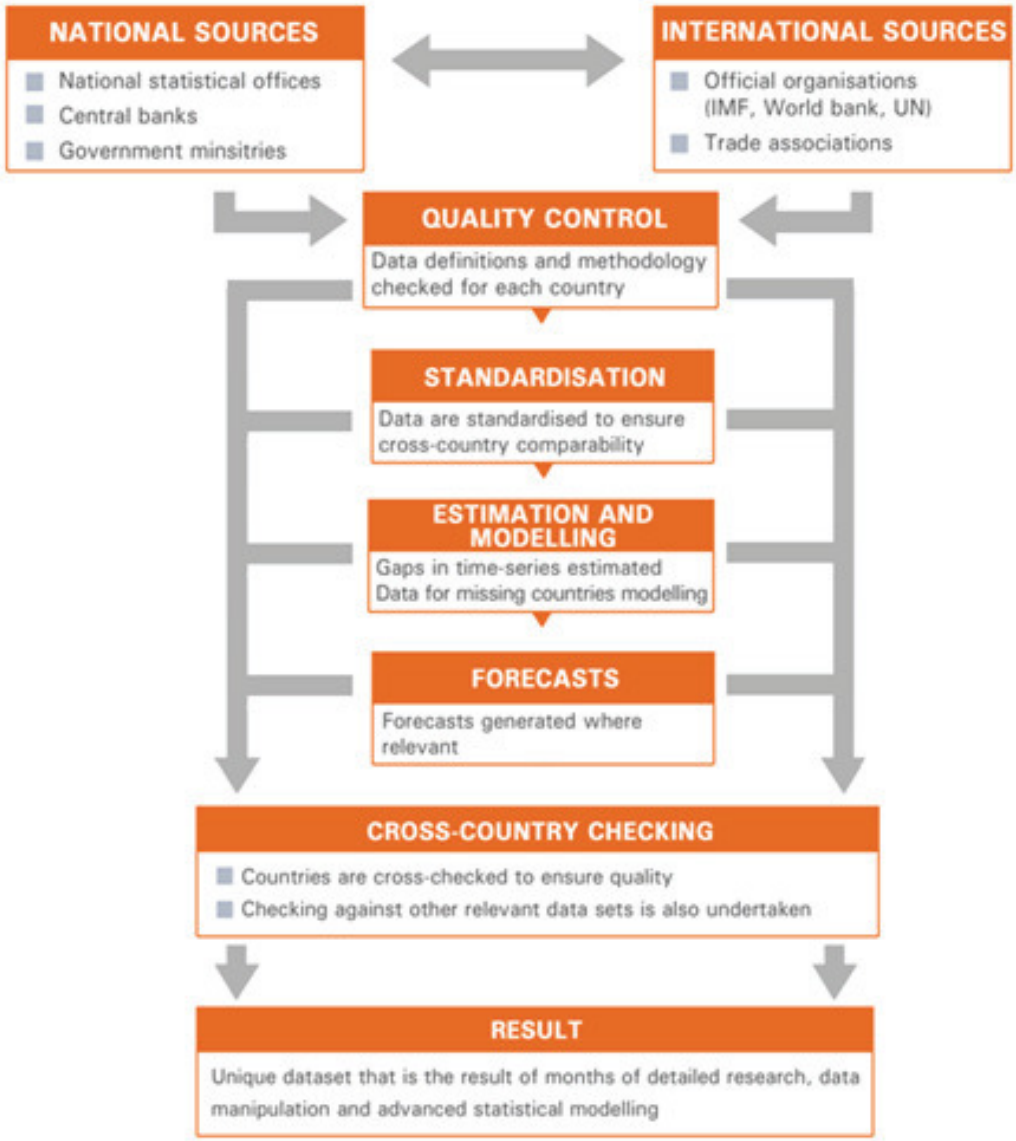
Research methodology - milk formula market data



- Euromonitor's independent research consists of both primary and secondary research obtained from various sources in the baby food industry.
- Secondary research involves reviewing official sources, company reports, independent research reports and data based on Euromonitor's own database.
- Store checks are carried out on the ground across a relevant mix of channels, and provides first-hand insights into baby food products. The results, combined with desk research findings, provide a strong basis for identifying key areas of questioning to take forward.
- Primary research involves conversations with leading industry participants and industry experts to support, verify and cross check the consistency of relevant data and estimates. Projected data were obtained from historical data analysis plotted against macroeconomic data with reference to specific industry-related factors.

- All data obtained in the course of the research is subjected to an exhaustive review process, at country, regional and global levels. Numbers are delivered to industry research team with an audit trail of sources and calculations to allow for a thorough evaluation of data integrity.
- Upon completion of the country review phase, data is reviewed on a comparative basis at regional and then at a global level. Comparative checks are carried out on per capita consumption and spending levels, growth rates, patterns of category and subcategory breakdowns and distribution of sales by channel. Top-down estimates are reviewed against bottom-up regional and global market and company sales totals.
- This process ensures international comparability across the database, that consistent category and subcategory definitions have been used and that all data has been correctly tested.

Research methodology - socio-economic data



- Each data point is collected together with detailed definitions and exact source location of the data.
- The data undergoes several layers of quality control and standardisation. For instance, structural breaks in times series that are often caused by changes in definitions or methodology at the source are removed by Euromonitor's team of expert statisticians. Any outliers in the data are detected and reported back to the sources for further resolution. Where necessary, seasonal adjustments of quarterly and monthly data are made by the team.
- Any gaps in time series are filled by means of statistical interpolation techniques and expert opinion.
- Rigorous checks of data definitions and adherence to international classifications helps to ensure cross-country comparability.

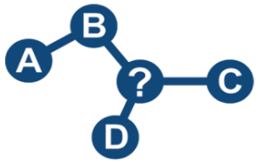
Description of Data Points

- **Retail Sales Value:** Market size data is reported in retail sales value, and includes only sales through formal retail channels. Retail sales are collected in local currency, and include any sales or value-added taxes. For baby food, retail sales are the primary data point collected.
- **Retail Sales Volume:** Volume sales through formal retail channels are estimated from retail sales values using unit prices associated with different package sizes collected during store audits annually. These are validated against other data sources.
- **Annual disposable income per household:** This is gross income minus social security contributions and income taxes.
- **Consumer Expenditure on food:** Food products purchased for consumption at home. Excludes: food products sold for immediate consumption away from the home by hotels, restaurants, cafés, bars, kiosks, street vendors, automatic vending machines, etc. (consumer expenditure on catering services); cooked dishes prepared by restaurants for consumption off their premises (consumer expenditure on catering services); cooked dishes prepared by catering contractors whether collected by the customer or delivered to the customer's home (consumer expenditure on catering services); and products sold specifically as pet foods (consumer expenditure on other recreational items and equipment, gardens and pets).
- **Consumer Expenditure on Milk, Cheese and Eggs:** Food products purchased for consumption at home. Excludes: food products sold for immediate consumption away from the home by hotels, restaurants, cafés, bars, kiosks, street vendors, automatic vending machines, etc. (consumer expenditure on catering services); cooked dishes prepared by restaurants for consumption off their premises (consumer expenditure on catering services); cooked dishes prepared by catering contractors whether collected by the customer or delivered to the customer's home (consumer expenditure on catering services); and products sold specifically as pet foods (consumer expenditure on other recreational items and equipment, gardens and pets).
- Raw milk, pasteurized or sterilized milk, condensed, evaporated or powdered milk, yoghurt, cream, milk-based desserts, milk-based beverages and other similar milk-based products, cheese and curd, eggs and egg products made wholly from eggs, milk, cream and yoghurt containing sugar, cocoa, fruit or flavourings, dairy products not based on milk such as soya milk. Excludes: butter and butter products (consumer expenditure on oils and fats).
- **Median Income per household**: The median income is the amount which divides the household income distribution into two equal groups, half having disposable income above that amount and half having income below that amount.
- **Female labour force participation rate:** Labour force participation rate is the proportion of the population ages 15 and older that is economically active: all people who supply labour for the production of goods and services during a specified period.
- **Maternity leave:** A period of absence from work granted to a mother before or after the birth of her child.

EUROMONITOR INTERNATIONAL

WHO: Global Infant Formula Data File

Data compiled by Euromonitor for WHO



The World Health Organisation, in collaboration with senior academics, is coordinating a report on breastfeeding. This spreadsheet provides supporting data and analysis from internal sources on breast milk substitutes (infant formula) globally, regionally, and in key countries. The data has been arranged to address the following objectives:

- What is the size (US$) of the infant formula market by the geographies below?
- What was the impact of the global economic crisis on consumption?
- Which countries show the greatest growth potential for future sales of infant formula?
- In Brazil, China, Nigeria, South Africa, UK and USA how much do families spend on breast milk substitutes (BMS) and what does this represent as a proportion of their average income?

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This data workbook includes tabs on the following:

Market Size Local Currency	Market Size USD	Market Size All Countries
Economic Factors	Interactive Charts	Summary Data Tables
Definitions		

Data output parameters include:

Geographies
World
Asia Pacific
  China
  Hong Kong, China
  Indonesia
  Thailand
  Vietnam
Australasia
Eastern Europe
  Russia
Latin America
  Brazil
  Mexico
  Venezuela
Middle East and Africa
  Nigeria
  Saudi Arabia
  South Africa
North America
  USA
Western Europe
  France
  United Kingdom

Categories
Baby Food
  Milk Formula
    Standard Milk Formula
      Liquid Standard Milk Formula
      Powder Standard Milk Formula
    Follow-on Milk Formula
      Liquid Follow-on Milk Formula
      Powder Follow-on Milk Formula
    Toddler Milk Formula
      Liquid Toddler Milk Formula
      Powder Toddler Milk Formula
    Special Baby Milk Formula
      Liquid Special Baby Milk Formula
      Powder Special Baby Milk Formula

Measures
Market Size LC - Current/Constant 2014 Prices
Market Size USD - Constant/Constant 2014 Prices
Market Size - USD Fixed 2014 Exchange Rate
Economic Factors - Constant/Constant 2014 Prices
Economic Factors - USD Fixed 2014 Exchange Rate

EUROMONITOR INTERNATIONAL

WHO: Milk Formula Summary Tables

Select the subcategory of interest to view data for total market size and per capita consumption for the relevant population age group

Category Information by Country

Retail Sales Value - USD Million

Subcategory	Milk Formula
Data Type	RSP USD million

Row Labels	Sum of 2014	Sum of 2019	CAGR 2014-2019
Brazil	672.1	951	7.2%
China	17783.8	37249.6	15.9%
France	769.3	678.2	-2.5%
Hong Kong, China	2274.5	4145.8	12.8%
Indonesia	2401.4	3096.4	5.2%
Mexico	1030.1	1144.6	2.1%
Nigeria	29.8	42.8	7.5%
Russia	862	1056.9	4.2%
Saudi Arabia	1059.5	1807.2	11.3%
South Africa	276.2	345.8	4.6%
Thailand	819.1	996.9	4.0%
United Kingdom	746.5	907.4	4.0%
USA	4762	4693.6	-0.3%
Venezuela	361.2	449.7	4.5%
Vietnam	1079.7	1589.3	8.0%
World	**44808.7**	**70660**	**9.5%**

Retail Sales Volumes - '000 tonnes

Subcategory	Milk Formula
Data Type	Retail Volume (000 tonnes)

Row Labels	Sum of 2014	Sum of 2019	CAGR 2014-2019
Brazil	39.5	52.6	5.9%
China	727.8	1,506.6	15.7%
France	88.6	84.7	-0.9%
Hong Kong, China	58.4	97.8	10.9%
Indonesia	257.7	344.1	6.0%
Mexico	47.0	50.9	1.6%
Nigeria	1.4	1.9	6.3%
Russia	51.2	60.5	3.4%
Saudi Arabia	45.9	77.7	11.1%
South Africa	21.9	26.6	4.0%
Thailand	129.7	163.6	4.8%
United Kingdom	57.3	74.3	5.3%
USA	146.7	139.7	-1.0%
Venezuela	8.9	10.5	3.4%
Vietnam	69.7	104.6	8.5%
World	**2,436.0**	**3,566.4**	**7.9%**

Select Subcategory here:

Milk Formula Category

- Baby Food
- Milk Formula
  - Toddler Milk Formula
  - Standard Milk Formula
  - Special Baby Milk Formula
  - Follow-on Milk Formula

Per Capita USD Consumption

Subcategory	Milk Formula	Per Capita
Data Type	(Multiple Items)	0 - 36 months

Row Labels	Sum of 2014	Sum of 2019	CAGR 2014-2019
Brazil	75.2	110.0	7.9%
China	423.6	880.3	15.8%
France	317.0	278.5	-2.6%
Hong Kong, China	11,026.4	23,707.1	16.5%
Indonesia	193.3	260.7	6.2%
Mexico	163.0	188.6	3.0%
Nigeria	1.7	2.1	4.3%
Russia	157.1	201.3	5.1%
Saudi Arabia	589.6	952.6	10.1%
South Africa	88.3	112.7	5.0%
Thailand	351.5	459.4	5.5%
United Kingdom	306.5	366.3	3.6%
USA	403.6	387.8	-0.8%
Venezuela	204.8	258.3	4.8%
Vietnam	259.1	406.8	9.4%
World	116.5	180.7	9.2%

Per Capita kg Consumption

Subcategory	Milk Formula	Per Capita
Data Type	(Multiple Items)	0 - 36 months

Row Labels	Sum of 2014	Sum of 2019	CAGR 2014-2019
Brazil	4.4	6.1	6.8%
China	17.3	35.6	15.5%
France	36.5	34.8	-0.9%
Hong Kong, China	283.3	559.2	14.6%
Indonesia	20.7	29.0	7.0%
Mexico	7.4	8.4	2.6%
Nigeria	0.1	0.1	0.0%
Russia	9.3	11.5	4.3%
Saudi Arabia	25.5	41.0	10.0%
South Africa	7.0	8.7	4.4%
Thailand	55.6	75.4	6.3%
United Kingdom	23.5	30.0	5.0%
USA	12.4	11.5	-1.5%
Venezuela	5.1	6.0	3.3%
Vietnam	16.7	26.8	9.9%
World	6.3	9.1	7.6%

Category	per Capita for
Milk Formula	0 - 36 months
Standard Milk Formula	0 - 6 months
Follow-on Milk Formula	6 - 12 months
Toddler Milk Formula	12 - 36 months
Special Baby Milk Formula	6 - 36 months

Category Information by Country Income Level

Per Capita USD Consumption

Subcategory	Milk Formula	Per Capita
Data Type	(Multiple Items)	0 - 36 months

Row Labels	Average of 2014	Average of 2019	CAGR 2014-2019
High	2,528.6	5,138.5	15.2%
Upper Middle	209.1	315.8	8.6%
Lower Middle	151.4	223.2	8.1%

Per Capita kg Consumption

Subcategory	Milk Formula	Per Capita
Data Type	(Multiple Items)	0 - 36 months

Row Labels	Average of 2014	Average of 2019	CAGR 2014-2019
High	76.2	135.3	12.2%
Upper Middle	15.2	21.7	7.4%
Lower Middle	12.5	18.6	8.3%

High Income Countries	France
	Hong Kong
	Saudi Arabia
	UK
	USA
	Russia
Upper Middle Income Countries	Brazil
	China
	Mexico
	South Africa
	Thailand
Lower Middle Income Countries	Venezuela
	Indonesia
	Nigeria
	Vietnam

Select the country of interest to view data for total market size and per capita consumption for the relevant population age group

Country Information by Category

BRAZIL

Retail Sales Value - USD Million

Country	Brazil
Data Type	RSP USD million

Row Labels	Sum of 2014	Sum of 2019	CAGR 2014-2019
Milk Formula	672.1	951.0	7.2%
Standard Milk Formula	263.9	367.2	6.8%
Follow-on Milk Formula	156.0	231.5	8.2%
Toddler Milk Formula	221.1	304.2	6.6%
Special Baby Milk Formula	31.0	48.1	9.2%

Retail Sales Volumes - '000 tonnes

Country	Brazil
Data Type	Retail Volume (000 tonnes)

Row Labels	Sum of 2014	Sum of 2019	CAGR 2014-2019
Milk Formula	39.5	52.6	5.9%
Standard Milk Formula	12.1	16.1	5.9%
Follow-on Milk Formula	7.9	10.7	6.3%
Toddler Milk Formula	19.0	25.0	5.6%
Special Baby Milk Formula	0.5	0.8	9.9%

Select Country here:

Country

- Asia Pacific
- Australasia
- Brazil
- China
- Eastern Europe
- France
- Hong Kong, China
- Indonesia

Per Capita USD Consumption

Country	Brazil
Data Type	(Multiple Items)

Row Labels	Sum of 2014	Sum of 2019	CAGR 2014-2019
Milk Formula	75.2	110.0	7.9%
Standard Milk Formula	171.5	258.7	8.6%
Follow-on Milk Formula	101.4	163.1	10.0%
Toddler Milk Formula	37.7	52.4	6.8%
Special Baby Milk Formula	4.2	6.7	9.8%

Per Capita kg Consumption

Country	Brazil
Data Type	(Multiple Items)

Row Labels	Sum of 2014	Sum of 2019	CAGR 2014-2019
Milk Formula	4.4	6.1	6.8%
Standard Milk Formula	7.8	11.3	7.7%
Follow-on Milk Formula	5.1	7.6	8.3%
Toddler Milk Formula	3.2	4.3	6.1%
Special Baby Milk Formula	0.1	0.1	0.0%

per Capita for

- 0 - 36 months
- 0 - 6 months
- 6 - 12 months
- 12 - 36 months
- 6 - 36 months

Select the country of interest to view data for total market size and per capita consumption for the relevant population age group

Country Information by Category

CHINA

Retail Sales Value - USD Million

Country	China
Data Type	RSP USD million

Row Labels	Sum of 2014	Sum of 2019	CAGR 2014-2019
Milk Formula	17,783.8	37,249.6	15.9%
Standard Milk Formula	4,816.7	9,439.8	14.4%
Follow-on Milk Formula	4,693.6	8,716.9	13.2%
Toddler Milk Formula	8,192.5	18,874.5	18.2%
Special Baby Milk Formula	81.0	218.5	22.0%

Retail Sales Volumes - '000 tonnes

Country	China
Data Type	Retail Volume (000 tonnes)

Row Labels	Sum of 2014	Sum of 2019	CAGR 2014-2019
Milk Formula	727.8	1,506.6	15.7%
Standard Milk Formula	176.9	342.6	14.1%
Follow-on Milk Formula	203.3	369.0	12.7%
Toddler Milk Formula	345.8	790.5	18.0%
Special Baby Milk Formula	1.8	4.6	20.6%

Per Capita USD Consumption

Country	China
Data Type	(Multiple Items)

Row Labels	Sum of 2014	Sum of 2019	CAGR 2014-2019
Milk Formula	423.6	880.3	15.8%
Standard Milk Formula	671.9	1,368.5	15.3%
Follow-on Milk Formula	654.7	1,263.7	14.1%
Toddler Milk Formula	296.4	661.8	17.4%
Special Baby Milk Formula	2.3	6.2	21.9%

Per Capita kg Consumption

Country	China
Data Type	(Multiple Items)

Row Labels	Sum of 2014	Sum of 2019	CAGR 2014-2019
Milk Formula	17.3	35.6	15.5%
Standard Milk Formula	24.7	49.7	15.0%
Follow-on Milk Formula	28.4	53.5	13.5%
Toddler Milk Formula	12.5	27.7	17.3%
Special Baby Milk Formula	0.1	0.1	0.0%

Select Country here:

Country

- Asia Pacific
- Australasia
- Brazil
- China
- Eastern Europe
- France
- Hong Kong, China
- Indonesia

per Capita for

- 0 - 36 months
- 0 - 6 months
- 6 - 12 months
- 12 - 36 months
- 6 - 36 months

Select the country of interest to view data for total market size and per capita consumption for the relevant population age group

Country Information by Category

FRANCE

Retail Sales Value - USD Million

Country	France
Data Type	RSP USD million

Row Labels	Sum of 2014	Sum of 2019	CAGR 2014-2019
Milk Formula	769.3	678.2	-2.5%
Standard Milk Formula	235.7	212.2	-2.1%
Follow-on Milk Formula	227.2	179.4	-4.6%
Toddler Milk Formula	260.9	244.2	-1.3%
Special Baby Milk Formula	45.5	42.4	-1.4%

Retail Sales Volumes - '000 tonnes

Country	France
Data Type	Retail Volume (000 tonnes)

Row Labels	Sum of 2014	Sum of 2019	CAGR 2014-2019
Milk Formula	88.6	84.7	-0.9%
Standard Milk Formula	9.1	8.9	-0.4%
Follow-on Milk Formula	14.7	11.8	-4.3%
Toddler Milk Formula	63.0	62.2	-0.3%
Special Baby Milk Formula	1.7	1.7	0.0%

Per Capita USD Consumption

Country	France
Data Type	(Multiple Items)

Row Labels	Sum of 2014	Sum of 2019	CAGR 2014-2019
Milk Formula	317.0	278.5	-2.6%
Standard Milk Formula	576.5	522.5	-1.9%
Follow-on Milk Formula	555.8	441.7	-4.5%
Toddler Milk Formula	162.2	150.5	-1.5%
Special Baby Milk Formula	22.5	20.9	-1.5%

Per Capita kg Consumption

Country	France
Data Type	(Multiple Items)

Row Labels	Sum of 2014	Sum of 2019	CAGR 2014-2019
Milk Formula	36.5	34.8	-0.9%
Standard Milk Formula	22.3	21.9	-0.4%
Follow-on Milk Formula	35.9	29.0	-4.2%
Toddler Milk Formula	39.2	38.4	-0.4%
Special Baby Milk Formula	0.9	0.9	0.0%

Select Country here:

Country

- Asia Pacific
- Australasia
- Brazil
- China
- Eastern Europe
- France
- Hong Kong, China
- Indonesia

per Capita for

- 0 - 36 months
- 0 - 6 months
- 6 - 12 months
- 12 - 36 months
- 6 - 36 months

Select the country of interest to view data for total market size and per capita consumption for the relevant population age group

Country Information by Category

NIGERIA

Retail Sales Value - USD Million

Country	Nigeria
Data Type	RSP USD million

Row Labels	Sum of 2014	Sum of 2019	CAGR 2014-2019
Milk Formula	29.8	42.8	7.5%
Standard Milk Formula	28.7	41.2	7.5%
Follow-on Milk Formula	0.9	1.2	5.9%
Toddler Milk Formula	0.2	0.2	0.0%
Special Baby Milk Formula	0.0	0.0	

Retail Sales Volumes - '000 tonnes

Country	Nigeria
Data Type	Retail Volume (000 tonnes)

Row Labels	Sum of 2014	Sum of 2019	CAGR 2014-2019
Milk Formula	1.4	1.9	6.3%
Standard Milk Formula	1.3	1.9	7.9%
Follow-on Milk Formula	0.0	0.0	
Toddler Milk Formula	0.0	0.0	
Special Baby Milk Formula	0.0	0.0	

Per Capita USD Consumption

Country	Nigeria
Data Type	(Multiple Items)

Row Labels	Sum of 2014	Sum of 2019	CAGR 2014-2019
Milk Formula	1.7	2.1	4.3%
Standard Milk Formula	9.2	12.0	5.5%
Follow-on Milk Formula	0.3	0.4	5.9%
Toddler Milk Formula	0.0	0.0	
Special Baby Milk Formula	0.0	0.0	

Per Capita kg Consumption

Country	Nigeria
Data Type	(Multiple Items)

Row Labels	Sum of 2014	Sum of 2019	CAGR 2014-2019
Milk Formula	0.1	0.1	0.0%
Standard Milk Formula	0.4	0.5	4.6%
Follow-on Milk Formula	0.0	0.0	
Toddler Milk Formula	0.0	0.0	
Special Baby Milk Formula	0.0	0.0	

Select Country here:

Country

- Middle East and Africa
- Nigeria
- North America
- Russia
- Saudi Arabia
- South Africa
- Thailand
- United Kingdom

per Capita for

- 0 - 36 months
- 0 - 6 months
- 6 - 12 months
- 12 - 36 months
- 6 - 36 months

Select the country of interest to view data for total market size and per capita consumption for the relevant population age group

Country Information by Category

UNITED KINGDOM

Retail Sales Value - USD Million

Country	United Kingdom
Data Type	RSP USD million

Row Labels	Sum of 2014	Sum of 2019	CAGR 2014-2019
Milk Formula	746.5	907.4	4.0%
Standard Milk Formula	412.9	527.2	5.0%
Follow-on Milk Formula	174.9	195.0	2.2%
Toddler Milk Formula	114.8	145.2	4.8%
Special Baby Milk Formula	43.9	40.0	-1.8%

Retail Sales Volumes - '000 tonnes

Country	United Kingdom
Data Type	Retail Volume (000 tonnes)

Row Labels	Sum of 2014	Sum of 2019	CAGR 2014-2019
Milk Formula	57.3	74.3	5.3%
Standard Milk Formula	27.7	35.5	5.1%
Follow-on Milk Formula	12.7	16.3	5.1%
Toddler Milk Formula	14.8	20.5	6.7%
Special Baby Milk Formula	2.1	2.0	-1.0%

Select Country here:

Country

- Thailand
- United Kingdom
- USA
- Venezuela
- Vietnam
- Western Europe
- World
- Country

Per Capita USD Consumption

Country	United Kingdom
Data Type	(Multiple Items)

Row Labels	Sum of 2014	Sum of 2019	CAGR 2014-2019
Milk Formula	306.5	366.3	3.6%
Standard Milk Formula	1,014.0	1,278.3	4.7%
Follow-on Milk Formula	429.6	472.8	1.9%
Toddler Milk Formula	70.8	87.9	4.4%
Special Baby Milk Formula	21.6	19.4	-2.1%

Per Capita kg Consumption

Country	United Kingdom
Data Type	(Multiple Items)

Row Labels	Sum of 2014	Sum of 2019	CAGR 2014-2019
Milk Formula	23.5	30.0	5.0%
Standard Milk Formula	68.0	86.0	4.8%
Follow-on Milk Formula	31.2	39.5	4.8%
Toddler Milk Formula	9.1	12.4	6.4%
Special Baby Milk Formula	1.0	1.0	0.0%

per Capita for

0 - 36 months
0 - 6 months
6 - 12 months
12 - 36 months
6 - 36 months

Select the country of interest to view data for total market size and per capita consumption for the relevant population age group

Country Information by Category

USA

Retail Sales Value - USD Million

Country	USA
Data Type	RSP USD million

Row Labels	Sum of 2014	Sum of 2019	CAGR 2014-2019
Milk Formula	4,762.0	4,693.6	-0.3%
Standard Milk Formula	2,358.6	2,295.4	-0.5%
Follow-on Milk Formula			
Toddler Milk Formula	473.2	512.6	1.6%
Special Baby Milk Formula	1,930.3	1,885.6	-0.5%

Retail Sales Volumes - '000 tonnes

Country	USA
Data Type	Retail Volume (000 tonnes)

Row Labels	Sum of 2014	Sum of 2019	CAGR 2014-2019
Milk Formula	146.7	139.7	-1.0%
Standard Milk Formula	62.6	56.4	-2.1%
Follow-on Milk Formula			
Toddler Milk Formula	42.0	44.4	1.1%
Special Baby Milk Formula	42.1	38.9	-1.6%

Select Country here:

Country

- Thailand
- United Kingdom
- USA
- Venezuela
- Vietnam
- Western Europe
- World

Country

Per Capita USD Consumption

Country	USA
Data Type	(Multiple Items)

Row Labels	Sum of 2014	Sum of 2019	CAGR 2014-2019
Milk Formula	403.6	387.8	-0.8%
Standard Milk Formula	1,194.7	1,137.3	-1.0%
Follow-on Milk Formula			
Toddler Milk Formula	60.3	63.5	1.0%
Special Baby Milk Formula	196.5	187.0	-1.0%

Per Capita kg Consumption

Country	USA
Data Type	(Multiple Items)

Row Labels	Sum of 2014	Sum of 2019	CAGR 2014-2019
Milk Formula	12.4	11.5	-1.5%
Standard Milk Formula	31.7	28.0	-2.5%
Follow-on Milk Formula			
Toddler Milk Formula	5.3	5.5	0.7%
Special Baby Milk Formula	4.3	3.9	-1.9%

per Capita for

0 - 36 months
0 - 6 months
6 - 12 months
12 - 36 months
6 - 36 months

Select the country of interest to view data for total market size and per capita consumption for the relevant population age group

Country Information by Category

WORLD

Retail Sales Value - USD Million

Country: World
Data Type: RSP USD million

Row Labels	Sum of 2014	Sum of 2019	CAGR 2014-2019
Milk Formula	44,808.7	70,660.0	9.5%
Standard Milk Formula	13,605.4	19,681.4	7.7%
Follow-on Milk Formula	10,311.0	15,490.9	8.5%
Toddler Milk Formula	17,364.6	31,490.4	12.6%
Special Baby Milk Formula	3,527.7	3,997.3	2.5%

Retail Sales Volumes - '000 tonnes

Country: World
Data Type: Retail Volume (000 tonnes)

Row Labels	Sum of 2014	Sum of 2019	CAGR 2014-2019
Milk Formula	2,436.0	3,566.4	7.9%
Standard Milk Formula	593.9	821.0	6.7%
Follow-on Milk Formula	547.3	775.3	7.2%
Toddler Milk Formula	1,194.4	1,855.2	9.2%
Special Baby Milk Formula	100.4	114.9	2.7%

Per Capita USD Consumption

Country: World
Data Type: (Multiple Items)

Row Labels	Sum of 2014	Sum of 2019	CAGR 2014-2019
Milk Formula	116.5	180.7	9.2%
Standard Milk Formula	210.1	301.5	7.5%
Follow-on Milk Formula	159.3	237.3	8.3%
Toddler Milk Formula	68.1	120.9	12.2%
Special Baby Milk Formula	11.0	12.3	2.3%

Per Capita kg Consumption

Country: World
Data Type: (Multiple Items)

Row Labels	Sum of 2014	Sum of 2019	CAGR 2014-2019
Milk Formula	6.3	9.1	7.6%
Standard Milk Formula	9.2	12.6	6.5%
Follow-on Milk Formula	8.5	11.9	7.0%
Toddler Milk Formula	4.7	7.1	8.6%
Special Baby Milk Formula	0.3	0.4	5.9%

Select Country here:

Country

- Thailand
- United Kingdom
- USA
- Venezuela
- Vietnam
- Western Europe
- World
- Country

per Capita for

- 0 - 36 months
- 0 - 6 months
- 6 - 12 months
- 12 - 36 months
- 6 - 36 months

WORLD

Web annex 9

Methods and additional data related to economic analyses related to cognitive losses associated with not breastfeeding

Estimated economic losses (as % of GNI) associated with cognitive deficits based on current infant feeding practices, as compared to all children breastfeeding for at least 6 months (Table 2 in the paper) is based on data for 96 countries (out of 197 in the UNICEF (2014) database) with both data on some breastfeeding to six months as well as GNI data. These countries account for 89.2% of world GNI (world total excludes GNI of the 15 countries, Atlas method, for which no data are available in the World Bank World Development Indicators for 2012), and 89.2% of the population of the 197 countries. Breastfeeding data were recalculated using detailed MICS data for 71 of the larger LMICs, and collected by Victora (Victora. Lancet 2015) for 27 high-income countries, and are defined as any breastfeeding at age 6 months (Web Appendix Table 2.1, Paper 1). Two countries had breastfeeding data but no GNI data available

Web Table 9.1. Estimated economic losses (as % of GNI) associated with cognitive deficits based on current infant feeding practices, as compared to all children receiving at least some breastmilk up to age six months, by country

Country	Loss $bn US 2012	Loss % GNI 2012
High Income		
Austria	2.5	0.60
Australia	6.3	0.46
Belgium	3.9	0.78
Canada	12.9	0.73
Czech Republic	0.1157	0.60
Finland	1.1068	0.44
France	21.3351	0.80
Germany	15.1300	0.42
Greece	2.0950	0.81
Italy	11.5487	0.56
Japan	23.3949	0.38
Korea, Republic	4.4971	0.40
Latvia	0.1698	0.58
Luxembourg	0.2469	0.61
Netherlands	5.6923	0.71
New Zealand	0.5670	0.42
Norway	1.4862	0.30
Poland	2.1106	0.44
Portugal	1.1779	0.54
Singapore	1.5073	0.60
Spain	7.7481	0.55
Sweden	2.6637	0.50
Switzerland	2.6097	0.39
United Kingdom	16.4519	0.69
US	84.2421	0.53
Eastern Europe & Central Asia		
Albania	0.0247	0.19
Armenia	0.0375	0.34
Azerbaijan	0.2666	0.47
Belarus	0.4547	0.74
Kazakhstan	0.3199	0.20
Kyrgyzstan	0.0026	0.05
Tajikistan	0.0074	0.11
Macedonia, former Yugoslav Rep	0.0409	0.41
Ukraine	0.2867	0.18
Uzbekistan	0.0272	0.06
Russian Federation	16.1054	0.89
Middle East/North Africa		
Jordan	0.1136	0.34
Morocco	0.2408	0.25
West Bank and Gaza	0.0158	0.12
Iraq	0.6684	0.35
Tunisia	0.1374	0.30
Saudi Arabia*	6.3529	1.25
United Arab Emirates*	4.2703	1.29
Eastern and Southern Africa		
Burundi	0.0005	0.02
Ethiopia	0.0125	0.03
Kenya	0.0035	0.01
Lesotho	0.0057	0.20
Mozambique	0.0041	0.03
Rwanda	0.0008	0.01
Swaziland	0.0081	0.23
Uganda	0.0066	0.04
Tanzania (U Rep)	0.0090	0.03
Comoros	0.0004	0.06
West and Central Africa		
Benin	0.0092	0.12
Cameroon	0.0116	0.05
Central African Republic	0.0010	0.05
Chad	0.0052	0.06
Congo, Republic	0.0103	0.09
Côte d'Ivoire	0.0137	0.06
Gabon	0.0430	0.26
Ghana	0.0065	0.02
Guinea	0.0017	0.03
Liberia	0.0005	0.03
Mali	0.0062	0.06
Niger	0.0012	0.02
Nigeria	0.1504	0.06
Sao Tome and Principe	0.0000	0.01
Senegal	0.0010	0.01
Sierra Leone	0.0025	0.07
East Asia and Pacific		
Cambodia	0.0107	0.08
China	26.0363	0.33
Indonesia	1.3437	0.16
Lao People's Dem. Rep.	0.0114	0.14
Philippines	0.7339	0.31
Timor-Leste	0.0014	0.03
Vanuatu	0.0005	0.07
Latin America and Caribbean		
Bolivia (Plurinat State)	0.0142	0.06
Belize	0.0064	0.06
Brazil	8.7613	0.38
Chile	2.0365	0.82
Colombia	0.5307	0.16
Costa Rica	0.0541	0.13
Cuba	0.2683	0.40
Guyana	0.0060	0.22
Haiti	0.0050	0.07
Jamaica	0.0329	0.23
Suriname	0.0226	0.50
Trinidad and Tobago	0.1026	0.53
Saint Lucia	0.0053	0.45
Uruguay	0.2285	0.50
South Asia		
Afghanistan	0.0136	0.08
Bhutan	0.0001	0.01
India	0.6285	0.03
Maldives	0.0019	0.10
Nepal	0.0013	0.01
Pakistan	0.3874	0.17

Losses as a proportion of GNI are calculated as: (1-BR6)*0.173*COGWAGE*0.5, where BR6 is the rate of breastfeeding at 6 months, 0.173 represents the increase in cognitive score (in standard deviations) associated with "any" breastfeeding at six months, COGWAGE is the proportional increase in wage associated with a one standard deviation increase in IQ (0.12 for high income countries; 0.16 for LMICs), and 0.5 represents the wage share in GNI.

Web Annex 10: Health expenditure analysis methods and treatment costs

Methods for health expenditure calculations

US and UK

For the US and the UK, we estimated the effect of a ten percentage point increase by prorating the estimates presented by the study authors of an increase from baseline to 90% EBF (for the US) and to 45% (for the UK), assuming that the increase in some breastfeeding at hospital discharge (required for the calculation for NEC) was proportionately similar.

The **UK** estimates come from Renfrew et al (2012), who use a nationally representative survey. The detailed assumptions for the four conditions are also given in Web Table 10.1 (compiled by these authors from Renfrew et al, 2012). The original study also includes costs for breast cancer but excluded here. For the UK, we cite the reduced health treatment costs if breastfeeding improve to 45% as estimated by the authors rather to 90% in other countries estimated in our analyses.

The **US** data come from Bartick and Reinhold (2010), who use a nationally representative survey. Bartick and Reinhold present much higher estimates in their paper than are included here, because they also include the costs of deaths, valued using Value of Statistical Life methods. Their published estimates are also high because they include indirect costs of treatment (loss of productivity and travel costs for patients and their families) which are not included in the other studies. The original US study estimate includes treatment costs for other childhood conditions (leukemia, asthma, childhood obesity and type one diabetes). The detailed assumptions for the four conditions included are extracted from Bartick and Reinhold, 2010 and summarised in Web Table 10.1. We summarize here their estimates for treatment costs for the four childhood conditions as in the other three countries, plus costs for childhood leukemia, asthma, childhood obesity and type one diabetes. It is not straightforward to calculate treatment costs for only four conditions based on the published article.

Brazil and China

In order to estimate the effect of a ten percentage point increase in exclusive breastfeeding in China and Brazil, we used standard epidemiological equations for population attributable risk, combined with the prevalence and relative risk data by condition, combined with the unit cost data for each country. We similarly estimated the effect of an increase to 90% exclusive breastfeeding.

The relative risks used for China and Brazil come from Victora et al (Lancet 2015: table 1), from a meta-analysis for LMICs. These are drawn from meta-analyses, and are for longer vs shorter breastfeeding duration (ever vs never, more months vs fewer months, longer EBF vs shorter, etc.). The relative risks used here are 0.42 (NEC), 0.28 for hospitalization for diarrhea (<5 years), 0.37 for incidence of diarrhea (<6 months), 0.46 for incidence of diarrhea (6 months-5 years), 0.43 for hospitalization for pneumonia (<2 years), 0.68 for incidence of pneumonia (<2 years), 0.67 for incidence of otitis media (< 2 years). We use the same relative risk for bronchiolitis as for pneumonia. We assume that outpatient visits have the same relative risk as incidence. Since we only have data aggregated for children below 2 years, we assume that the pooled risk for incidence of diarrhea <2 years is 0.39 (a weighted average of the rates for <6 months, and 6-59 months). We use continued breastfeeding to age two for four of the five conditions, and for NEC which occurs only in newborns, where we use the rate of any breastfeeding up to six months.

The **China** analysis utilizes unpublished data provided by the China National Health Development Research Centre, from the computer records of two hospitals in Qingdao municipality, Shandong province, namely a District People's Hospital (a first-level hospital with 700 beds, serving one of the 16 districts in the municipality) and another providing specialty maternal and child services (with 1160 beds, serving as a referral hospital for all 16 districts in the municipality). The data are for 12 months, October 2013 to September 2014. These data may provide a reasonable estimate of treatment costs for the 53% of China's population (World Bank, World Development Indicators: data for 2013) living in urban areas; however no information is available for those in rural areas.

Qingdao has a total population of 8.7 million. We assume that the district hospital for which we have data (which serves a population of 524,000) is approximately representative of the other district hospitals. Our cost estimates for

a population of 8.7 million equal the sum of the cost of the speciality children's hospital, plus the costs at the district hospital scaled up by a factor of 16.626 (based on that district's share of the municipality's population). Data were obtained for all children under two, but not finer age ranges. We assume where needed that treatment costs for the candidate conditions are equally divided for the 0-5, 6-11, 12-17 and 18-23 month ages. There are some additional treatment costs not captured in the hospital data, for example treatment by traditional Chinese medicine clinics (note that the public hospitals also offer traditional medicine), by private hospitals or clinics, or non-prescription drugs purchased by families.

The five candidate conditions account for 128,190 outpatient visits and 7,749 hospitalizations in children below two in the year considered. The five conditions represent 22.9% of outpatient visits, 26.5% of hospitalizations, and 23.3% of expenditures for all conditions affecting children less than two in the hospitals represented. Within the group of the five conditions, 16.5% of the expenditures are related to diarrhea, 38.9% to bronchiolitis, 43.3% to pneumonia, 0.5% to otitis media and 0.7% to NEC. Hospitalization accounts for 48.4% of all expenditures (hospitalization plus outpatient visits) on the five conditions (but only 21.5% of visits for treatment).

For **Brazil** we use national data from the Ministry of Health. The Federal Ministry reimburses the states for hospitalization costs, and has a national database on hospitalization expenditures included within a larger database on federal health expenditures (DATASUS: description of data available at http://tabnet.datasus.gov.br/cgi/sih/%5CFIdescr.htm). We use an extract containing hospitalization costs for infants (below one year) for the selected conditions, for 2014. Since outpatient expenditures and expenditures at clinics are not generally covered by the federal government, these data were not available. Although it is difficult to compare across countries whose health systems are organized differently, we might expect that we have captured only half of the health expenditures on these conditions in Brazil in infants less than one year of age, since in China outpatient expenditures for the five conditions for children less than two are similar in size to inpatient expenditures.

Of the five conditions analyzed here for Brazil, pneumonia and bronchiolitis combined account for 85.5% of the hospital expenditures, diarrhea for 14%, with the other two conditions contributing a negligible share of expenditures. We use the same relative risks for hospitalization as for China (above), derived from Victora et al (Lancet 2015) and apply the rate for some breastfeeding to age 12 months, except for NEC, where we use the rate of any breastfeeding up to six months.

REFERENCE

Victora et al. Lancet 2015

Web Annex Table 10.1. Assumptions for treatment probabilities and costs for US (Bartick and Reinhold, 2010) and UK (Renfrew et al, 2012)

Condition	Type/duration of breastfeeding	OR in favour of breast-feeding	Overall Incidence	Cost
US ($ of 2007) – extracted from Bartick and Reinhold, 2010				
Gastro-enteritis	EBF for 6 months	0.36	0.222 ambulatory visits; 0.00298 hospitalizations in infants < 1yr	$66/outpatient (direct); $2395/hospitalization (direct); $339/outpatient (total); $2668/hospitalization (total)
LRTI hospitalization	EBF for 4 months	0.28	0.0409	$4338/case (direct); $4680/case (total)
NEC	EBF for 3 months	0.42	LBW infants 0.00308: very LBW infants 0.0414	**LBW**: $150,408/surgical NEC (direct;) $81,219/medical NEC (direct); $155,845/surgical NEC (total); $84,858/medical NEC (total). **VLBW:** $260,508/surgical NEC (direct); $140,848/medical NEC (direct); $265,945/surgical NEC (total); $144,497/medical NEC (total)
Otitis media	EBF and any BF for 3 months	0.77 any BF 0.5 EBF	1.9 episodes in first year	$156/episode (direct); $291 (total)
UK (£ of 2009/10) – extracted from Renfrew et al, 2012				
Gastro-enteritis	EBF and any BF to 4 mths	**EBF**: 0.39 (hospitalize) 0.28 (outpatient) **Any BF:** 0.52 (hospitalize) 0.36 (outpatient)	Hospitalizations: 17.2/1000 live births Outpatient visits: 4,682/100,000 infants < 1 year	Hospitalization: £989/admitted child Outpatient visit: £36/visit
LRTI	EBF and any BF to 4 mths	**EBF:** 0.70 (hospitalize) 0.69 (outpatient) **Any BF:** 0.67 (hospitalize) 0.65 (outpatient)	Hospitalizations: 59.1/1000 live births Outpatient visits: 23,433/ 100,000 infants < 1 year	Hospitalization: £1,078/admitted child Outpatient visit: £36/visit
NEC	Any breastmilk:	0.19	NEC cases: 1/100 neonatal admissions. Surgical NEC 31%, medical NEC 69%	Surgical: £1,450/episode Neonatal unit stay: £618/bed-day; average length of stay is 26.7 days
Otitis media	EBF and any BF to 4 mths	EBF: 0.50 outpatient Any BF: 0.40 outpatient	Outpatient visits: 136/100,000 infants < 1 year	Outpatient visit: £36/visit

Web annex Table 10.2. Treatment costs for childhood conditions associated with lower rates of exclusive and continued breastfeeding, in selected countries

	US	UK	Urban China	Brazil
Source of calculations	Bartick and Reinhold (2010)	Renfrew et al (2012)	Authors (2015)	Authors (2015)
Coverage of five conditions: diarrhoea, pneumonia, NEC, bronchiolitis, otitis media (US study adds another four conditions: obesity, leukaemia, atopic dermatitis and asthma)	Yes: except bronchiolitis	Yes, except bronchiolitis	Yes	Yes
Total annual direct treatment cost due to lower rates/duration of inadequate breastfeeding, as defined in study. (Year and currency of original estimates study)	$2.21 bn (2007 US $);	£17m (2009-10 UK £) or $27.71m US.	175 m Yuan (2013-4 Yuan) or $2.8m US for a city of 8.7m ($227m if same rate applies to all of China's 719m urban residents).	13.7m Reales (2014 Reales) or $6.2m US
Definition of "improved breastfeeding" in study	Increases to 90% EBF at 6 months from current level of 12.3%	Increases to 45% EBF at 4 months from current level of 7%; for NEC increases to 75% at discharge from current level of 35%	Increases are to 90% any BF at 6 months (NEC) from 76.2%; 90% any BF up to 2 years from 15.0% (other conditions)	Increases are to 90% any BF at 6 mths (NEC) from 72.6%; 90% any BF up to 12 mths from 56.0% (other conditions)
Annual treatment cost reductions associated with a ten percentage point increase in "improved breastfeeding" **	$282m (US $ of 2007) [$312.3m in US $ of 2012]	$7.3m (US $ of 2009-10) [7.8m in US $ of 2012]	$30.3m (for urban population only) (US $ of 2013/14) [29.9m in US $ of 2012]	$1.8m (US $ of 2014) [$1.8m in US $ of 2012]
Annual treatment savings for childhood conditions associated with "improved breastfeeding" to 90% as defined above, US $ of 2012* (UK to 45% only) **	$2.45bn ($7.79 per capita)	$29.45m ($0.46 per capita)	$223.6m ($0.31 per capita)	$6.01m ($0.03 per capita)

*Converted to US $ for original year of study using IMF exchange rate data, and to US $ of 2012 using US CPI.

Exchange rate used for UK is £1=$1.195 US; for China is 6.115 Yuan=$1 US; for Brazil is 2.2307 Reales=$1 US.

Conversion to per capita figures using World Bank World Development Indicators 2012 population.

**National figures, except China urban population only.